

Module Manual

Master of Science (M.Sc.) Civil Engineering

Cohort: Winter Term 2024 Updated: 8th May 2025

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	Underground Constructions	
	Examination of Materials, Structural Condition and Damages	
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	Water Resources and -Supply	
	Construction Robotics	
	Environmental microbiology and analytics	
	Wastewater Systems	
	Jrban Environmental Management	
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	Building Materials and Building Preservation	
	Statics and Dynamics of Structures	
	Transportation Modelling	
	Modeling in Water Management	
	Management of Surface Water	
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Module M1724:	Smart Monitoring	
Module M1721:	Water and Environment: Theory and Application	
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Module M2032	Advanced Vadace Zene Ludrology	
	Process Modeling in Water Technology	
	Concrete Structures	
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	Study work Water and Traffic	
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	Selected Topics in Civil Engineering	
	Sustainable Nature-based Coastal Protection in a Changing Climate (SeaPiaC)	
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	Water Protection	
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Thesis		

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 five alternative specializations "Coastal Engineering", "Geotechnical Engineering", "Structural Engineering", "Water and Traffic" and "Computational Engineering", as well as the master thesis. The core qualification covers 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	Successful completion of the modul "Foundations of Management"
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	 Students are able to find their way around selected special areas of management within the scope of business manageme Students are able to explain basic theories, categories, and models in selected special areas of business management. Students are able to interrelate technical and management knowledge.
Skills	 Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in areas of business management
Personal Competence Social Competence	• Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems
Autonomy	• Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.
Workload in Hours	Depends on choice of courses
Credit points	

Courses

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

Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous	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 teaching architecture , in its teaching and learning arrangements , in teach areas and by means of teaching offerings in which students can qualify by opting for specific competences and a compete level 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
	 explain specialized areas in context of the relevant non-technical disciplines, outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in learning area, different specialist disciplines relate to their own discipline and differentiate it as well as make connections, sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representa in the specialized sciences are subject to individual and socio-cultural interpretation and historicity, Can communicate in a foreign language in a manner appropriate to the subject.
Skills	Professional Competence (Skills)
	In selected sub-areas students can
	 apply basic and specific methods of the said scientific disciplines, aquestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specied discipline, to handle simple and advanced questions in aforementioned scientific disciplines in a successful manner, justify their decisions on forms of organization and application in practical questions in contexts that go beyond

Module Manual M.Sc. "Civil Engineering"

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

Courses

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

	ainable Circular Economy			
Courses				
Title		Тур	Hrs/wk	СР
Circular Economy (L3264)		Seminar	2	3
Environment and Sustainability (L0		Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives		ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to describe single tech Economy as well as environmental and su		field of safety and risk a	assessment, Circu
	 basics in safety and reliability of tec 	hnical facilities		
	 risk assessment and reliability analy 	rsis methods		
	Circularity of material			
	Identification and evaluation of mate	erial flows		
	energy production and supply			
	 sustainable product design 			
Personal Competence Social Competence Autonomy	Students can gain knowledge of the subje	d costs for processes and select economical ect area from given sources and transform rch-oriented duties in for risk management	n it to new questions. Fu	
		impact.		pts accordance w
Workload in Hours	Independent Study Time 124 Study Time			pts accordance w
Workload in Hours Credit points				pts accordance w
Credit points	6			pts accordance w
Credit points Course achievement	6 None			pts accordance w
Credit points Course achievement Examination	6 None Written elaboration	n Lecture 56		pts accordance w
Credit points Course achievement	6 None Written elaboration Elaboration and presentation (45 minutes	n Lecture 56		pts accordance w
Credit points Course achievement Examination Examination duration and scale	6 None Written elaboration Elaboration and presentation (45 minutes	in Lecture 56		pts accordance w
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp	in Lecture 56	ocus Management and (
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes	in Lecture 56	ocus Management and (
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory	in Lecture 56		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe	in Lecture 56 in groups) pulsory : - Bioeconomic Process Engineering, Fo	ective Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe	in Lecture 56 in groups) pulsory : - Bioeconomic Process Engineering, Fo cialisation General Process Engineering: Ele	ective Compulsory Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe	in Lecture 56 in groups) iulsory : - Bioeconomic Process Engineering, Fo cialisation General Process Engineering: Elective cialisation Bioprocess Engineering: Elective	ective Compulsory Compulsory Elective Compulsory	Controlling: Elect
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe	in Lecture 56 in groups) bulsory : - Bioeconomic Process Engineering, Fo cialisation General Process Engineering: Elective cialisation Bioprocess Engineering: Elective cialisation Chemical Process Engineering: E	ective Compulsory Compulsory Elective Compulsory eering: Elective Compulso	Controlling: Elect
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Civil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Environmental Engineering: Specialisation	in Lecture 56 in groups) culsory : - Bioeconomic Process Engineering, Fo cialisation General Process Engineering: Elective cialisation Bioprocess Engineering: Elective cialisation Chemical Process Engineering: E cialisation Chemical and Bio process Engine	ective Compulsory Compulsory Elective Compulsory eering: Elective Compulso y	Controlling: Elect
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Environmental Engineering: Specialisation Product Development, Materials and Product	in Lecture 56 in groups) culsory : - Bioeconomic Process Engineering, Fo cialisation General Process Engineering: Elective cialisation Bioprocess Engineering: Elective cialisation Chemical Process Engineering: E cialisation Chemical and Bio process Engine Energy and Resources: Elective Compulsor	ective Compulsory Compulsory Elective Compulsory eering: Elective Compulso y Elective Compulsory	Controlling: Elect
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written elaboration Elaboration and presentation (45 minutes Divil Engineering: Core Qualification: Comp Bioprocess Engineering: Specialisation C Compulsory Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Chemical and Bioprocess Engineering: Spe Environmental Engineering: Specialisation Product Development, Materials and Produ Product Development, Materials and Produ	in Lecture 56 in groups) culsory : - Bioeconomic Process Engineering; Fo cialisation General Process Engineering: Elective cialisation Bioprocess Engineering: Elective cialisation Chemical Process Engineering: E cialisation Chemical and Bio process Engine Energy and Resources: Elective Compulsor ction: Specialisation Product Development:	ective Compulsory compulsory elective Compulsory eering: Elective Compulsory y Elective Compulsory ompulsory	Controlling: Elect

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

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

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

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

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

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	(L0497)	Lecture	2	2
Advanced Foundation Engineering	(L0498)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Geotechnics I and II, Mathematics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	After successfully completing the module, students wil	l be able to		
	describe individual procedures for the geotechni	ical monitoring of civil engineering me	asuras	
	 reproduce exploration and investigation method 		usures,	
	 select suitable types of field and laboratory tests 		e their results	
	 state the differences between various stress and 	-		variants of the stress
	and distortion tensor,		Significance of int	
	 outline the standard and special soil mechanics 	tests used to determine the stress-str	ain behavior of soi	il.
	 describe continuum models and the resulting bo 			,
	 as well as define boundary value problems from 		in such a way tha	t thev can be solved
	unambiguously.	5 5 5	,	2
Skills	Students will be able to			
		6 ft 11-		
	 dimension vertical drains for soil improvement of soft soils, calculate depth compaction using various appropriate methods, apply principles of horizontal bearing capacity of piles, verify the internal and external stability of fluid-supported diaphragm walls, evaluate the boundary conditions for the design of a deep excavation and design the individual components of t excavation, 			
	 perform, evaluate and interpret tests for the description and classification of soils according to applicable standards, 			
	 perform, evaluate and interpret tests for the description and classification of solis according to applicable standards, computationally implement numerical algorithms to solve boundary value problems, 			
	 select and apply the types of analyses depending on the degree of saturation, the impact, and the material behavior 			
	 determine appropriate model parameters for different possibilities and limitations of material models for the grain structur 			
	of soils.			
Personal Competence				
Social Competence	Students can work in groups and support each other in	finding solutions.		
Autonomy	Students are able to assess their own strengths and we and think in terms of processes.	eaknesses and, based on this, organize	e their time and le	arning management
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement				
	Written exam			
Examination duration and				
scale				
	Civil Engineering: Specialisation Structural Engineering	r Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural Engineering Civil Engineering: Specialisation Geotechnical Engineer			
i onowing curricula	Civil Engineering: Specialisation Coastal Engineering: C	• • •		
	Civil Engineering: Specialisation Water and Traffic: Elec			
	Civil Engineering: Specialisation Computational Engine			
	International Management and Engineering: Specialisa		pulsory	
		- 5		

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:
	 Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering)
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn

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

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

Courses						
Title				Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	(7)			Lecture	2	3
Introduction to tunnel construction	(L0707)			Lecture	1	2
Introduction to tunnel construction	(L1811)			Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe					
Admission Requirements	None					
Recommended Previous	Modules from Bachelo	r studies Civil and e	nvironmental engineeri	ng:		
Knowledge	Geotechnics I-II					
Educational Objectives	After taking part succe	essfully, students ha	ave reached the followir	ig learning results		
Professional Competence						
Knowledge	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction.					
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis.					
Personal Competence						
Social Competence	Capacity for teamwork concerning project management and design of tunnels.					
Autonomy	Promotion of independent and creative work flow in the framework of a design exercise.					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Course achievement	Course achievement Compulsory Bonus Form Description					
	No 5 %	Excercises				
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Spec	cialisation Structura	l Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Spec	cialisation Geotechr	nical Engineering: Comp	ulsory		
	Civil Engineering: Spec	cialisation Coastal E	ngineering: Compulsory	/		
	Civil Engineering: Spec	cialisation Water an	d Traffic: Elective Comp	oulsory		
			tional Engineering: Elec			
	THE REPORT OF A			I Engineering: Elective Comp		

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

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

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

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

Module M0593: Building Materials and Building Preservation

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

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

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

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

Course L0254: Transport 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	NN			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of concr	rete structures.		
Knowledge	Madulaa, Dainfanaad Cananata Churchuraa I	U. Chrysteinel Analysia I. U. Mashanina I. U. Conser	-t- Church uno -	
	Modules: Reinforced Concrete Structures I	+II, Structural Analysis I+II, Mechanics I+II, Concre	ate Structures	
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	The students know the main bridge types	s, their applications and the various loads. They	can explain the b	asic design meth
	They can explain the design of a prestress	ed bridge.		
CI-ill-	The shudents are able to design asinfarred			
SKIIIS	The students are able to design reinforced	for prestressed concrete bridges.		
Personal Competence				
Social Competence	The students can design in teamwork a rea	al concrete bridge.		
4	The students are able to desire a grant			
Αυτοποτηγ	The students are able to design a prestres	sed concrete bridge and discuss the problems and	i results with othe	r students.
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Er	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Computat	ional Engineering: Elective Compulsory		
	International Management and Engineering			

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

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

	lechanics and -Dynamic	.			
Courses					
Title			Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L	0374)		Lecture	2	2
Soil Dynamics (L0452)			Lecture	2	2
Experimental Researches in Geote	hnics (L0706)		Practical Course	2	2
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules: Mathematics I-III, Mechan	nics I-II, Geotechnics	I		
Knowledge	Courses: Soil laboratory course, (A	pplied structural dyı	namics)		
Educational Objectives	After taking part successfully, stuc	lents have reached t	he following learning results		
Professional Competence					
Knowledge	Students will be able to,				
	 describe wave propagation in the ground under dynamic excitation and define the relevant parameters, to measure vibrations and to interpret the data obtained with regard to their effect on people and structures, justify when elastodynamic methods are sufficient and when plastodynamic effects must be taken into account, to reproduce the collapse theorems of plasticity theory, describe the viscous behavior of cohesive soils and computationally account for creep deformation and rate-depende shear strengths as well as to determine the effect of partial saturation on the seepage flow and the shear strength. 				
Skills	After the successful completion of	the module the stuc	lents should be able to:		
	 to derive and apply the basis to understand the wave pro 		ble mass oscillator, under dynamic excitation and to c	detect the relevant par	rameters.
			to determine soil dynamic charact		
	 to design machine foundation 				
	 to measure shocks to perform 	rm vibration forecasi	<u>-</u> ,		
	 to evaluate shocks in terms 	of their effect on pe	ople and buildings,		
	 to evaluate possibilities of is 	solation,			
	• to understand mechanisms	that cause earthqua	kes and evaluate earthquakes in	terms of their magnitu	ide and intensity,
	 to know methods to determ 	ine axial pile capacit	ty, integrity, and the dynamic bed	lding modulus,	
	 to know the mechanisms th mathematically, 	at lead to a deforma	ation accumulation due to cyclic l	oading and to estimat	e these deformatio
	 to distinguish the area of ap 	plication of the met	hod of elastodynamics and plasto	dynamics,	
	 to detect the undrained she 	ar strength as a fun	ction of a number of state variable	es,	
	calculations,		Is and to consider the effects of c	reep and rate-depend	ent shear strength
	 to consider the impact of th 	e partly saturated of	f a seepage and shear strength.		
Personal Competence					
Social Competence	Students will be able to work in to	eams to achieve res	ults on measurement and experi	mental principles and	present their resu
	together at the end of the semeste	er.			
Autonomy	Students are able to assess their o	wn strengths and w	eaknesses and organize their time	e and learning manage	ement based on thi
Workload in Hours	Independent Study Time 96, Study	/ Time in Lecture 84			
Credit points	6				
Course achievement	Compulsory Bonus Form Yes None Subject t	theoretical and	cription		
Examination 1	practical w	JIK			
Examination	Written exam				
Examination duration and scale	135 min				
Assignment for the	Civil Engineering: Specialisation St	ructural Engineering	: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation G				
-	Civil Engineering: Specialisation Co				
	Civil Engineering: Specialisation Co	omputational Engine	ering: Elective Compulsory		

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

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

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

Module M0827: Mode	ling in Water Management			
	,			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modfle		Lecture	1	1
Groundwater Modeling using Modfle Modeling of Water Supply Network		Recitation Section (small) Project-/problem-based Learnin	2 q 2	2 3
		rioject-phoblem-based Learnin	y z	5
Module Responsible Admission Requirements				
Recommended Previous				
Knowledge	Groundwater			
	 groundwater hydraulics and transport of a 	substances		
	Pipe Systems			
		res, in particular drinking water systemsand	urban drainag	e systems includin
	special structures			
	Hydraulics of drinking water supply systeBasic knowledge on water management	nis and sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling	of groundwater flow and transport as well as u	ırban water infr	astructures. They ca
	carry out systems analyses and can detect tech	nical and conceptual weak points within the s	ystems in case	studies. Besides the
	are able to analyse interdependencies of hydrau	lic and toxic phenomena in soil and water.		
Skills	Skills The students are able to construct and apply scientific groundwater models indipendently. They can work on di			
	and can compare or assess different solutions for		software produ	cts. The students are
	able to use different software solutions (e.g. EPA	NET, EPA-SWMM).		
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Leo	ture 70		
Credit points				
Course achievement	None			
Examination				
	30 min			
scale				
-	Civil Engineering: Specialisation Structural Engin	•		
Following Curricula	Civil Engineering: Specialisation Geotechnical En			
	Civil Engineering: Specialisation Coastal Engineer	• • •		
	Civil Engineering: Specialisation Water and Traff			
	Civil Engineering: Specialisation Computational Water and Environmental Engineering: Specialis	• • • •		
	Water and Environmental Engineering: Specialis			
	Water and Environmental Engineering: Specialis			
	sector and environmental engineering. Specialis	Enter a company		

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	 Knowledge on Urban planning 			
Knowledge	Knowledge on Urban planning			
	 Knowledge on measures for climate protection General knowledge of scientific writing/working 			
	 General knowledge of scientific writing/working 			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as	current and future urban environ	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 contri	bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Cl-ill-	Skills Students are able to develop specific solutions for correcting existing or future environment-related prob		much lands of sur	
	development. They can define a range of conceptual and technical solutions for environmental problems for different development paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urba			
	context.		nu integrate t	
Personal Competence				
	The students can work together in international groups.			
	····			
Autonomy	Students are able to organize their work flow to prepare them	selves for presentations and cont	ributions to th	ne discussions. Th
	can acquire appropriate knowledge by making enquiries indepe	endently.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		
	Environmental Engineering: Core Qualification: Elective Compu	lsory		
	Joint European Master in Environmental Studies - Cities and Sus	stainability: Core Qualification: Co	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructu	ire and Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Environm	onti Elective Compulsory		
	water and Environmental Engineering. Specialisation Environmental	ent. Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414)		Project-/problem-based Learning	1	2
Port Planning and Port Construction	(L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose de	esign approaches for the functional c	lesign of a po	rt and apply ther
	design tasks. They can design the fundamental elements of	a port.		
<i>CL 11</i>				
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 ir	applied problems such as the funct	tional design	of ports. Addition
	they will be able to work in team with engineers of other dis	ciplines.		
Autonomy	The students will be able to independently extend their kno	wledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. The examination	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: Elec	ctive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Comp	ulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		
	International Management and Engineering: Specialisation I	I Civil Engineering: Elective Compuls	orv	

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

Module Manual M.Sc. "Civil Engineering"

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

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

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

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

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

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

Module M0874: Wast	ewater Systems			
	,			
Courses				
Title		Тур	Hrs/wk	СР
Biological Wastewater Treatment (L0517)		Lecture	2	2
Biological Wastewater Treatment (Recitation Section (la	5	1
Advanced Wastewater Treatment (Lecture	2 (rae) 1	2
Advanced Wastewater Treatment (Recitation Section (la	rge) I	T
Module Responsible				
•				
	Knowledge of wastewater management and the key processes involved in wastewater treatment.			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas o	f the full range of treatment systems in was	e water management, a	s well as their mut
	dependence for sustainable water protect	tion. They can describe relevant economic,	environmental and socia	l factors.
Skills	Students are able to pre-design and ex	plain the available wastewater treatment p	rocesses and the scope	of their application
SKIIIS	municipal and for some industrial treatm		ocesses and the scope	or their application
		ient plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this mode	ule.		
Autonomy	•	a subject and to organize their work flow i	ndependently. They can	also present on t
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structur	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water a	nd Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A	- General Bioprocess Engineering: Elective C	Compulsory	
	Environmental Engineering: Specialisation	on Water Quality and Water Engineering: Elec	ctive Compulsory	
	International Management and Engineer	ing: Specialisation II. Process Engineering an	d Biotechnology: Elective	e Compulsory
	International Management and Engineer	ing: Specialisation II. Energy and Environmer	tal Engineering: Elective	e Compulsory
	Process Engineering: Specialisation Envir	ronmental Process Engineering: Elective Com	ipulsory	
	Process Engineering: Specialisation Proce	ess Engineering: Elective Compulsory		
	Water and Environmental Engineering: S	pecialisation Water: Compulsory		
	Water and Environmental Engineering: S	pecialisation Environment: Elective Compuls	ory	
	Water and Environmental Engineering: S	pecialisation Cities: Compulsory		

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

ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv?
id=2842122&prov=M&dok_var=1&dok_ext=htm
Berlin [u.a.] : Springer, 2007
TUB_HH_Katalog
Henze, Mogens
Wastewater treatment : biological and chemical processes
ISBN: 3540422285 (Pp.)
Berlin [u.a.] : Springer, 2002
TUB_HH_Katalog
Imhoff, Karl (Imhoff, Klaus R.;)
Taschenbuch der Stadtentwässerung : mit 10 Tafeln
ISBN: 3486263331 ((Gb.))
München [u.a.] : Oldenbourg, 1999
TUB_HH_Katalog
Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;)
Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft
ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/00000700334
Donaueschingen-Pfohren : Mall-Beton-Verl., 2000
TUB_HH_Katalog
Mudrack, Klaus (Kunst, Sabine;)
Biologie der Abwasserreinigung : 18 Tabellen
ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903
Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003
TUB_HH_Katalog
Tchobanoglous, George (Metcalf & Eddy, Inc., ;)
Wastewater engineering : treatment and reuse
ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk))
Boston [u.a.] : McGraw-Hill, 2003
TUB_HH_Katalog
Henze, Mogens
Activated sludge models ASM1, ASM2, ASM2d and ASM3
ISBN: 1900222248
London : IWA Publ., 2002
TUB_HH_Katalog
Kunz, Peter
Umwelt-Bioverfahrenstechnik
Vieweg, 1992
Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für
Wasserwirtschaft, Abwasser und Abfall, ;)
Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe
aus der Abwasserbehandlung, Kleinkläranlagen
ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL:
http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf
Weimar : Universitätsverl, 2006
TUB_HH_Katalog
Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall
DWA-Regelwerk
Hennef : DWA, 2004
TUB_HH_Katalog
Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;)
Fundamentals of biological wastewater treatment
ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm
Weinheim : WILEY-VCH, 2007
TUB_HH_Katalog

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

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

Course L0358: Advanced Wa	stewater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
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	for "Principles of Urban Planning": none
Knowledge	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Trans
	Planning and Traffic Engineering"
	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	use technical terms of urban planning.
	describe the main determinants of urban development.
	 explain and compare different possibilities of how urban development can be influenced.
	discuss requirements for public streetscapes.
	explain the importance of street design.
Skills	Students are able to:
	 read and analyze urban development concepts and designs for streetscapes
	appraise such concepts in the context of competing requirements.
	 design, justify and reflect their own solutions for concrete examples.
Personal Competence	
Social Competence	Students are able to:
	discuss intermediate results with each other.
	constructively accept feedback on their own work.
	provide constructive feedback to others.
Autonomy	
Αυτοποπιγ	Students are able to:
	 independently complete a written report including drawings following a broadly pre-defined process.
	 assess the consequences of their proposed solutions.
	 independently acquire knowledge and apply this to new issues or problem areas.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
-	
Course achievement	
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 Coastal Engineering: Elective Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Compulsory

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

Courses				
Title	Тур	р	Hrs/wk	СР
Construction Logistics (L1163)		ture	1	2
Construction Logistics (L1164)		citation Section (small)	1	2
Project Development and Management (L1161) Project Development and Management (L1162)		ture ject-/problem-based Learning	1	1
		Ject-/problem-based Learning	1	I
Module Responsible	-			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	Students can			
	give definitions of the main terms of construction logistics and	d project development and ma	anagement	
	name advantages and disadvantages of internal or external co	onstruction logistics		
	• explain characteristics of products, demand and production of	f construction objects and the	eir consequer	nces for construction
	specific supply chains			
	differentiate constructions logistics from other logistics system	ns		
Chille	Students can			
SKIIIS	Students can			
	 carry out project life cycle assessments 			
	 apply methods and instruments of construction logistics 			
	 apply methods and instruments of project development and management 			
	 apply methods and instruments of conflict management 			
	 design supply and waste removal concepts for a construction r 	project		
Personal Competence	Chudanta and			
Social Competence	Students can			
	 hold presentations in and for groups 			
	apply methods of conflict solving skills in group work and case	e studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow oriented thinking 	g		
	• improve their creativity, negotiation skills, conflict and crise	es solution skills by applying	methods of	moderation in ca
	studies			
Washiand in Harris	Indexedent Chudu Time 124, Chudu Time in Leshurg 50			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Course achievement				
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulse			
	International Management and Engineering: Specialisation II. Civil En		лу	
	International Management and Engineering: Specialisation II. Logistic			
	Logistics, Infrastructure and Mobility: Specialisation Production and L			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure an	a Mobility: Elective Compulse	ory	

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

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

Course L1161: Project Devel	ourse L1161: Project Development and Management		
Тур	Lecture		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei		
Language	DE		
Cycle	SoSe		
Content	Within the lecture, the main aspects of project development and management are tought:		
	 Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work 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. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis	of statically determinate and indeterminate strue	ctures; Mechanics	I/II, Mathematics
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence		······································		
	After successful completion of this more	lule, the student can explain the basic aspects of	dynamic effects (on structures and f
	respective methods.		-,	
Skills	After successful completion of this mo	odule, the students will be able to predict the re	esponse of mater	rial and structures
		computational approaches and methods.		
Personal Competence				
Social Competence	Students can			
boelar competence				
	 participate in subject-specific and 	interdisciplinary discussions,		
	 defend their own work results in f 	ront of others		
	 promote the scientific developme 	nt of colleagues		
	 Furthermore, they can give and a 	ccept professional constructive criticism		
Autonomy	Students are able to gain knowledge of	the subject area from given and other sources and	apply it to pow p	colome Eurthorme
Autonomy				oblems. Fulthermo
	they are able to structure the solution pi	rocess for problems in the area of Structural Analys	15.	
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structur	ral Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory		
	Civil Engineering: Specialisation Comput	ational Engineering: Elective Compulsory		

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

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

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

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			
Recommended Previous	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the v	hole project and explain it to the others.		
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction			
	changing conditions resulting from other pa	rticipants 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 ag	reement with respect to intergroup depend	lencies.	
	They can distribute and process tasks indep	pendently.		
Autonomy	Students can handle their part of the projec	t on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnic	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural	Engineering: Compulsory		
	Civil Engineering: Specialisation Computation	onal Engineering: Elective Compulsory		

Course L1206: Steel Constru	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)	Undrewlie Engine grieg (11146)	Recitation Section (large)	2	2	
Steel Structures in Foundation and		Lecture	Z	Z	
Module Responsible Admission Requirements					
	Complete modules: Geotechnics I-III, Math	omatics LIII			
Kecommended Previous Knowledge	complete modules: Geotechnics I-III, Math				
Kilowiedge	Courses: Soil laboratory course				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay wa				
	Furthermore, the students get all the necessary knowledge to design singular construction elements for sheet pile walls and know how to choose the right construction elements depending on the influencing conditions.				
	Furthermore, the students are able to div				
SKIIIS	Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to choose the				
	suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls walls and combined sheet pile walls) and to dimension all construction elements and connections.				
	waits and combined sheet pile waits) and t		10115.		
Personal Competence					
Social Competence					
Autonomy	Students are able to assess their own stre	ngths and weaknesses and organize their time and	learning manage	ement based on th	
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	Civil Engineering: Specialisation Geotechn	ical Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal E	ngineering: Compulsory			
	Civil Engineering: Specialisation Computat	ional Engineering: Elective Compulsory			
		5 5 7 7			

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

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

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

-				
Courses Title		Typ	Hrs/wk	СР
Port Logistics (L0686)		Typ Lecture	2	3
Port Logistics (L1473)		Recitation Section (small)	2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	ollowing learning results		
Professional Competence				
Knowledge	Th			
	After completing the module, students can			
	 reflect on the development of seaports (in terms of t 		orresponding ter	minals, as well as t
	relevant operator models) and place them in their hi			
	explain and evaluate different types of seaport	t terminals and their specific c	haracteristics (cargo, transhipme
	technologies, logistic functional areas);analyze common planning tasks (e.g. berth plannin	a stowage planning ward planning	a) at caapart to	rminals and devel
	 analyze common plaining tasks (e.g. betti plaining suitable approaches (in terms of methods and tools) 		ig) at seapoir te	
	 identify future developments and trends regarding 		vative seaport te	erminals and discu
	them in a problem-oriented manner.			
Skills	After completing the module, students will be able to			
	recognize functional areas in ports and seaport terminals;			
	define and evaluate suitable operating systems for container terminals;			
	 perform static calculations with regard to given boundary conditions, e.g. required capacity (parking spaces, equipmer requirements, guay wall length, part access) on calested terminal types; 			
	 requirements, quay wall length, port access) on selected terminal types; reliably estimate which boundary conditions influence common logistics indicators in the static planning of selected terminal 			
	 reliably estimate which boundary conditions influence types and to what extent. 	e common logistics indicators in th	ie statić planning	of selected termin
	types and to what extent.			
Personal Competence				
Social Competence	After completing the module, students can			
	 transfer the acquired knowledge to further questions 	s of port logistics;		
	 discuss and successfully organize extensive task pace 	ckages in small groups;		
	• in small groups, document work results in writing in	an understandable form and prese	nt them to an ap	propriate extent.
Autonomy	After completing the module, the students are able to			
	 research and select specialist literature, including s independently; 	standards, guidelines and journal	papers, and to c	levelop the conten
	 submit own parts in an extensive written elaboratio 	n in small groups in due time and	to present them	iointly within a fix
	time frame.		to present them	Jointry within a fixe
	une nune.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	Compulsory Bonus Form Descripti	on		
Evaninat:	No 15 % Written elaboration			
Examination	Written exam			
Examination duration and	120 minutes			
scale	Civil Engineering: Englishing Coasts! Engineering Elect			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Election			
Following Curricula	International Management and Engineering: Specialisation		son	
	Logistics, Infrastructure and Mobility: Specialisation Product	•	-	
	Logistics, Infrastructure and Mobility: Specialisation Infrastr Renewable Energies: Specialisation Wind Energy Systems:		uisui y	
	Naval Architecture and Ocean Engineering: Core Qualificati			
		e Technology: 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 ar understanding of structures and processes in ports. The focus will be on different types of terminals, their characteristical layouts and the technical equipment used as well as the ongoing digitization and interaction of the players involved. In addition, renowned guest speakers from science and practice will be regularly invited to discuss some lecture-relevant topics from alternative perspectives. The following contents will be conveyed in the lectures: • Instruction of structures and processes in the port • Planning, control, implementation and monitoring of material and information flows in the port • Fundamentals of different terminals, characteristical layouts and the technical equipment used • Handling of current issues in port logistics
Literature	 Alderton, Patrick (2013). Port Management and Operations. Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium. Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen. Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele. Jahn, Carlos; Saxe, Sebastian (Hg.). Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag, 2017. Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management. Woitschützke, Claus-Peter (2013). Verkehrsgeografie.

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

Courses					
Title		Тур	Hrs/wk	СР	
Maritime Transport (L0063) Maritime Transport (L0064)		Lecture Recitation Section (small)	2	3 3	
	Prof. Carlos John	Reclation Section (smail)	2	5	
Module Responsible	Prof. Carlos Jahn				
Admission Requirements Recommended Previous	None				
Kecommended Previous Knowledge					
	After taking part successfully, students have reached	the following learning results			
Professional Competence	Arter taking part successiony, students have reached	the following learning results			
	The students are able to				
Knowledge					
	 present the actors involved in the maritime transmission 	ansport chain with regard to their typical	tasks;		
	 name common cargo types in shipping and classifier 	assify cargo to the corresponding categor	ies;		
	 explain operating forms in maritime shipping, 	transport options and management in tra	ansport networks	;	
	 weigh the advantages and disadvantages of the second second		and apply them i	in practice;	
	 estimate the potential of digitisation in maritir 	ne shipping.			
Skills	The students are able to				
	determine the mode of transport, actors and functions of the actors in the maritime supply chain;				
	 identify possible cost drivers in a transport characteristic 	s in a transport chain and recommend appropriate proposals for cost reduction;			
	 record, map and systematically analyse ma 	terial and information flows of a marit	ime logistics cha	ain, identify possib	
	problems and recommend solutions;				
	 perform risk assessments of human disruption 	ns to the supply chain;			
	 analyse accidents in the field of maritime logistics and evaluating their relevance in everyday life; deal with current research topics in the field of maritime logistics in a differentiated way; 				
	plan the deployment of a fleet based on scenarios;				
	 apply different process modelling methods in 	a hitherto unknown field of activity and to	o work out the re	spective advantag	
Personal Competence					
	The students are able to				
,					
	 discuss and organise extensive work package 				
	 document and present the elaborated results. 				
Autonomy	The students are capable to				
	 research and select technical literature, including the select technical literature. 	• •			
	 submit own shares in an extensive written ela 	boration in small groups in due time.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56			
Credit points	6				
Course achievement	Compulsory Bonus Form D	escription			
	No 15 % Subject theoretical andT	eilnahme an einem Planspiel und anschli	eßende schriftlich	ne Ausarbeitung	
	practical work				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	: Elective Compulsory			
Following Curricula	International Management and Engineering: Speciali	sation II. Logistics: Elective Compulsory			
-	Logistics, Infrastructure and Mobility: Specialisation I	Production and Logistics: Elective Compu	sory		
	Logistics, Infrastructure and Mobility: Specialisation I	nfrastructure and Mobility: Elective Comp	oulsory		
	Renewable Energies: Specialisation Wind Energy Sys	tems: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisation M	laritime Technology: Elective Compulsory			

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

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

Courses				
Title		Тур	Hrs/wk	СР
Water and Environment (L2754) Water and Environment (L2753)		Project-/problem-based Learning Lecture	3 3	3 3
	Deef Nime Chalum	Lecture	2	3
Module Responsible Admission Requirements				
		dralagy		
Kecommended Previous Knowledge	Basic knowledge in water and environmental research, Hy	arology		
	After taking part successfully, students have reached the	iollowing loorning results		
Professional Competence	After taking part successiony, students have reached the	onowing learning results		
•	Common research tools and techniques together with	the fundamental knowledge relevan	t to multi-co	alo and multi ph
KIIOWIEdge	challenges present in water and environmental research	-		
	considered.	will be discussed in this module. Bo	our theory and	u application will
	considered.			
Skills	In addition to the fundamental knowledge, the students	will be exposed to several analytical,	experimental	and numerical to
	and techniques relevant to water and environmental rese	arch at different scales. This will prov	ide the stude	nts with an excell
	opportunity to improve their skills on multiple fronts which will be useful in their future career.			
Personal Competence				
Social Competence	Developing teamwork and problem solving skills through F	Research-Based Teaching approaches v	will be at the o	ore of this modul
Autonomy	The students will be involved in writing individual repo	rts and presentation. This will contri	bute to the s	students' ability
,	willingness to work independently and responsibly.			,
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement				
	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
-	Civil Engineering: Specialisation Coastal Engineering: Elect			
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Specialisation Environment ar			
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Water			
	Water and Environmental Engineering: Specialisation Envi	ronment: Compulsory		

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

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

Courses				
Courses				
Title Smart Monitoring (L2762)		Typ Integrated Lecture	Hrs/wk	CP 2
Smart Monitoring (L2762) Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous		programming and sensor technologic	ogies are helpful	Interest in mor
Knowledge	Basic knowledge or interest in object-oriented modeling, programming, and sensor technologies are helpful. Interest in mod research and teaching areas, such as Internet of Things, Industry 4.0 and cyber-physical systems, as well as the will to deep			
-	skills of scientific working, are required. Basic knowledge			
	After taking part successfully, students have reached the	following loorning results		
	After taking part successfully, students have reached the	rollowing learning results		
Professional Competence	The students will become familiar with the principles of	nd practices of smart monitoring	The students wi	II ha abla ta da
Kilowiedye	The students will become familiar with the principles a decentralized smart systems to be applied for contin			
	environment. In addition, the students will learn to desig			
	analysis techniques, modern software design concepts, a also part of this module, which will be conducted throug			
	students will design smart monitoring systems that integr		-	•
	Specific focus will be put on the application of machine learning techniques. The smart monitoring systems will be mounted or real-world (built or natural) systems, such as bridges or slopes, or on scaled lab structures for validation purposes. The outcome of			
	real-world (built or natural) systems, such as bridges or slopes, or on scaled lab structures for validation purposes. The outcome of every group will be documented in a paper. All students of this module will "automatically" participate with their smart monitoring			
	system in the annual "Smart Monitoring" competition. The	5 1		
	will be taught in English. Limited enrollment.			J
Skills	The students will gain insights into operating state-of-the	-art smart sensor systems, used for	monitoring a wi	de range of phys
	processes relevant to engineering, such as environmental, structural, or comfort monitoring. The students will be capable			
	devising monitoring strategies of physical processes as part of group projects, tailored to their knowledge backgrounds, and			
	implement the strategies in smart wireless sensor nodes, using embedded computing and programming. Finally, the students w			
	be able to document the findings of their projects in short	reports.		
Personal Competence				
	The students will be able to work in groups, share parts	of the work for their projects, and de	evelop communio	ation skills, tow
	achieving the common project goals.			
Autonomy	The students will be able to gain a solid basis on appro		ineering, as well	as on documen
	results, through their involvement in their monitoring gro	up projects.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective	e Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elec	1 9		
	Civil Engineering: Specialisation Structural Engineering: E			
	Computer Science: Specialisation II: Intelligence Engineer	• • •		
	Environmental Engineering: Specialisation Energy and Re			
	Environmental Engineering: Specialisation Environment a			
	Environmental Engineering: Specialisation Water Quality		pulsory	
	Mechatronics: Technical Complementary Course: Elective	Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisation Robot		ompulsory	
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Env Water and Environmental Engineering: Specialisation Wat			

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

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

Module M1845: Thin-	walled structures			
Courses				
Title		Тур	Hrs/wk	СР
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)		Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	Structural Analysis IStructural Analysis IIFinite Element Methods			
Educational Objectives	After taking part successfully, students have reac	ned the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the walled structures.	students can express the basic aspects of	the load-carryin	g behaviour of thir
Skills	After successful completion of this module, the students will be able to predict load-carrying behaviour of thin-walled structure using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdiscipate 	plinary discussions,		
	 defend their own work results in front of other second seco	ners		
	 promote the scientific development of college 	agues		
	 Furthermore, they can give and accept prot 	essional constructive criticism		
Autonomy	Students are able to gain knowledge of the subject they are able to structure the solution process for	÷ .		
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	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineeri	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Er	gineering: Compulsory		
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Simulation Technology: Elective Compulso	ry	

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

Courses					
		Tree	Have Aude	CD	
Title Offshore Geotechnical Engineering	(10067)	Typ Lecture	Hrs/wk	CP 1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011)		Lecture	2	3	
Nind Energy Use - Focus Offshore	L0012)	Lecture	1	1	
Module Responsible	Dr. Marvin Scherzinger				
Admission Requirements	None				
Recommended Previous	Module: Technical Thermodynamics I,				
Knowledge	Module: Technical Thermodynamics II,				
	Module: Fundamentals of Fluid Mechanics				
Educational Objectives	After taking part successfully, students have reached	I the following learning results			
Professional Competence					
Knowledge	By ending this module students can explain in detail	ail knowledge of wind turbines w	ith a particular focus o	f wind energy us	
	offshore conditions and can critical comment these	aspects in consideration of current	nt developments. Furthe	rmore, they are a	
	to describe fundamentally the use of water power to	generate electricity. The student	s reproduce and explair	n the basic proced	
	in the implementation of renewable energy projects	n countries outside Europe.			
	Through active discussions of various topics within	the seminar of the module. stu	idents improve their un	derstanding and	
	application of the theoretical background and are the			j.	
Skills	5 Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate a				
	assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can				
	compare critically the special procedure for the implementation of renewable energy projects in countries outsic				
	in principle applied approach in Europe and can appl	y this procedure on exemplary th	eoretical projects.		
Personal Competence					
Social Competence	Students can discuss scientific tasks subjet-specificly	y and multidisciplinary within a se	eminar.		
A					
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of t lecture and to acquire the particular knowledge about the subject area.				
	lecture and to acquire the particular knowledge about	it the subject area.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	180 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering	ng: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	• • •			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory				
	International Management and Engineering: Specialis	•••			
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory				
	Renewable Energies: Core Qualification: Compulsory		0.7/		
	Theoretical Mechanical Engineering: Specialisation E				
	Process Engineering: Specialisation Environmental Provide Specialisation Environmental Engineering: Specialisation		puisory		
	Water and Environmental Engineering: Specialisation				
	Water and Environmental Engineering: Specialisation	i Environment: Elective Compuiso	лу		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory			

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

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

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

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

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

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

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

Module M0858: Coast	tal Hydraulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L08		Lecture	3	4
Basics of Coastal Engineering (L14		Project-/problem-based Learning	, 1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of hydraulic engineering, hydrology	y and hydromechanics		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students are able to define and expla	in the basic concepts of coastal engineering and port	engineering. Th	ney are able to app
	the concepts to selected practical proble	ms of coastal engineering. Students can define and o	determine the b	asics for design a
	dimensioning of coastal engineering const	tructions.		
Skills	The students are canable to apply basic d	lesign approaches to selected and pre-defined design	tasks in coastal	engineering
Skiis	The statenes are capable to apply basic a	iesign approaches to selected and pre defined design		engineering.
Personal Competence				
Social Competence	The students are able to deploy their gai	ined knowledge in applied problems such as the des	ign of coastal p	rotection structure
	Additionaly, they will be able to work in te	eam with engineers of other disciplines, for instance d	esigning of coas	stal breakwaters.
Autonomy	The students will be able to independently	y extend their knowledge and applyit to new problem	S.	
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 ho	ours. The examination includes tasks with respect to	b the general u	inderstanding of th
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Coastal E	ngineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Compulsory		
	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory		
	Environmental Engineering: Specialisation	n Environment and Climate: Elective Compulsory		
	Environmental Engineering: Specialisation	n Water Quality and Water Engineering: Elective Comp	oulsory	
	International Management and Engineering	ng: Specialisation II. Civil Engineering: Elective Compu	lsory	
	Water and Environmental Engineering: Sp	pecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Water: Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura		Lecture	3	4
Examination of Materials, Structura	al Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials or ma	terial science, for example by the me	odule Building Ma	aterials and Buildi
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tra	ding, use and marking of construction p	roducts in Germar	ny. They know which
	methods for the testing of building material proper	ties are usable and know the limitations	and characterics o	f the most importa
	testing methods.			
CI-III-				
SKIIIS	The students are able to responsibly discover the ru			tion of domograp of
	They are able to chose suitable methods for the te the examination of the structural conditions of built	• • •		-
	are able to describe an examination in form of a te	• • •	mptons to the cau	se of damages. In
Personal Competence				
•	The students can describe the different roles of m	anufacturers as well as testing supervis	ory and certificati	on hodies within t
Social competence	framework of material testing. They can describe th	÷ .	-	on boules within t
	manework of material testing. They can describe th		ai proceedings.	
Autonomv	The students are able to make the timing and the o	peration steps to learn the specialist kno	wledge of a verv e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectury	e 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engir	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory		
-	Civil Engineering: Specialisation Water and Traffic:			
	Civil Engineering: Specialisation Structural Engineer			
	International Management and Engineering: Specia	• • • •	pulsory	
	Materials Science: Specialisation Engineering Mater			

Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 CP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 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	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	77)		Lecture	2	3
Structural Concrete Members (L05	78)		Recitation Section (large)	2	2
Module Responsible	Dr. Adrian Faron				
Admission Requirements	None				
Recommended Previous	Basics of structural an	nalysis, conception ar	nd dimensioning of structural concrete		
Knowledge					
	Modules: Reinforced (Concrete Structures I	+II, Structural Analysis I+II, Mechanics I+II		
Educational Objectives	After taking part succ	essfully, students ha	ve reached the following learning results		
Professional Competence					
Knowledae	The students broader	n their skills in structu	Iral engineering, especially in the field of buildi	nas (houses. roofs. h	alls). They dispose
			gn of concrete buildings and structural membe	•	
	5				
	tills The students are able to apply procedures of the conception and dimensioning to to practical problems of struct				
Skills	The students are able	e to apply procedures	s of the conception and dimensioning to to pra	octical problems of st	ructural engineeri
Skills			s of the conception and dimensioning to to pra dings and to design them for general action		•
Skills	They are capable to	draft concrete build		effects and to plar	•
	They are capable to	draft concrete build	dings and to design them for general action	effects and to plar	•
Personal Competence	They are capable to execution. Moreover,	draft concrete build they can make desig	dings and to design them for general action n and construction sketches and draw up techr	effects and to plar	•
Personal Competence	They are capable to execution. Moreover,	draft concrete build they can make desig	dings and to design them for general action	effects and to plar	-
Personal Competence Social Competence	They are capable to execution. Moreover, The students are able	o draft concrete build they can make desig	dings and to design them for general action n and construction sketches and draw up techr	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy	They are capable to execution. Moreover, The students are able The students are able	 draft concrete build they can make desig to obtain results of h to carry out complex 	dings and to design them for general action n and construction sketches and draw up techr nigh quality in teamwork.	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti	 draft concrete build they can make desig to obtain results of h to carry out complex 	dings and to design them for general action n and construction sketches and draw up techr nigh quality in teamwork.	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6	 draft concrete build they can make desig to obtain results of h to carry out complex 	dings and to design them for general action n and construction sketches and draw up techr nigh quality in teamwork.	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6	a draft concrete build they can make desig to obtain results of H to carry out complex ime 110, Study Time	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. < conception and dimensioning tasks of structu in Lecture 70	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6 Compulsory Bonus	e to obtain results of f e to carry out complex ime 110, Study Time	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. < conception and dimensioning tasks of structu in Lecture 70 Description	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam	e to obtain results of f e to carry out complex ime 110, Study Time	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. < conception and dimensioning tasks of structu in Lecture 70 Description	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam	e to obtain results of f e to carry out complex ime 110, Study Time	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. < conception and dimensioning tasks of structu in Lecture 70 Description	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam 120 minutes	o draft concrete build they can make desig e to obtain results of f e to carry out complex ime 110, Study Time Form Presentation	dings and to design them for general action n and construction sketches and draw up techn nigh quality in teamwork. <a and="" conception="" dimensioning="" of="" structur<br="" tasks="">in Lecture 70	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Spe	o draft concrete build they can make desig e to obtain results of f e to carry out complex ime 110, Study Time Form Presentation	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. < conception and dimensioning tasks of structu in Lecture 70 Description	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	They are capable to execution. Moreover, The students are able The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Spe Civil Engineering: Spe	o draft concrete build they can make desig e to obtain results of f e to carry out complex ime 110, Study Time Form Presentation ecialisation Structural ecialisation Geotechni	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. conception and dimensioning tasks of structur in Lecture 70 Description Es werden 2 Referate ausgegeben Engineering: Compulsory ical Engineering: Elective Compulsory	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	They are capable to execution. Moreover, The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	o draft concrete build they can make desig e to obtain results of f e to carry out complex ime 110, Study Time Form Presentation ecialisation Structural ecialisation Geotechni ecialisation Coastal Er	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. conception and dimensioning tasks of structur in Lecture 70 Description Es werden 2 Referate ausgegeben Engineering: Compulsory ical Engineering: Elective Compulsory ngineering: Elective Compulsory	effects and to plar nical descriptions.	n their detailing a
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	They are capable to execution. Moreover, The students are able Independent Study Ti 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	o draft concrete build they can make desig e to obtain results of f e to carry out complex ime 110, Study Time Form Presentation ecialisation Structural ecialisation Geotechni ecialisation Coastal Er ecialisation Water and	dings and to design them for general action n and construction sketches and draw up techn high quality in teamwork. conception and dimensioning tasks of structur in Lecture 70 Description Es werden 2 Referate ausgegeben Engineering: Compulsory ical Engineering: Elective Compulsory	effects and to plar nical descriptions.	n their detailing a

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

Course L0577: Structural Co	ncrete Members
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	
	• Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997

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

Courses				
Title	Тур		Hrs/wk	СР
Integrated Transportation Planning		blem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergradua	ate class "Transport P	lanning and T	raffic Engineerin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	results		
Professional Competence				
Knowledge	Students are able to:			
	describe interdependencies between land-use/location choice and tra	ansportation/mobility	hehaviour	
	 explain and evaluate the social, ecological and economic effects of tra- 			res.
	 relate current issues in the area of integrated transport planning and 			
Skills	Students are able to:			
		influence of here it		
	 quantify important parameters, which influence travel demand or are comprehensively examine a pre-defined or self-selected topic from a 		oc porcpoctiv	a and document t
	results in accordance with scientific conventions.		es perspectiv	
Personal Competence				
	Students are able to:			
eeelar eempetenee				
	 provide feedback on topical contents and their teaching. 			
	 constructively handle feedback on their own work. 			
	 produce results in group work and document these. 			
Autonomy	Students are able to:			
	 assess potential consequences of their future professional activities 			
	 independently plan working on a pre-defined project topic, acquire th 	ne necessary knowled	lge and use a	opropriate means
	its execution.	,	5	
Worklood in Hours	Independent Study Time 124, Study Time in Lesture 56			
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			
Examination duration and scale	whitten assignment with presentation during the semester			
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory	v		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Computer	-		
J	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory	-		
	Civil Engineering: Specialisation Water and Traffic: Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobil	lity: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Cities: Compulsory			

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

Module M0963: Steel	and Composite Structures			
Courses				
Title	204)	Тур	Hrs/wk 2	CP
Steel and Composite Structures (L1 Steel and Composite Structures (L1		Lecture Recitation Section (large)	2	2 2
Steel Bridges (L1097)	203)	Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I and	I II, BUBC)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	describe the phenomenon of local buckling			
	 explain warping torsion 			
	 illustrate the behaviour of composite structures 	-		
	 specify the principles in design of composite structures 			
	 sketch the contructions of steel and composite 	bildges		
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structur	es		
	 recognize and verify warping tosion in strucure 	S		
	 design composite structures 			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
, Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	ļ		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	g: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
	Civil Engineering: Specialisation Computational Engine			
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Comr	ulsony	

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

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

Courses				
Title	Typ Hrs/wk CP			
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Subjects of the Port and Coastal Engineering specialisation.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students are able to demonstrate their detailed knowledge in the field of port and coastal engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science as society.			
	The students can develop solving strategies and approaches for fundamental and practical problems in port and coast engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view poir of science and society.			
Skills	Scientific work techniques that are used can be described and critically reviewed. The students are able to independently select methods for the project work and to justify this choice. They can explain how the methods relate to the field of work and how the context of application has to be adjusted. General findings and furth developments may essentially be outlined.			
Personal Competence				
	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems f the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to the colleagues.			
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the 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			

Courses					
Title		Тур	Hrs/wk	СР	
Design of Composite Bridges (L309	2)	Integrated Lecture	2	3	
Analysis of Offshore Structures (L1	867)	Lecture	1	1	
Solid Matter Process Technology fo	r Biomass (L0052)	Lecture	2	3	
Innovative Timber Construction (L2	666)	Lecture	2	4	
Glass Structures (L1152)		Lecture	2	2	
Glass Structures (L1447)		Recitation Section (large)	1	1	
Sustainable landfill design and ope	ration (L3270)	Integrated Lecture	3	3	
Special Topics in Steel Design (L30	91)	Integrated Lecture	2	3	
Special topics of civil engineering 1			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				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have reac	hed the following learning results			
Professional Competence					
Knowledge					
	 Students are able to find their way through 			-	
	 Students are able to explain basic models a 	and procedures in selected special areas of	civil and structur	al engineering.	
	 Students are able to interrelate scientific and 	nd technical knowledge.			
Skills					
	 Students are able to apply basic methods in 	n selected areas of civil and structural engir	eering.		
Personal Competence					
-					
Social Competence					
Autonomy	 Students can chose independently, in which 	ch fields they want to deepen their knowle	dge and skills th	rough the election	
	courses.		-	-	
	Depends on choice of courses				
Credit points	6				
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			

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

Module Manual M.Sc. "Civil Engineering"

Course L1867: Analysis of Of				
Тур	Lecture 1			
CP Workload in Hours	1 Independent Study Time 16, Study Time in Lecture 14			
Examination Form	ndependent Study Time 16, Study Time in Lecture 14			
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 fat			
	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 L0052: Solid Matter I	Process Technology for Biomass				
Тур	lecture				
Hrs/wk					
CP	3				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Examination Form	Klausur				
Examination duration and	60 min				
scale					
Lecturer	Prof. Werner Sitzmann				
Language)E				
Cycle	SoSe				
Content	The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - products. Aspects of explosion protection and plant design complete the lecture.				
Literature	Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4 Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175				

Course L2666: Innovative Tir	nber Construction			
Тур	Lecture			
Hrs/wk				
СР	4			
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28			
Examination Form	Schriftliche Ausarbeitung			
Examination duration and	45 Minuten			
scale				
Lecturer	Dr. Andreas Meisel			
Language	E			
Cycle	liSe			
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				
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				
Workload in Hours	ndependent Study Time 16, Study Time in Lecture 14			
Examination Form	Mündliche Prüfung			
Examination duration and				
scale				
Lecturer	Marvin Matzik			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

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

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

Course L2378: Special topics of civil engineering 1CP				
Тур				
Hrs/wk	1			
СР	1			
Workload in Hours	ndependent Study Time 16, Study Time in Lecture 14			
Examination Form	achtheoretisch-fachpraktische Arbeit			
Examination duration and	ird 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	ndependent Study Time 32, Study Time in Lecture 28			
Examination Form	achtheoretisch-fachpraktische Arbeit			
Examination duration and	vird zu Beginn der Lehrveranstaltung festgelegt			
scale				
Lecturer	ozenten 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	ndependent Study Time 48, Study Time in Lecture 42			
Examination Form	achtheoretisch-fachpraktische Arbeit			
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt			
scale				
Lecturer	ozenten des SD B			
Language	DE			
Cycle	NiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	Die Literatur wird kurzfristig festgelegt.			

Course L2789: Structural Des	sign			
Тур	Seminar			
Hrs/wk	2			
CP				
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	
Chemistry of Drinking Water Treatment (L0311)		Lecture	2	1	
Chemistry of Drinking Water Treatment (L0312)		Recitation Section (large)	1	2	
Water Resource Management (L04	02)	Lecture	2	2	
Water Resource Management (L04	03)	Recitation Section (small)	1	1	
Module Responsible	Prof. Mathias Ernst				
Admission Requirements	None				
Recommended Previous	Knowledge of water management and 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					
Knowledge	Students will be able to outline key area	s of conflict in water management, as well as t	heir mutual depen	dence for sustaina	
	water supply. They will understand relev	ant economic, environmental and social factor	s. 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 and				
	the scope of their application.				
o					
Skills		lex problems in drinking water production a		-	
	management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students wi				
	be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and				
	standards to these processes.				
Personal Competence					
Social Competence	Working in a diverse group of specialists,	students will be able to develop and document	complex solutions	for the managem	
	and treatment of drinking water. They will be able to take an appropriate professional position, for example representing use				
	interests. They will be able to develop joir	nt solutions in teams of diverse experts and prese	ent these solutions	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	ical Engineering: Elective Compulsory			
-	Civil Engineering: Specialisation Water and Traffic: Compulsory				
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory				
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory				
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Process Engineering: Specialisation Proces				
	Water and Environmental Engineering: Sp				
	5 5 1				
	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	 MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.

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

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

Module Manual M.Sc. "Civil Engineering"

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

Courses	
Title	Typ Hrs/wk CP
Adaptation to climate change in hy	
Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous	
Knowledge	Hydrology, Hydraulic Engineering
	 Hydromechanic, Hydraulics Fundamentals of Coastal Engineering, Coastal- and Flood Protection
	Hydrological Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Climate protection and climate adaptation
	 Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models
	 Impacts of climate change on the components of the regional hydrological cycle
	Fundamentals of analysis of climate data
	Consequences of the impact of the climate change
	Measures for climate adaptation
	 Assessment, prioritization and communication of adaptation measures
	 Fundamentals of the analysis of hydrometeorological and hydrological data
Skills	
SKIIS	 Critical thinking: analysis of processes and relations, assessment of needs for action
	 Creative thinking: development of adaptation strategies and adaptation measures
	Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, plann
	methods
	Consideration of complex tasks
Personal Competence	
Social Competence	
	Working in heterogenous groups
	Working with different scientific / non-scientific disciplines
	Self reflection
Autonomy	
	Application oriented use of knowledge and skills
	Autonomous work on complex tasks
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	Preparation of a written report and a presentation of a complex task.
scale	
Assignment for the	
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

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

Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-based Learning	6	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String interest in t	opics related to computing in civil engine	ering.	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
	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.			
Skills	The students will be capable (i) of solving a scientific effectively in the form of a paper, and (iii) of sharing the	-	gy, (ii) of docu	umenting their wo
Personal Competence				
Social Competence	The students will be able to work in a multidisciplinary	eam and develop communication skills ne	ecessary for pr	oblem solving.
Autonomy	The students will be able to extend their knowledge and	l apply it to solve scientific problems by w	orking indepe	ndently in a proje
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
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: Elec	ive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ng: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: E			
	Civil Engineering: Specialisation Structural Engineering			
	Civil Engineering: Specialisation Computational Enginee	•		
	Computer Science: Specialisation II: Intelligence Engine	ering: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory			

Course L2764: Scientific Wor	ourse L2764: Scientific Working in Computational Engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	6		
СР	6		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Lecturer	Prof. Kay Smarsly		
Language	EN		
Cycle	WiSe/SoSe		
	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.		
Literature	Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany.		

Typ Project-/problem-based Learning Flood Protection following learning results the and Water Cycle tesses n s, assessment of needs for action egies and adaptation measures tation of calculation approaches, meth	Hrs/wk 4	СР 6
Project-/problem-based Learning I Flood Protection following learning results te and Water Cycle tesses n s, assessment of needs for action egies and adaptation measures		6
following learning results ne and Water Cycle esses n s, assessment of needs for action egies and adaptation measures		
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n s, assessment of needs for action egies and adaptation measures		
egies and adaptation measures		
	nods, numerica	al models, plannir
ciplines		
presentation and subsequent discussion	on. The work o	on the complex ta
g: Elective Compulsory lective Compulsory re Compulsory nd Climate: Elective Compulsory		
	ciplines presentation and subsequent discussi ctive Compulsory g: Elective Compulsory lective Compulsory re Compulsory nd Climate: Elective Compulsory es: Elective Compulsory ironment: Elective Compulsory ter: Elective Compulsory	presentation and subsequent discussion. The work of citive Compulsory g: Elective Compulsory lective Compulsory re Compulsory nd Climate: Elective Compulsory es: Elective Compulsory ironment: Elective Compulsory

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

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	Finite Element Methods			
Knowledge	Flächentragwerke			
	• Flachentiagwerke			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stu	dents can express the basic aspects of moder	n discretization r	methods in structu
	mechanics.			
Skille	After successful completion of this module, the	students will be able to use and further impro	ve modern discr	atization methods
381115	problems in structural mechanics.	students will be able to use and further impro	ve modern discre	
	problems in scructural mechanics.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdi 	sciplinary discussions		
	 defend their own work results in front of 			
	 promote the scientific development of co 			
	 Furthermore, they can give and accept p 	•		
Autonomy	Students are able to gain knowledge of the sub	ject area from given and other sources and a	oply it to new pro	oblems. Furthermo
	they are able to structure the solution process	or problems in the area of modern discretizati	on methods.	
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Computational	Engineering: Elective Compulsory		
	Computational Engineering: Core Qualification:	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisat	ion Simulation Technology: Elective Compulso	ry	

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

Course L3044: Modern discre	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		

ourses					
itle		Тур	Hrs/wk	СР	
onstruction law BGB and VOB - law in (e onstruction disputes from construction (Lecture Lecture	2	3 3	
Module Responsible Prof.		Lecture	£	5	
Admission Requirements None					
Recommended Previous Com					
Knowledge					
Educational Objectives After	taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge Stude	ents will gain knowledge of				
•	the history of civil engineering law,				
	basics of foundation and civil engineeri	ng law,			
٠	legal aspects of technical regulations ir	civil engineering (with case studies),			
٠	the civil engineering contract,				
•	the liability of the designer and contrac	tor in civil engineering,			
•	the subsoil risk and the system risk,				
•	the total debt in (civil) engineering law,				
	 the (construction) conflict, dispute avoidance models and the construction process, the systematics of construction contract law, the BGB construction contract law, responsibilities on the construction site, 				
	remuneration and contract management	nt,			
	liability for defects,				
	public procurement law	much manay am Lontitlad to?			
	Disturbed construction processes: How Correct calculation of supplements.	much money and rentitied to?			
	correct calculation of supplements.				
	unte la sua la sua la sua la sua suba (n. ala su		d		
		ning and construction in a legally balance e (planning and construction) on the cons			
	mage the construction project optimally.	(planning and construction) on the cons	struction site in a targe		
	mage the construction project optimally.				
Personal Competence					
Social Competence Stude	ents can work in groups and support eacl	n other in finding solutions.			
Autonomy Stude	ents are able to assess their own strengt	ns and weaknesses and organize their tim	ne and learning manage	ement based on th	
Workload in Hours Indep	endent Study Time 124, Study Time in L	ecture 56			
Credit points 6					
Course achievement None					
Examination Oral	exam				
Examination duration and 30 m	in				
scale					
-	Engineering: Specialisation Coastal Engir	• • • •			
	Engineering: Specialisation Geotechnical	5 5 1 5			
	Engineering: Specialisation Structural En				
	Engineering: Specialisation Water and Tr Engineering: Specialisation Computation				

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

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

Courses					
Title		Тур		Hrs/wk	СР
Title Coastal- and Flood Protection (L0808)		Lecture		пі 5/ w к 2	3
Coastal- and Flood Protection (L141	- /		m-based Learning	1	1
Maintenance and Defence of Flood	Lecture	5	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Coastal Engineering I				
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following learning res	ults		
Professional Competence					
Knowledge	The students have the capability to define	and explain in detail the importan	t aspects of erosic	on protection	and flood protecti
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension in				dimension importa
	coastal protection measures from the functional and from the constructional point of view.				
Skills	Skills The students are able to select design approaches for the functional and constructional design of erosion a				and flood protect
Skiis	measures and apply these approaches to practical design tasks.				
		5			
Personal Competence					
Social Competence	The students are able to deploy their gain	• • • •			-
	coastal and flood protection structures. Add				isciplines.
-	The students will be able to independently extend their knowledge and apply it to new problems.				
	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 130 m	in. The examination includes tasks	s with respect to	the general u	inderstanding of t
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Coastal Eng	jineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnic	al Engineering: Elective Compulsor	ý		
	Civil Engineering: Specialisation Structural E				
	Environmental Engineering: Specialisation E	nvironment and Climate: Elective C	Compulsory		
	Environmental Engineering: Specialisation V Water and Environmental Engineering: Specialisation			lsory	

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

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

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

Courses	
Title	Typ Hrs/wk CP
Waste and Environmental Chemist	
Biological Waste Treatment (L0318	
Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	
Educational Objectives	
Professional Competence	
Knowledge	The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to expla design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treat plants for biological waste treatment plants and explain different methods for waste analytics.
Skills	s The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and q control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der m and plan additional tests. They are capable of reflecting and evaluating findings in the group.
Personal Competence	
-	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend thei
Social competence	work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give accept professional constructive criticism.
Autonomy	Y Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fu
	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance wit potential social, economic and cultural impact.
Workload in Hours	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with
Workload in Hours Credit points	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance wit potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70
	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance wit potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6
Credit points Course achievement	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. s Independent Study Time 110, Study Time in Lecture 70 s 6 t Compulsory Bonus Form Description Yes None Subject theoretical
Credit points Course achievement Examination Examination duration and	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. s Independent Study Time 110, Study Time in Lecture 70 s 6 t Compulsory Bonus Form Ves None Subject theoretical and practical work a Presentation a Elaboration and Presentation (15-25 minutes in groups)
Credit points Course achievement Examination Examination duration and scale	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance wit potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups)
Credit points Course achievement Examination Examination duration and	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. s Independent Study Time 110, Study Time in Lecture 70 s 6 t Compulsory Bonus Form Description Yes None Subject theoretical and practical work t Presentation d Elaboration and Presentation (15-25 minutes in groups) c Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. s Independent Study Time 110, Study Time in Lecture 70 s 6 t Compulsory Bonus Yes None Subject theoretical a Presentation t Elaboration and Presentation (15-25 minutes in groups) a Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. s Independent Study Time 110, Study Time in Lecture 70 s 6 t Compulsory Bonus Form Description Yes None Subject theoretical and practical work t Presentation d Elaboration and Presentation (15-25 minutes in groups) c Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	 steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	 steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal 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
Credit points Course achievement Examination Examination duration and scale Assignment for the	 steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance wit potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 Independent Study Time 110, Study Time in Lecture 70 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Mater and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation General Process Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	 steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 Independent Study Time 110, Study Time in Lecture 70 G Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. s Independent Study Time 110, Study Time in Lecture 70 s 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation I Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact.
Credit points Course achievement Examination Examination duration and scale Assignment for the	 steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioproce
Credit points Course achievement Examination Examination duration and scale Assignment for the	 steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemica
Credit points Course achievement Examination Examination duration and scale Assignment for the	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation IE laboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical a

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

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

Courses				
Title		Тур	Hrs/wk	СР
Finite element modeling of structures (L3046)		Lecture	2	3
Finite element modeling of structu	es (L3047)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	Finite Element MethodsThin-walled structures			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, students	can express the basic aspects of mod	elling of structures	with finite elements
Skills	After successful completion of this module, the students will be able to model structures with finite elements and to analys structures using appropriate computational methods.			
Personal Competence				
Social Competence	 Students can participate in subject-specific and interdiscipli defend their own work results in front of other promote the scientific development of colleag Furthermore, they can give and accept profes 	s		
Autonomy	Students are able to gain knowledge of the subject a they are able to structure the solution process for pr	-		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	written elaboration of a project work (10-15 pages)			
scale	Civil Engineering, Englishing Computational English			
Following Curricula	Civil Engineering: Specialisation Computational Engin Civil Engineering: Specialisation Coastal Engineering			
i onowing curricula	Civil Engineering: Specialisation Coastal Engineering Civil Engineering: Specialisation Geotechnical Engine			
	Civil Engineering: Specialisation Structural Engineeri			
	Computational Engineering: Core Qualification: Elect			
	Theoretical Mechanical Engineering: Specialisation S		lsory	

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

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

Courses						
Title		Тур	Hrs/wk	СР		
Modeling of Subsurface Processes (L2731)	Recitation Section (small)	3	3		
Subsurface Solute Transport (L2728	3)	Lecture	2	2		
Subsurface Solute Transport (L2729))	Recitation Section (large)	1	1		
Module Responsible	Dr. Milad Aminzadeh					
Admission Requirements	None					
Recommended Previous	Basic Mathematics, Hydrology					
Knowledge						
Educational Objectives	After taking part successfully, students h	ave reached the following learning results				
Professional Competence						
Knowledge	Upon completion of this module, the s	tudents will understand the mechanisms controllin	ng solute transpor	t in soil and nat		
	porous media and will be able to work w	ith the equations that govern the fate and transpor	t of solutes in porc	us media. Analyti		
	numerical and experimental tools and te	chniques will be used in this module.				
<i>CL:</i> !!-						
SKIIIS	s 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.					
Personal Competence						
	Teamwork & problem solving					
Autonomy		g individual reports and presentation. This will o	ontribute to the s	students' ability		
	willingness to work independently and re					
	Independent Study Time 96, Study Time	in Lecture 84				
Credit points	6					
	None					
	Subject theoretical and practical work					
Examination duration and	Report					
scale						
Assignment for the	Civil Engineering: Specialisation Structur	al Engineering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory				
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory					
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory					
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory					
	Environmental Engineering: Core Qualifie	cation: Compulsory				
	Process Engineering: Specialisation Envir	onmental Process Engineering: Elective Compulsor	У			
	Process Engineering: Specialisation Proce	ess Engineering: Elective Compulsory				

Course L2731: Modeling of S	ubsurface Processes
Тур	Recitation Section (small)
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Mohammad Aziz Zarif
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	Dr. Milad Aminzadeh
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	Dr. Milad Aminzadeh			
Language	EN			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M2076: Intro	duction to Climate Informed Engin	neering			
Courses					
Title		Тур	Hrs/wk	СР	
Methods in Climate Informed Engir	eering (L3347)	Lecture	3	3	
Topics in Climate Informed Engine	ering (L3348)	Lecture	3	3	
Module Responsible	Prof. Nima Shokri				
Admission Requirements	None				
Recommended Previous	Students are expected to have a foundational	understanding of environmental scie	ence, basic engineerin	g principles, and a	
Knowledge	interest in sustainability. Recommended knowled	lge includes climate science, data anal	ysis, and familiarity wit	h engineering desig	
	processes. Analytical and critical thinking and cre	eative problem-solving skills are also b	eneficial		
Educational Objectives	After taking part successfully, students have read	ched the following learning results			
Professional Competence					
Knowledge	This module explores next-generation climate m engineering products and processes. It covers ho based learning activities, expert talks, and pres analysis in climate-informed engineering.	w various engineering disciplines can	benefit from climate in	formation. Researcl	
Skills	Climate data analysis, engineering adaptation strategies, problem-solving, research-based learning, and interdisciplinat collaboration.				
Personal Competence					
Social Competence	Collaboration, interdisciplinary teamwork, communication skills, problem-solving, ethical responsibility, and decision-making climate-resilient engineering.				
Autonomy	Time management, self-directed learning, critical thinking, accountability, initiative, and the ability to conduct independer research and make informed decisions in climate-informed engineering.				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Report and Presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal Engineer	ring: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	• • •			
_	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic				
	Civil Engineering: Specialisation Computational E	ngineering: Elective Compulsory			
	Data Science: Specialisation III. Applications: Elec	tive Compulsory			
	Environmental Engineering: Core Qualification: El	lective Compulsory			
	Process Engineering: Specialisation Process Engir	neering: Elective Compulsory			
	Water and Environmental Engineering: Specialisa	tion Cities: Elective Compulsory			
	Water and Environmental Engineering: Specialisa	tion Environment: Elective Compulsor	у		
	Water and Environmental Engineering: Specialisa	tion Water: Elective Compulsory			

Course L3347: Methods in Cl	imate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nima Shokri, Prof. Cathy Hohenegger, Prof. Irina Smirnova
Language	EN
Cycle	WiSe
Content	Students will learn techniques for incorporating climate data and environmental factors into engineering design. It covers climate modelling and the use of sensors and devices to measure climate-related parameters and engineering processes. Students will have the opportunity to conduct their own measurements, analyze the collected data, and write a report on their findings. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Course L3348: Topics in Clim	ate Informed Engineering
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova, Prof. Cathy Hohenegger, Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Exploring specific applications of climate data in various engineering disciplines. Invited speakers will present their research and discuss the relevance of climate-informed engineering to their work. Additionally, there will be a segment on effective communication, covering how to give impactful presentations and write research papers. Students will also give presentations on their own class projects related to climate-informed engineering, applying the concepts they've learned. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Courses					
Title			Тур	Hrs/wk	СР
Water Protection (L3459)			Integrated Lecture	6	6
Module Responsible		palexiou			
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge	e in water management;			
Kilowieuge	 Good knowledge 	in urban drainage;			
	-	of wastewater treatmer			
	 Good knowledge 	e of pollutants (e.g. COD,	BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part succe	ssfully, students have rea	ached the following learning results		
Professional Competence					
Knowledge	The students can desc	ribe the basic principles of	of the regulatory framework related to the	e international and Eu	uropean water secto
	They can explain limr	ological processes, subs	stance cycles and water morphology in	detail. They are abl	e to assess comple
	problems related to w	ater protection, such as	ecosystem service and wastewater treated	tment with a specia	I focus on innovativ
	solutions, remediation	measures as well as con	ceptual approaches.		
Skills	Students can accurate	ly assess current probler	ns and situations in a country-specific or	local context. They	can suggest concre
	actions to contribute	to the planning of tomo	rrow's urban water cycle. Furthermore,	they can suggest a	ppropriate technica
	administrative and legi	slative solutions to solve	these problems.		
Personal Competence					
	The students can work	together in international	aroups		
Social competence	The students can work		groups.		
Autonomy			o prepare presentations and discussions.	They can acquire ap	opropriate knowledg
	by making enquiries in	dependently.			
Workload in Hours	Independent Study Tim	e 96, Study Time in Lect	ure 84		
Credit points					
Course achievement	Compulsory Bonus	Form	Description		
	Yes 20 %	Presentation	10-minütige Präsentation von Arbeits	ergebnissen	
Examination	Written exam				
Examination duration and	150 minutes				
scale					
Assignment for the	5 5 1	5	ering: Elective Compulsory		
Following Curricula					
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory				
	-				
	-	• • •	ecialisation II. Civil Engineering: Elective (sation Cities: Elective Compulsory	Lompulsory	
			sation Environment: Compulsory		
			sation Water: Elective Compulsory		

Course L3459: Water Protect	ourse L3459: Water Protection		
Тур	Integrated Lecture		
Hrs/wk	6		
СР	6		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Lecturer	Prof. Simon Michael Papalexiou		
Language	EN		
Cycle	WiSe		
Content			
Literature			

Courses						
Fitle	a (L 2 4 5 0)		Тур	Hrs/wk	CP 6	
Uncertainty Modelling for Engineer						
Module Responsible		apalexiou				
Admission Requirements Recommended Previous						
Knowledge	 General familia 	rity with engineering	concepts.			
-	2. Elementary pro	-	s, and mathematical skills.			
		skills for handling da				
	4. Interest in solvi	ng engineering probl	ems using statistical and probabilistic meth	nods.		
Educational Objectives	After taking part succe	essfully, students hav	ve reached the following learning results			
Professional Competence						
Knowledge	Students will develop	a strong foundation	n in uncertainty, probability, and risk anal	ysis in engineering appl	ications. The cou	
	introduces probability	as a measure of ur	ncertainty, covering frequency-based met	hods. Students will explo	ore Bayes' Theor	
	probability distribution	ns, extreme value th	eory, joint probability distributions, and st	tochastic optimization to	model and quan	
			course also covers linear and nonlinear r			
			Additionally, students will gain insight into			
	and disutility and lear	пом со арргу вауез	ian Decision Theory to optimize engineerin	ig solutions under uncert	amty.	
Skills	By the end of the cour	se, students will be a	able to apply probabilistic models to quanti	fy uncertainty and assess	s risks in enginee	
	problems. They will g	ain expertise in fittir	ng probability distributions, performing ext	treme value analysis, an	d applying Bayes	
			enges. Students will also develop skills i			
	-		ering datasets and improve risk predictions	÷		
		ement stochastic me	ethods and optimization techniques to sup	port reliability-based des	sign and enginee	
	decision-making.					
Personal Competence						
Social Competence	Students will develop	the ability to wor	k collaboratively on engineering risk ass	sessments, communicati	ng technical res	
	effectively with peers, engineers, and decision-makers. They will engage in discussions on risk perception, safety factors, a					
	uncertainty quantification, ensuring that engineering analyses are both rigorous and applicable to real-world infrastructu					
	challenges.					
Autonomy	Students will learn to	independently analy	ze and model engineering uncertainties, s	electing and applying ap	propriate probab	
	distributions, regression methods, and stochastic techniques for various applications. They will also gain the ability to evaluate					
			nade hazards, ensuring they can make info	ormed engineering decisi	ons in design, sa	
	assessment, and disas	ster mitigation.				
Workload in Hours	Independent Study Tir	ne 96, Study Time in	Lecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 20 %	Presentation	10-minütige Präsentation von Arbe	eitsergebnissen		
Examination						
Examination duration and	150 min					
scale						
Assignment for the			igineering: Elective Compulsory			
Following Curricula			cal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Computational Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory					
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	Civil Engineering: Spe	cialisation Computati	onal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory					
	Environmental Engineering: Core Qualification: Elective Compulsory					
	_		tion: Elective Compulsory			
			ecialisation Cities: Elective Compulsory	271/		
			ecialisation Environment: Elective Compulso ecialisation Water: Elective Compulsory	л у		
		• • •				
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory					
	Water and Environme	ntal Engineering: Spe	cialisation Environment: Elective Compulse	bry		

Course L3458: Uncertainty M	lodelling for Engineers
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	SoSe
Content	Engineering decisions are rarely made with complete certainty—uncertainty affects material properties, environmental conditions, structural performance, and risk assessments. This course provides students with theoretical foundations and practical tools to quantify uncertainty, assess risks, and enhance decision-making in civil, structural, geotechnical, and environmental engineering applications. Students will begin with fundamental probability concepts, learning how Bayes' Theorem, probability distributions, and extreme value theory help evaluate engineering uncertainties. They will explore linear and nonlinear regression methods for analyzing complex datasets, as well as joint probability distributions and stochastic optimization to improve predictive modeling and reliability assessments. The course also introduces Bayesian Decision Theory, offering a structured approach to decision-making under uncertainty. With a focus on real-world engineering problems, students will apply probabilistic models, extreme value analysis, and stochastic techniques to assess risks in infrastructure design, system reliability, and disaster resilience. Hands-on computational exercises will reinforce key concepts, preparing students to work with data-driven models and uncertainty quantification techniques used in engineering practice. This course is ideal for students interested in engineering risk assessment, reliability analysis, and data-driven modeling. By the end of the course, students will have developed critical analytical and problem-solving skills, equipping them for careers in structural safety, geotechnical engineering, environmental risk management, and beyond.
Literature	

Specialization Geotechnical Engineering

Module M0699: Geote	chnics III						
Courses							
		T	Line (sub-	CD.			
Title Numerical Methods in Geotechnics	(10375)	Typ Lecture	Hrs/wk 3	СР 3			
Advanced Foundation Engineering		Lecture	2	2			
Advanced Foundation Engineering		Recitation Section (large)	1	1			
Module Responsible							
Admission Requirements							
Recommended Previous	Geotechnics I and II, Mathematics I-III						
Knowledge							
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results					
Professional Competence							
Knowledge	After successfully completing the module, students will be	able to					
	describe individual procedures for the geotechnical		asures,				
	 reproduce exploration and investigation methods of coloct suitable types of field and laboratory tests for 		their recults				
	 select suitable types of field and laboratory tests for state the differences between various stress and de 			ariants of the stress			
	and distortion tensor,	iornation states and the physical	significance of fin				
	 outline the standard and special soil mechanics test 	s used to determine the stress-str	ain behavior of so	I			
				ι,			
	 describe continuum models and the resulting boundary value problems, as well as define boundary value problems from the field of geotechnical engineering in such a way that they can be solved 						
	unambiguously.	nera or geoteenniear engineering	in such a way the				
Skills	Students will be able to						
	 dimension vertical drains for soil improvement of so 	ft soils,					
	calculate depth compaction using various appropriate methods,						
	apply principles of horizontal bearing capacity of piles,						
	 verify the internal and external stability of fluid-supported diaphragm walls, 						
	 evaluate the boundary conditions for the design of a deep excavation and design the individual components of the 						
	excavation,						
	 perform, evaluate and interpret tests for the description and classification of soils according to applicable standards, computationally implement numerical algorithms to solve boundary value problems, select and apply the types of analyses depending on the degree of saturation, the impact, and the material behavior determine appropriate model parameters for different possibilities and limitations of material models for the grain structure 						
	of soils.						
Personal Competence							
-	Students can work in groups and support each other in find	ding solutions					
Social competence		ang solutions.					
Autonomy	Students are able to assess their own strengths and weakr and think in terms of processes.	nesses and, based on this, organize	e their time and le	arning management			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84						
Credit points	6						
Course achievement							
Examination							
Examination duration and							
scale							
	Civil Engineering: Specialisation Structural Engineering: Co	mpulsory					
	Civil Engineering: Specialisation Structural Engineering: Co						
i onowing curricula	Civil Engineering: Specialisation Coastal Engineering: Com						
	Civil Engineering: Specialisation Coastar Engineering: Com Civil Engineering: Specialisation Water and Traffic: Elective						
	Civil Engineering: Specialisation Computational Engineerin						
	International Management and Engineering: Specialisation		nulsory				
		Lighteening. Licetive com					

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:
	 Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering)
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn

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

Course L0498: Advanced Fou	undation Engineering		
Тур	Recitation Section (large)		
Hrs/wk			
СР	1		
Workload in Hours	ndent 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				Түр	Hrs/wk	СР	
Applied Tunnel Constructions (L24))7)			Lecture	2	3	
Introduction to tunnel construction	(L0707)			Lecture	1	2	
Introduction to tunnel construction	(L1811)			Recitation Section (large)	1	1	
Module Responsible	Prof. Jürgen Grabe						
Admission Requirements	None						
Recommended Previous	Modules from Bachelo	or studies Civil a	and environmental eng	gineering:			
Knowledge	Geotechnics I-II						
Educational Objectives	After taking part succ	After taking part successfully, students have reached the following learning results					
Professional Competence							
•	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction.						
-	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis.						
Personal Competence							
Social Competence	Capacity for teamwor	rk concerning pr	roject management ar	nd design of tunnels.			
		• •		mework of a design exercise.			
Workload in Hours	ndependent Study Time 124, Study Time in Lecture 56						
Credit points							
Course achievement		Form	Descript	ion			
	No 5 %	Excercises					
Examination	Written exam						
Examination duration and	120 minutes						
scale							
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
Following Curricula	a Civil Engineering: Specialisation Geotechnical Engineering: Compulsory						
	Civil Engineering: Specialisation Coastal Engineering: Compulsory						
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory						
	Civil Engineering: Spe	ecialisation Com	putational Engineerin	g: Elective Compulsory			

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

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

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

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

Hrs/wk 6 CP 6 Workload in Hours Indep Lecturer Prof. Language EN Cycle WiSe Content 1. 2. 3. 4. 5.	ject-/problem-based Learning ependent Study Time 96, Study Time in Lecture 84 f. Kay Smarsly, Jan Stührenberg
CP 6 Workload in Hours Indep Lecturer Prof. Language EN Cycle WiSe Content 1. 2. 3. 4. 5.	f. Kay Smarsly, Jan Stührenberg ie 1. Introduction: Robotics in civil engineering 2. Presentation of potential topics 3. Programming of algorithms in Python 4. Application of software systems: LINUX distribution, ROS, CloudCompare,
Workload in Hours Indep Lecturer Prof. Language EN Cycle WiSe Content 1. 2. 3. 4. 5.	f. Kay Smarsly, Jan Stührenberg ie 1. Introduction: Robotics in civil engineering 2. Presentation of potential topics 3. Programming of algorithms in Python 4. Application of software systems: LINUX distribution, ROS, CloudCompare,
Lecturer Prof. Language EN Cycle WiSe Content 1. 2. 3. 4. 5.	f. Kay Smarsly, Jan Stührenberg ie 1. Introduction: Robotics in civil engineering 2. Presentation of potential topics 3. Programming of algorithms in Python 4. Application of software systems: LINUX distribution, ROS, CloudCompare,
Language EN Cycle WiSe Content 1. 2. 3. 4. 5.	ie 1. Introduction: Robotics in civil engineering 2. Presentation of potential topics 3. Programming of algorithms in Python 4. Application of software systems: LINUX distribution, ROS, CloudCompare,
Cycle WiSe Content 1. 2. 3. 4. 5.	 Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare,
Content 1. 2. 3. 4. 5.	 Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare,
1. 2. 3. 4. 5.	 Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare,
7.	 6. Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming 7. Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization
Verl e	k/Linner: Construction Robotics I et al.: Soft Robotics quale: New Laws of robotics

Module M0593: Building Materials and Building Preservation

Courses							
Title			Ту	p	Hrs/wk	СР	
Repair of Structures (L0255)			-	ture	1	1	
Mineral Building Materials (L0253)			Leo	ture	2	2	
Technology of mineral Building Mat	erials (L0256)		Pro	ject-/problem-based Learn	ing 1	2	
Transport Processes in Building Mat	ing Materials and Damage Processes (L0254) Lecture 1 1					1	
Module Responsible	Prof. Frank Schmidt-D	öhl					
Admission Requirements	None						
Recommended Previous	Basic knowledge abo	ut building materials, b	ouilding physics and b	uilding chemistry, for e	example by the n	nodules Principles	
Knowledge	Building Materials and Building Physics and Building Materials and Building Chemistry.						
Educational Objectives	After taking part succ	essfully, students have r	eached the following l	earning results			
Professional Competence							
Knowledge	The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They are able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlations of their material parameters. They are able to show the principles of anchor technology and design.						
Skills	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repai and strengthening measures.						
Personal Competence							
Social Competence	The students are able to develop in small grous the mixture of a special mortar. They present their results to the lecturer and the other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their special building material on the basis of this feedback.						
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to get missing components.						
Workload in Hours	Independent Study Ti	me 110, Study Time in L	ecture 70				
Credit points	6						
Course achievement	CompulsoryBonusYes20 %	Form Subject theoretical practical work	Description and				
Examination	Written exam						
Examination duration and scale	120 min						
	Civil Engineering, Spe	cialisation Geotechnical	Engineering: Compuls	orv			
Following Curricula	• • ·		• • •	-			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
5	Civil Engineering: Spe	cialisation Structural End	aineerina: Elective Cor	npulsory			

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of conc	rete structures.		
Knowledge				
	Modules: Reinforced Concrete Structures I	+II, Structural Analysis I+II, Mechanics I+II, Concre	ete Structures	
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	e The students know the main bridge types, their applications and the various loads. They can explain the basic desig			asic design meth
	They can explain the design of a prestress	ed bridge.		
Skills	The students are able to design reinforced	l or prestressed concrete bridges.		
Personal Competence				
Social Competence	The students can design in teamwork a re	al concrete bridge.		
Autonomy	The students are able to design a prestres	sed concrete bridge and discuss the problems and	I results with othe	r students.
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	l Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechn	ical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Computat	ional Engineering: Elective Compulsory		
	International Management and Engineerin	g: Specialisation II. Civil Engineering: Elective Com		

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

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

	lechanics and -Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L	0374)	Lecture	2	2
Soil Dynamics (L0452)		Lecture	2	2
Experimental Researches in Geote	hnics (L0706)	Practical Course	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules: Mathematics I-III, Mechanics I-II, O	Geotechnics I		
Knowledge	Courses: Soil laboratory course, (Applied st	ructural dynamics)		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students will be able to,			
	 to measure vibrations and to interpr justify when elastodynamic methods to reproduce the collapse theorems describe the viscous behavior of coshear strengths 	ound under dynamic excitation and define th et the data obtained with regard to their effe are sufficient and when plastodynamic effe of plasticity theory, ohesive soils and computationally account partial saturation on the seepage flow and t	ect on people and struc cts must be taken into for creep deformation	tures, account,
Skills	After the successful completion of the mod	ule the students should be able to:		
	 to derive and apply the basic equation 	on of a simple mass oscillator		
		in the soil under dynamic excitation and to	detect the relevant par	ameters
		field tests to determine soil dynamic charac		
	 to design machine foundations to dy 			
	 to measure shocks to perform vibrat 			
	• to evaluate shocks in terms of their			
	 to evaluate possibilities of isolation, 			
	 to understand mechanisms that cau 	se earthquakes and evaluate earthquakes in	terms of their magnitu	ide and intensity,
	 to know methods to determine axial 	pile capacity, integrity, and the dynamic be	dding modulus,	
	 to know the mechanisms that lead t mathematically, 	o a deformation accumulation due to cyclic	loading and to estimat	e these deformatio
	 to distinguish the area of application 	of the method of elastodynamics and plasto	odynamics,	
	 to detect the undrained shear streng 	th as a function of a number of state variab	les,	
	calculations,	ohesive soils and to consider the effects of	creep and rate-depend	ent shear strength
	 to consider the impact of the partly : 	saturated of a seepage and shear strength.		
Personal Competence				
Social Competence	Students will be able to work in teams to	achieve results on measurement and exper	rimental principles and	present their resu
	together at the end of the semester.			
Autonomy	Students are able to assess their own strer	gths and weaknesses and organize their tim	ne and learning manage	ement based on thi
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	Compulsory Bonus Form Yes None Subject theoretic	Description al and		
	practical work			
Examination	Written exam			
Examination duration and scale	135 min			
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechni			
-	Civil Engineering: Specialisation Coastal En			
	Civil Engineering: Specialisation Computati	onal Engineering: Elective Compulsory		

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

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

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

Module M0827: Mode	ling in Water Management			
	,			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modflow (L0543)		Lecture	1	1
Groundwater Modeling using Modfle Modeling of Water Supply Network		Recitation Section (small) Project-/problem-based Learning	2	2 3
		Project-/problem-based Learning	Z	5
Module Responsible Admission Requirements				
Recommended Previous				
Knowledge	Groundwater			
	 groundwater hydraulics and transport of s 	ubstances		
	Pipe Systems			
		es, in particular drinking water systemsand	urban drainag	le systems includin
	special structures	ns and sower systems		
	Hydraulics of drinking water supply systemBasic knowledge on water management	השמות שבאבו אארווא		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling	of groundwater flow and transport as well as ur	ban water infr	astructures. They ca
	carry out systems analyses and can detect tech		stems in case	studies. Besides the
	are able to analyse interdependencies of hydrau	lic and toxic phenomena in soil and water.		
Skills	Skills The students are able to construct and apply scientific groundwater models indipendently. They can work on diff			
	and can compare or assess different solutions for		ottware produ	cts. The students are
	able to use different software solutions (e.g. EPA	INET, EPA-SWMM).		
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points				
Course achievement				
Examination				
	30 min			
scale				
-	Civil Engineering: Specialisation Structural Engin	•		
Following Curricula	Civil Engineering: Specialisation Geotechnical En			
	Civil Engineering: Specialisation Coastal Engineer			
	Civil Engineering: Specialisation Water and Traff Civil Engineering: Specialisation Computational I			
	Water and Environmental Engineering: Specialis			
	Water and Environmental Engineering: Specialis Water and Environmental Engineering: Specialis			
	Water and Environmental Engineering: Specialis			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	 Knowledge on Urban planning 			
Knowledge	Knowledge on Urban planning			
	 Knowledge on measures for climate protection General knowledge of scientific writing/working 			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the follow	ng learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as o	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 contri	bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Cl-ill-			anablana af un	
Skills Students are able to develop specific solutions for correcting existing or future environment-related development. They can define a range of conceptual and technical solutions for environmental problems for d				
	paths. To solve specific urban environmental problems they ca			
	context.		nu integrate t	
Personal Competence				
	The students can work together in international groups.			
boelar competence				
Autonomy	Students are able to organize their work flow to prepare thems	selves for presentations and cont	ributions to th	ne discussions. Th
	can acquire appropriate knowledge by making enquiries indepe	ndently.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	ompulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	Environmental Engineering: Core Qualification: Elective Compul	sory		
	Joint European Master in Environmental Studies - Cities and Sus	tainability: Core Qualification: Cor	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructu	re and Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Environme	nti Electivo Compulsory		
	water and Environmental Engineering. Specialisation Environme	enc. Elective Compulsory		

Course L1109: Noise Protect	ourse L1109: Noise Protection		
Тур	Lecture		
Hrs/wk	2		
CP	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.
	 Compaction of cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

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

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

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

тур	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	 Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures

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

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

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

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

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

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

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

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

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

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

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

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

Courses				
Title	Тур	1	Hrs/wk	СР
Construction Logistics (L1163)	Lect		1	2
Construction Logistics (L1164)		tation Section (small)	1	2
Project Development and Managen		ure ect-/problem-based Learning	1	1
Project Development and Managen		ect-/problem-based Learning	1	1
Module Responsible				
Admission Requirements Recommended Previous				
Kecommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following lea	arning recults		
	After taking part successiony, students have reached the following lea			
Professional Competence	Students can			
Kilowiedge				
	• give definitions of the main terms of construction logistics and	project development and m	anagement	
	 name advantages and disadvantages of internal or external co 	nstruction logistics		
	 explain characteristics of products, demand and production of 	construction objects and the	eir consequer	nces for construction
	specific supply chains			
	 differentiate constructions logistics from other logistics system 	S		
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		
	apply methods and instruments of conflict management			
	 design supply and waste removal concepts for a construction p 	oroject		
Personal Competence				
Social Competence	Students can			
	 hold presentations in and for groups 			
	 apply methods of conflict solving skills in group work and case 	studios		
	• apply methods of connect solving skins in group work and case	studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow oriented thinking 			
	 improve their creativity, negotiation skills, conflict and crises 		methods of	moderation in cas
	studies	s solution skins sy applying	incentous of	
	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement				
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Com	pulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso			
	International Management and Engineering: Specialisation II. Civil Eng		ory	
	International Management and Engineering: Specialisation II. Logistics		,	
	Logistics, Infrastructure and Mobility: Specialisation Production and Logistics, Infrastructure and Mobility: Specialisation Infrastructure and			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	a mobility. Elective compulse	Ji y	

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in		Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis	of statically determinate and indeterminate stru-	ctures; Mechanics	I/II, Mathematics
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence		5 5		
	After successful completion of this mod	ule, the student can explain the basic aspects of	dynamic effects o	on structures and
	respective methods.		-,	
Skills	After successful completion of this mo	odule, the students will be able to predict the r	esponse of materi	ial and structures
	dynamics loading using the appropriate of			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and 			
	 defend their own work results in fr 	ront of others		
	 promote the scientific development 	nt of colleagues		
	 Furthermore, they can give and ac 	ccept professional constructive criticism		
4	Chudente en oble to onin lucoulodae of t			
Autonomy		the subject area from given and other sources and		obientis. Functientic
	they are able to structure the solution pr	ocess for problems in the area of Structural Analys	IS.	
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structure	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	5 5 1 5		
string carrieula	Civil Engineering: Specialisation Coastal			
	Civil Engineering: Specialisation Water an			
	Civil Engineering: Specialisation Compute	na Tramic: Elective Compulsory ational Engineering: Elective Compulsory ing: Specialisation II. Civil Engineering: Elective Cor		

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

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

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

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			
Recommended Previous	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the	whole project and explain it to the others.		
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction			
	changing conditions resulting from other p	participants of the project.		
Personal Competence				
Social Competence	Students can present their results to other members of the group.			
	They have the ability to work for a broad a	agreement with respect to intergroup depen	dencies.	
	They can distribute and process tasks ind	ependently.		
Autonomy	Students can handle their part of the proje	ect on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechr	ical Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Structura	l Engineering: Compulsory		
	Civil Engineering: Specialisation Computa	tional Engineering: Elective Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)	Undrewlie Engine grieg (11146)	Recitation Section (large)	2	2
Steel Structures in Foundation and		Lecture	Z	Z
Module Responsible Admission Requirements				
	Complete modules: Geotechnics I-III, Math	omatics LIII		
Kecommended Previous Knowledge	complete modules: Geotechnics I-III, Math			
Kilowiedge	Courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay wa			
	Furthermore, the students get all the necessary knowledge to design singular construction elements for sheet pile w know how to choose the right construction elements depending on the influencing conditions.			et pile walls and th
	Furthermore, the students are able to div			
SKIIIS	Skills Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile wal walls and combined sheet pile walls) and to dimension all construction elements and connections.			
			alls (wave sheet	
	waits and combined sheet pile waits) and t		10115.	
Personal Competence				
Social Competence				
Autonomy	Students are able to assess their own stre	ngths and weaknesses and organize their time and	learning manage	ement based on th
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechn	ical Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Compulsory		
	Civil Engineering: Specialisation Computat	ional Engineering: Elective Compulsory		
		5 5 7 7		

Course L0548: Marine 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	 Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures 		
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin 		

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

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

Courses				
Courses			_	
Title		Typ	Hrs/wk	СР
Smart Monitoring (L2762) Smart Monitoring (L2763)		Integrated Lecture Recitation Section (small)	2	2 4
Module Responsible	Prof. Kay Smarsly	Recitation Section (Smail)	L	7
Admission Requirements	None		alaa aya balaful	Internet in mer
Recommended Previous Knowledge	Basic knowledge or interest in object-oriented r research and teaching areas, such as Internet of			
Kilowiedge	skills of scientific working, are required. Basic kn			s the will to dee
	skills of sciencific working, are required. basic kir		36113.	
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	The students will become familiar with the pri	nciples and practices of smart monitoring.	The students wi	II be able to de
	decentralized smart systems to be applied for	or continuous (remote) monitoring of system	ms in the built	and in the nat
	environment. In addition, the students will learn	to design and to implement intelligent senso	r systems using	state-of-the-art o
	analysis techniques, modern software design cor	ncepts, and embedded computing methodolog	gies. Besides lect	ures, project wo
	also part of this module, which will be conducte	ed throughout the semester and will contribut	te to the grade.	In small groups,
	students will design smart monitoring systems th	hat integrate a number of "intelligent" sensors	s to be implemen	ited by the stude
	Specific focus will be put on the application of	machine learning techniques. The smart mor	nitoring systems	will be mounted
	real-world (built or natural) systems, such as brid	dges or slopes, or on scaled lab structures for	validation purpo	ses. The outcom
	every group will be documented in a paper. All s	tudents of this module will "automatically" pa	articipate with th	eir smart monito
	system in the annual "Smart Monitoring" compet	tition. The written papers and oral examinatio	ns form the final	grades. The mo
	will be taught in English. Limited enrollment.			
Skills	The students will gain insights into operating sta			
	processes relevant to engineering, such as environmental, structural, or comfort monitoring. The students will be capable			
	devising monitoring strategies of physical proce			
	implement the strategies in smart wireless sense		ogramming. Fina	lly, the students
	be able to document the findings of their project	s in short reports.		
Personal Competence				
	The students will be able to work in groups, sha	re parts of the work for their projects, and de	evelop communio	ation skills, tow
	achieving the common project goals.			
Autonomy	The students will be able to gain a solid basis of	on approaching and solving problems in eng	ineering, as well	as on documen
	results, through their involvement in their monito	oring group projects.		
Workload in Hours	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points				
Course achievement	None			
Examination	Written elaboration			
	10 pages of work with 15-minute oral presentation	on		
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffi	ic: Elective Compulsory		
Following Curricula				
j	Civil Engineering: Specialisation Coastal Enginee			
	Civil Engineering: Specialisation Structural Engin	5 1 5		
	Computer Science: Specialisation II: Intelligence			
	Environmental Engineering: Specialisation Energ	• • • • •		
	Environmental Engineering: Specialisation Enviro			
	Environmental Engineering: Specialisation Water		pulsory	
	Mechatronics: Technical Complementary Course:		,,	
	Mechatronics: Core Qualification: Elective Compu			
	Theoretical Mechanical Engineering: Specialisatio		ompulsory	
		STATISTICS and Compater Science. Liettive C	5paisory	
	Water and Environmental Engineering: Specialisa Water and Environmental Engineering: Specialisa	ation Cities: Elective Compulsory		

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

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

Module M1845: Thin-	walled structures			
	walled structures			
Courses				
Title		Тур	Hrs/wk	СР
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)		Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous				
Knowledge	Structural Analysis I			
	Structural Analysis II			
	Finite Element Methods			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the st	udents can express the basic aspects of	the load-carryin	g behaviour of thir
	walled structures.			
Skills	After successful completion of this module, the stu		g behaviour of th	nin-walled structure
	using appropriate analytical and coputational metho	ods.		
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdiscipl 	inary discussions		
	 defend their own work results in front of othe 	•		
	 promote the scientific development of collead 			
	 Furthermore, they can give and accept profes 			
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 p	roblems in the area of modelling and analy	sis of thin-walled	d structures.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engi	neering: Compulsory		
	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation S	Simulation Technology: Elective Compulso	ry	

Тур	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Bastian Oesterle
Language	DE
Cycle	SoSe
Content	Plates loaded in-plane
	 Governing equations (equilibrium, kinematics, constitutive law)
	Differential equation
	Airy stress function
	Plane stress / plane strain
	Structural behaviour of plates loaded in-plane
	• finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results
	Plates in bending
	Governing equations (equilibrium, kinematics, constitutive law)
	Differential equation
	Navier solution / Fourier series expansion
	Approximation procedures
	Circular and rectangular plates
	Structural behaviour of plates in bending
	 finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results
	Shells
	Phenomenona of the structural behaviour of shells
	Membrane and bending theory
	Equilibrium equations of shells of revolution
	• Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell
	finite elements for shells
	Stability problems (overview)
	Plate buckling
	Shell buckling
Literature	
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	

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

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

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Digital Twinning in Civil Engineerin	g (L3136)	Lecture	2	2	
Digital Twinning in Civil Engineerin	g (L3137)	Seminar	2	4	
Module Responsible	Alexander Chmelnizkij				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge					
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Presentation				
Examination duration and	20 min presentation and 5 pages hando	out			
scale					
Assignment for the	Civil Engineering: Specialisation Compu	tational Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Geotec	hnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structu	ral Engineering: Elective Compulsory			

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

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

Module M0858: Coast	tal Hydraulic Engineering I				
Courses					
Title		Тур	Hrs/wk	СР	
Basics of Coastal Engineering (L08	07)	Lecture	3	4	
Basics of Coastal Engineering (L14		Project-/problem-based Learni	ng 1	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Basics of hydraulic engineering, hydrolog	gy and hydromechanics			
Knowledge					
Educational Objectives	After taking part successfully, students h	nave reached the following learning results			
Professional Competence					
Knowledge	The students are able to define and expl	ain the basic concepts of coastal engineering and po	rt engineering. T	hey are able to app	
	the concepts to selected practical proble	ems of coastal engineering. Students can define and	determine the b	pasics for design a	
	dimensioning of coastal engineering con-	structions.			
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.				
Personal Competence					
Social Competence	The students are able to deploy their ga	ained knowledge in applied problems such as the d	esign of coastal p	protection structure	
	Additionaly, they will be able to work in t	team with engineers of other disciplines, for instance	designing of coa	stal breakwaters.	
Autonomy	The students will be able to independent	tly extend their knowledge and applyit to new proble	ms.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 2 h	nours. The examination includes tasks with respect	to the general u	understanding of t	
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Coastal	Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotech	nnical Engineering: Compulsory			
	Civil Engineering: Specialisation Structur	al Engineering: Elective Compulsory			
	Environmental Engineering: Specialisation	on Environment and Climate: Elective Compulsory			
	Environmental Engineering: Specialisation	on Water Quality and Water Engineering: Elective Cor	npulsory		
	International Management and Engineer	ing: Specialisation II. Civil Engineering: Elective Com	oulsory		
	Water and Environmental Engineering: S	pecialisation Environment: Elective Compulsory			
	Water and Environmental Engineering: S	pecialisation Water: Elective Compulsory			

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

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

Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	I Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura	I Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials or n	naterial science, for example by the mo	dule Building Ma	aterials and Buildi
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reac	ned the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tr	ading, use and marking of construction p	oducts in Germar	ny. They know whi
	methods for the testing of building material prope	erties are usable and know the limitations a	nd characterics o	f the most importa
	testing methods.			
Chille			unte la Commo	
SKIIIS	The students are able to responsibly discover the rules for trading and using of building products in Germany. They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages a			
	-			
	the examination of the structural conditions of bu are able to describe an examination in form of a t	• • •	nptons to the cau	se of damages. Th
Personal Competence				
Social Competence	The students can describe the different roles of i	manufacturers as well as testing, supervis	ory and certificati	on bodies within t
	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 kno	wledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineeri	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic	: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
	International Management and Engineering: Speci	alisation II. Civil Engineering: Elective Com	pulsory	
	Materials Science: Specialisation Engineering Mate	erials: Elective Compulsory		

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

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

Module M0713: Conci	ata Churchura					
Module M0715: Conci	ete Structure	5				
Courses						
Title				Тур	Hrs/wk	СР
Concrete Structures (L0579)				Seminar	1	1
Structural Concrete Members (L05	77)			Lecture	2	3
Structural Concrete Members (L05	78)			Recitation Section (large)	2	2
Module Responsible	Dr. Adrian Faron					
Admission Requirements	None					
Recommended Previous	Basics of structural	analysis, conception ar	nd dimensioning of stru	ictural concrete		
Knowledge	Mala Data Cara			1.11. M		
	Modules: Reinforced	Concrete Structures I	+II, Structural Analysis	I+II, Mechanics I+II		
Educational Objectives	After taking part suc	ccessfully, students ha	ve reached the followir	ng learning results		
Professional Competence				5 5		
Knowledae	The students broade	en their skills in structu	ural engineering, espec	ially in the field of buildings	(houses, roofs, h	alls). They dispose
	The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose the knowledge for the conception and design of concrete buildings and structural members that are often used.					
	5		5			
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing an					
	execution. Moreove	r, they can make desig	in and construction ske	tches and draw up technica	I descriptions.	
Personal Competence						
•	The students are able to obtain results of high quality in teamwork.					
	The stadents 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			
Credit points						
Course achievement		Form	Description			
	No None	Presentation	Es werden 2 F	Referate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Sp	pecialisation Structural	Engineering: Compuls	ory		
Following Curricula	Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
-			ngineering: Elective Co			
			d Traffic: Elective Comp			
			ional Engineering: Elec			
				I Engineering: Elective Com	pulsory	
			5	3 -		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treat	nent (L0311)	Lecture	2	1
Chemistry of Drinking Water Treat	nent (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04	02)	Lecture	2	2
Water Resource Management (L04	03)	Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Knowledge of water management and the k	ey processes involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas	of conflict in water management, as well as t	heir mutual depen	dence for sustaina
	water supply. They will understand relevar	t economic, environmental and social factors	. Students will be	able to explain a
	outline the organisational structures of wate	r companies. They will be able to explain the a	available water trea	atment processes a
	the scope of their application.			
Skills	Students will be able to assess complex	c problems in drinking water production a	nd establish solut	ions involving wa
	management and technical measures. They	will be able to assess the evaluation methods	s that can be used	for this. Students
	be able to carry out chemical calculations	for selected treatment processes and apply	generally accepted	d technical rules a
	standards to these processes.			
Personal Competence				
-	Working in a diverse group of specialists of	udents will be able to develop and desument	complay colutions	for the managem
Social Competence		udents will be able to develop and document		
		be able to take an appropriate professional productions in teacher of divergence and appropriate professional productions and appropriate professional professi		
	interests. They will be able to develop joint s	solutions in teams of diverse experts and prese	nt these solutions	to others.
Autonomy	Students will be in a position to work on a su	bject independently and present on this subject	ct.	
Workload in Hours	Independent Study Time 96, Study Time in I	octuro 94		
Credit points				
Course achievement				
	Written exam			
	60 min (chemistry) + presentation			
scale				
	Civil Engineering: Specialisation Structural E	ngineering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechnica			
	Civil Engineering: Specialisation Water and	5 5 1 ,		
	Civil Engineering: Specialisation Coastal Eng			
	5 5 1 5	nical Complementary Course: Elective Compuls	ony	
		nical Complementary Course: Elective Compuls	-	Compulsory
		Specialisation II. Energy and Environmental Er	• •	compuisory
		nental Process Engineering: Elective Compulso	ry	
	Process Engineering: Specialisation Process			
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering: Spec	ialisation Cities: Elective Compulsory		

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

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

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

Course L0403: Water Resour	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	

	grated Transportation Planning	
Courses		
Title	Typ Hrs/wk	СР
Integrated Transportation Planning	g (L1068) Project-/problem-based Learning 4	6
Module Responsible	e Prof. Carsten Gertz	
Admission Requirements	s None	
Recommended Previous		Traffic Engineerin
Knowledge		
Educational Objectives		
Professional Competence		
Knowledge	e Students are able to:	
	describe interdependencies between land-use/location choice and transportation/mobility behaviour	
	explain and evaluate the social, ecological and economic effects of transport and land-use policy mean	sures.
	 relate current issues in the area of integrated transport planning and formulate an opinion on them. 	
Skills	s Students are able to:	
	 quantify important parameters, which influence travel demand or are influenced by it. 	
	comprehensively examine a pre-defined or self-selected topic from a transportation studies perspect	ive and document
	results in accordance with scientific conventions.	
Personal Competence	e	
Social Competence	e Students are able to:	
	 provide feedback on topical contents and their teaching. 	
	 constructively handle feedback on their own work. 	
	 produce results in group work and document these. 	
Autonomy	y 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.	
	Independent Study Time 124, Study Time in Lecture 56	
Credit points	s 6	
Course achievement	t None	
Examination	n Written elaboration	
Examination duration and	d written assignment with presentation during the semester	
scale	e	
Assignment for the	e Civil Engineering: Specialisation Structural Engineering: Elective Compulsory	
Following Curricula		
	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 Cities: Compulsory	

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

Module M0963: Steel	and Composite Structures			
Courses				
litle		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	204)	Lecture	2	2
Steel and Composite Structures (L1		Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I an	nd II, BUBC)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	 describe the phenomenon of local buckling 			
	explain warping torsion			
	 illustrate the behaviour of composite structure 	es		
	 specify the principles in design of composite s 			
	 sketch the contructions of steel and composit. 			
	• sketen the contractions of steel and composit	e bhuges		
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structure 	ires		
	 recognize and verify warping tosion in strucur 	es		
	 design composite structures 			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineeri	ng: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	eering: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic: E			
	Civil Engineering: Specialisation Computational Engin			
	International Management and Engineering: Speciali		ulcon	
	international Management and Engineering: Special	sation in civil Engineering. Elective Comp	uisui y	

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

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

Courses	
Title	Typ Hrs/wk CP
Module Responsible	Dozenten des SD B
Admission Requirements	None
Recommended Previous	Subjects of the Foundation Engineering specialisation.
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of geotechnical and foundation engineering. They ca 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 feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Course achievement	None
Examination	Study work
Examination duration and scale	see FSPO
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Following Curricula	

Courses				
Title		Тур	Hrs/wk	СР
Design of Composite Bridges (L3092)		Integrated Lecture	2	3
Analysis of Offshore Structures (L1	867)	Lecture	1	1
Solid Matter Process Technology for	or Biomass (L0052)	Lecture	2	3
Innovative Timber Construction (L2	2666)	Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Sustainable landfill design and ope		Integrated Lecture	3	3
Special Topics in Steel Design (L30		Integrated Lecture	2	3
Special topics of civil engineering 1			1	1
Special topics of civil engineering 2			2	2
Special topics of civil engineering 3	3 LP (L2380)	Seminar	3 2	3 2
Structural Design (L2789)		Seminar	Z	Z
	Prof. Frank Schmidt-Döhl			
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	. Chudente en able te find their wey through			_
	Students are able to find their way through			
	Students are able to explain basic models		civil and structur	al engineering.
	Students are able to interrelate scientific a	nd technical knowledge.		
Skills				
	 Students are able to apply basic methods i 	n selected areas of civil and structural engir	neering.	
Personal Competence				
Social Competence				
,				
Autonomy	 Students can chose independently, in white 	ch fields they want to deepen their knowle	dge and skills th	rough the election
	courses.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	1			
	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineer Civil Engineering: Specialisation Water and Traffic			

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

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

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

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

Course L1152: Glass Structures	
Тур	Lecture
Hrs/wk	2
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	
Cycle	
Content	Glass structures
	- Introduction of the material glass (production, refinement, material characteristic)
	- design of facades
	- facade types
	- static calculation of glazing
	- static calculation of facades
	- load bearing behavior of glazing (plate or membrane stiffness)
	- vertical / horizontal glazing with safety-related requirements
	- glass structures
	- fire safety of glass facades
	- construction physics of facades and glazing
Literature	

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

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

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

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

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

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

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

Courses	
Title 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	
Recommended Previous Knowledge	 Hydrology, Hydraulic Engineering Hydromechanic, Hydraulics Fundamentals of Coastal Engineering, Coastal- and Flood Protection Hydrological Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge Skills	 Climate protection and climate adaptation Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle Fundamentals of analysis of climate data Consequences of the impact of the climate change Measures for climate adaptation Assessment, prioritization and communication of adaptation measures Fundamentals of the analysis of hydrometeorological and hydrological data
Personal Competence Social Competence Autonomy	 Working in heterogenous groups Working with different scientific / non-scientific disciplines Self reflection
	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	
Examination	
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	 Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data
Literature	 Wird bereitgestellt über die HOOU - eLearning Plattform abhängig von den jeweils schwerpunktmäßig behandelten Fragestellungen wird das Schrifttum (aktuelle Paper) in der Veranstaltung bzw. über StudIP zur Verfügung gestellt.

Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	I Engineering (L2764)	Project-/problem-based Learning	6	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String interest in topic	s related to computing in civil engined	ering.	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	ollowing learning results		
Professional Competence				
	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 proj 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.			
Skills	The students will be capable (i) of solving a scientific pro effectively in the form of a paper, and (iii) of sharing their v	-	gy, (ii) of docu	menting their wo
Personal Competence				
Social Competence	The students will be able to work in a multidisciplinary tear	n and develop communication skills ne	ecessary for pr	oblem solving.
Autonomy	The students will be able to extend their knowledge and ap	ply it to solve scientific problems by w	orking indeper	ndently in a proje
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Election	ve Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Computational Engineering			
	Computer Science: Specialisation II: Intelligence Engineerin	g: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory			
	Mechatronics: Technical Complementary Course: Elective C	Compulsory		

Course L2764: Scientific Wor	rking in Computational Engineering
Тур	Project-/problem-based Learning
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.
Literature	Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany.

nd Climate Change	Typ Hrs/wk CP Project-/problem-based Learning 4 6 oastal- and Flood Protection
e Engineering chanics, Hydraulics ntals of Coastal Engineering, Coa successfully, students have rea nd Climate Change	Project-/problem-based Learning 4 6
Engineering hanics, Hydraulics htals of Coastal Engineering, Coa successfully, students have rea nd Climate Change	
hanics, Hydraulics ntals of Coastal Engineering, Coa successfully, students have rea nd Climate Change	
hanics, Hydraulics ntals of Coastal Engineering, Coa successfully, students have rea nd Climate Change	
nd Climate Change	eached the following learning results
npacts of Climate Change on Wi nces of Climate Change for Coas otection in Taiwan and Germany ntals of Climate Adaptation sed Solutions (NBS) for Coastal I	astal Processes ny
hinking: development of adapta	nd relations, assessment of needs for action ation strategies and adaptation measures ions, application of calculation approaches, methods, numerical models, pla
n international groups vith different scientific / non-scie	ientific disciplines
n oriented use of knowledge and ous work on complex tasks	nd skills
dy Time 124, Study Time in Lect	ecture 56
ion	
written report on a complex ta	ask with a presentation and subsequent discussion. The work on the complex
ourse of the lecture.	
: Specialisation Structural Engin : Specialisation Water and Traffi ngineering: Specialisation Enviro	Engineering: Elective Compulsory ineering: Elective Compulsory
	ction on oriented use of knowledge a ous work on complex tasks udy Time 124, Study Time in Le course of the lecture. g: Specialisation Coastal Engine g: Specialisation Geotechnical Eng g: Specialisation Structural Eng g: Specialisation Structural Eng g: Specialisation Water and Tra Engineering: Specialisation Envi

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

Co				
Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in s Modern discretization methods in s		Lecture Recitation Section (small)	2	3
Module Responsible		Recitation Section (Small)	2	5
Admission Requirements				
Recommended Previous				
Knowledge	Finite Element Methods			
	Flächentragwerke			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stu	dents can express the basic aspects of moder	n discretization r	nethods in structu
	mechanics.			
Skills	After successful completion of this module, the	students will be able to use and further impro	ve modern discre	etization methods f
211112	problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interd 	sciplinary discussions,		
	 defend their own work results in front of 			
	 promote the scientific development of contract 	lleagues		
	 Furthermore, they can give and accept p 	rofessional constructive criticism		
Δυτοροπγ	Students are able to gain knowledge of the sub	iect area from given and other sources and a	only it to new pro	blems Furthermo
7.420770779	they are able to structure the solution process			
	,			
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engine	•		
Following Curricula	Civil Engineering: Specialisation Geotechnical E			
	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Computational	Engineering: Elective Compulsory		
	Computational Engineering: Core Qualification:	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisa	ion Simulation Technology: Elective Compulso	ry	

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

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

Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3
Lecture Lecture	2	3
Lecture		
ring learning results	2	3
(with case studies)		
ering,		
• the subsoil risk and the system risk,		
d the construction proce	ess,	
Lentitled to?		
T childed to:		
tion in a legally balance	ed way. Students learn h	ow to use legal :
instruction, on the con	struction site in a target	
solutions.		
es and organize their tin	ne and learning manager	ment based on th
<u></u> _		
1 3		
	I entitled to? tion in a legally balanc onstruction) on the con solutions.	ering, d the construction process, I entitled to? tion in a legally balanced way. Students learn h onstruction) on the construction site in a target solutions. es and organize their time and learning manager compulsory titve Compulsory e Compulsory npulsory

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

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

Courses					
Title		T	Line (mile	CD.	
Coastal- and Flood Protection (L08)	0)	Typ Lecture	Hrs/wk	СР 3	
Coastal- and Flood Protection (L000		Project-/problem-based Learning	1	1	
Maintenance and Defence of Flood	-	Lecture	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Coastal Engineering I				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the	e following learning results			
Professional Competence					
Knowledge	The students have the capability to define and explain	in detail the important aspects of erosi	on protection	and flood protecti	
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension importan				
	coastal protection measures from the functional and from the constructional point of view.				
Skills	The students are able to select design approaches for	the functional and constructional design	n of erosion	and flood protecti	
<i>onmo</i>	The students are able to select design approaches for the functional and constructional design of erosion and flood protection measures and apply these approaches to practical design tasks.				
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the functional and constructive design				
	coastal and flood protection structures. Additionaly, they	-		lisciplines.	
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Course achievement					
Examination					
	The duration of the examination is 130 min. The exam	nination includes tasks with respect to	the general u	inderstanding of t	
	lecture contents and calculations tasks.				
•	Civil Engineering: Specialisation Coastal Engineering: Co				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
	Environmental Engineering: Specialisation Environment and Climate: Elective Compulsory Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory				
			lisury		
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Water: Elective Compulsory				

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

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

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

	gical Waste Treatment			
Courses				
Title		Тур	Hrs/wk	СР
Waste and Environmental Chemist		Practical Course	2	2
Biological Waste Treatment (L0318	1	Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements				
Recommended Previous	chemical and biological basics			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence			ta Chudanta a	
Knowledge	design and layout of anaerobic and aerobic w	ing the planning of biological waste treatment plan aste treatment plants in detail, describe different to nd explain different methods for waste analytics.		
Skills	control measurements. The students can rec	tion of design and layout of plants. They can critical therché and evaluate literature and date connected f reflecting and evaluating findings in the group.	-	
Personal Competence				
		and interdisciplinary discussions, develop cooperate	ad solutions a	nd defend their (
Seedi competence		the scientific development in front of colleagues		
Autonomy	are capable, in consultation with supervisors	rom literature, business or test reports and transfo as well as in the interim presentation, to assess the refine targets for new application-or research-orien t.	ir learning lev	el and define furt
Workload in Hours	Independent Study Time 110, Study Time in I	Lecture 70		
Workload in Hours Credit points		Lecture 70		
		Lecture 70 Description and		
Credit points	6 Compulsory Bonus Form Yes None Subject theoretical practical work	Description		
Credit points Course achievement Examination Examination duration and	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation	Description and		
Credit points Course achievement Examination Examination duration and scale	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes	Description and in groups)		
Credit points Course achievement Examination Examination duration and	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin	Description and in groups) neering: Elective Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory igineering: Elective Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory igineering: Elective Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory agfic: Elective Compulsory	pulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specialisation Specialisation A - Ge	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory	-	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specialisation Specialisation A - Ge Chemical A -	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory lisation General Process Engineering: Elective Comp	npulsory	ry
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specialisation Coastal Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation Structural Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation Structural Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specialisation Mater Adv Chemical and Bioprocess Engineering: Specialisation Mater Adv Chemical and Bioprocess Engineering: Specialisation Mater Adv Chemical	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory Ilisation General Process Engineering: Elective Compulsory Ilisation Chemical Process Engineering: Elective Compulsory	npulsory tive Compulso	ry
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: Special Chemical and Bioprocess Engineering: Speci	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory Ilisation General Process Engineering: Elective Compulsion Chemical Process Engineering: Elective Compulsation Chemical Process Engineering: Elective Compulsation Chemical and Bioprocess Engineering: Elective Computer Chemical and Bioprocess Engineering: Elective Chemical and Bioprocess En	npulsory tive Compulso ry	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: Special Chemical and Bioprocess Engineering: Speci	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory ilisation General Process Engineering: Elective Compulsation Chemical Process Engineering: Elective Compulsation Chemical and Bioprocess Engineering: Elective Compulsation Bioprocess Engineering: Elective Compulsation Bioprocess Engineering: Elective Compulsation Chemical and Bioprocess Engineering: Elective Compulsation Bioprocess Engineering: Elective Compulsation Chemical and Bioprocess Engineering: Elective Computer Chemical and Bioprocess Engineering: Elective Computer Chemical and Bioprocess Engineering: Elective Computer Chemical and Bioprocess Engineering: Elective	npulsory tive Compulso ry	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Special Chemical Bioprocess Engineering: Special	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory disation General Process Engineering: Elective Compulsation Chemical Process Engineering: Elective Compulsation Chemical and Bioprocess Engineering: Elective Compulsor ilisation Chemical and Bioprocess Engineering: Elective Compulsory ilisation Chemical and Bioprocess Engineering: Elective Compulsory ilisation Chemical and Bioprocess Engineering: Elective Compulsory ilisation Chemical and Bioprocess Engineering: Elective Compulsory Specialisation II. Renewable Energy: Elective Compu	npulsory tive Compulso ry tive Compulso	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia Process Engineering: Specialisation Environmental Process Engineering: Specialisation Environmental Process Engineering: Specialisation Environmental Process Engineering: Specialisation Environmental Chemical Specialisation Environmental Chemical Specialisation Environmental Chemical Specialisation Environmental Computer Specialisation Environmental Civil Specialisatio	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory ilisation General Process Engineering: Elective Compulsation Chemical Process Engineering: Elective Compulsory ilisation Chemical and Bioprocess Engineering: Elect ilisation Bioprocess Engineering: Elective Compulsor ilisation Chemical and Bioprocess Engineering: Elect ilisation Chemical and Bioprocess Engineering: Elect ilisation Chemical and Bioprocess Engineering: Elective Compulsory Specialisation II. Renewable Energy: Elective Compulsory iental Process Engineering: Elective Compulsory	npulsory tive Compulso ry tive Compulso	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Form Yes None Subject theoretical practical work Presentation Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Special Chemical Bioprocess Engineering: Special	Description and in groups) neering: Elective Compulsory I Engineering: Elective Compulsory I Engineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory lisation General Process Engineering: Elective Compulsory ilisation Chemical Process Engineering: Elective Compulsory ilisation Chemical and Bioprocess Engineering: Elect ilisation Chemical and Bioprocess Engineering: Elect in: Compulsory Specialisation II. Renewable Energy: Elective Compulsory alisation Cities: Elective Compulsory	npulsory tive Compulso ry tive Compulso	

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Finite element modeling of structu	res (L3046)	Lecture	2	3	
Finite element modeling of structu	res (L3047)	Recitation Section (small)	2	3	
Module Responsible	Prof. Bastian Oesterle				
Admission Requirements	None				
Recommended Previous Knowledge	Finite Element MethodsThin-walled structures				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	After successful completion of this module, students	can express the basic aspects of mode	lling of structures	with finite elements	
Skills	After successful completion of this module, the students will be able to model structures with finite elements and to analy structures using appropriate computational methods.				
Personal Competence					
Social Competence					
	 participate in subject-specific and interdiscipling 				
	defend their own work results in front of others				
	 promote the scientific development of colleague 				
	 Furthermore, they can give and accept profess 	ional constructive criticism			
Autonomy	Students are able to gain knowledge of the subject area from given and other sources and apply it to new problems. Furthermore				
	they are able to structure the solution process for pro	blems in the area of finite element mo	delling of structure	25.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56			
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	written elaboration of a project work (10-15 pages)				
scale					
Assignment for the	Civil Engineering: Specialisation Computational Engin	eering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Structural Engineering				
	Computational Engineering: Core Qualification: Elective Compulsory				
	Theoretical Mechanical Engineering: Specialisation Si	mulation Technology: Elective Compuls	sory		

 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 	Тур	Lecture
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 th phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base 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 	Hrs/wk	2
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 th phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base 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 	CP	3
Language EN Cycle WiSe Content Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of th phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base 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 	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Cycle WiSe Content Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of th phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base 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 	Lecturer	Prof. Bastian Oesterle
Content Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of th phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base 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 	Language	EN
 phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base 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 	Cycle	WiSe
 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 	Content	phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-based
• dynamic problems, modal analyses		 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

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

Courses					
Title		Тур	Hrs/wk	СР	
Modeling of Subsurface Processes	(L2731)	Recitation Section (small)	3	3	
Subsurface Solute Transport (L272	8)	Lecture	2	2	
Subsurface Solute Transport (L272	9)	Recitation Section (large)	1	1	
Module Responsible	Dr. Milad Aminzadeh				
Admission Requirements	None				
Recommended Previous	Basic Mathematics, Hydrology				
Knowledge					
Educational Objectives	After taking part successfully, students h	nave reached the following learning results			
Professional Competence					
Knowledge	Upon completion of this module, the s	tudents will understand the mechanisms controllin	ng solute transpor	t in soil and nat	
	porous media and will be able to work w	ith the equations that govern the fate and transpor	t of solutes in porc	us media. Analyti	
	numerical and experimental tools and te	chniques will be used in this module.			
<i></i>					
Skills		students will be exposed to analytical, experimenta			
	this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in the				
	future career.				
Personal Competence					
,	Teamwork & problem solving				
Autonomy		ig individual reports and presentation. This will c	ontribute to the	students' ability	
	willingness to work independently and re				
	Independent Study Time 96, Study Time	in Lecture 84			
Credit points					
Course achievement					
	Subject theoretical and practical work				
Examination duration and	Report				
scale					
Assignment for the	Civil Engineering: Specialisation Structur	al Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory				
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory				
	Environmental Engineering: Core Qualification: Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Process Engineering: Specialisation Process Engineering: Elective Compulsory				
	Water and Environmental Engineering: S				

Course L2731: Modeling of Subsurface Processes	
Тур	Recitation Section (small)
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Mohammad Aziz Zarif
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 Solute Transport	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Milad Aminzadeh
Language	EN
Cycle	WiSe
Content	Basic physical properties of soil: Definition and quantification; Liquid flow in soils (Darcy's law); Solute transport in soils; Practical analysis to measure dispersion coefficient in soil under different boundary conditions; Advanced topics (e.g. Application of Artificial Intelligence to predict soil salinization)
Literature	- Environmental Soil Physics, by Daniel Hillel - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton

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

Courses						
Title		Тур	Hrs/wk	СР		
Methods in Climate Informed Engin	eering (L3347)	Lecture	3	3		
Topics in Climate Informed Enginee	ering (L3348)	Lecture	3	3		
Module Responsible	Prof. Nima Shokri					
Admission Requirements	None					
Recommended Previous	Students are expected to have a foundationa	al understanding of environmental so	cience, basic engineerin	g principles, and		
Knowledge	interest in sustainability. Recommended knowle	edge includes climate science, data an	alysis, and familiarity wit	h engineering des		
	processes. Analytical and critical thinking and c	reative problem-solving skills are also	beneficial			
Educational Objectives	After taking part successfully, students have re	ached the following learning results				
Professional Competence						
	This module explores next-generation climate	models and high-resolution data em	nhasizing their impact o	n environmental a		
Knowledge						
	engineering products and processes. It covers how various engineering disciplines can benefit from climate information. Research-					
	based learning activities, expert talks, and presentations will expose students to state-of-the-art modeling, measurement, and analysis in climate-informed engineering.					
	anarysis in enhate morned engineering.					
Skills	Climate data analysis, engineering adaptati	ion strategies, problem-solving, res	earch-based learning, a	and interdisciplin		
	collaboration.					
Personal Competence						
Social Competence	Collaboration, interdisciplinary teamwork, com	munication skills, problem solving	thical reconcibility and	d decision making		
Social Competence	climate-resilient engineering.	intunication skins, problem-solving, e	and tesponsibility, and			
	clinitic resilient engineering.					
Autonomy	Time management, self-directed learning, cri	tical thinking, accountability, initiativ	ve, and the ability to c	onduct independe		
	research and make informed decisions in climate-informed engineering.					
Workload in Hours	Independent Study Time 96, Study Time in Lect	turo 8/				
Credit points	6					
Course achievement	None					
Examination	Subject theoretical and practical work					
Examination duration and	Report and Presentation					
scale						
Assignment for the	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical E					
· · · · · · · · · · · · · · · · · · ·	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Water and Traf					
	Civil Engineering: Specialisation Computational					
	Data Science: Specialisation III. Applications: El	• • • • •				
	Environmental Engineering: Core Qualification:					
	Process Engineering: Specialisation Process Engineering:					
	Water and Environmental Engineering: Specialis					
	Water and Environmental Engineering: Specialis		orv			
		Line and Liceave compulse	,			

Course L3347: Methods in Cl	imate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nima Shokri, Prof. Cathy Hohenegger, Prof. Irina Smirnova
Language	EN
Cycle	WiSe
Content	Students will learn techniques for incorporating climate data and environmental factors into engineering design. It covers climate modelling and the use of sensors and devices to measure climate-related parameters and engineering processes. Students will have the opportunity to conduct their own measurements, analyze the collected data, and write a report on their findings. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Course L3348: Topics in Clim	ate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova, Prof. Cathy Hohenegger, Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Exploring specific applications of climate data in various engineering disciplines. Invited speakers will present their research and discuss the relevance of climate-informed engineering to their work. Additionally, there will be a segment on effective communication, covering how to give impactful presentations and write research papers. Students will also give presentations on their own class projects related to climate-informed engineering, applying the concepts they've learned. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Courses						
Title			Ture	Hane (such	CD	
Water Protection (L3459)			Typ Integrated Lecture	Hrs/wk	CP 6	
Module Responsible	Prof Simon Michae	Panalexiou		Ŭ	, i i i i i i i i i i i i i i i i i i i	
Admission Requirements						
Recommended Previous	None					
Knowledge	 Basic knowle 	edge in water managemen	t;			
		edge in urban drainage;				
		edge of wastewater treatm				
	 Good knowle 	edge of pollutants (e.g. CO	D, BOD, TS, N, P) and their properties;			
Educational Objectives	After taking part su	ccessfully, students have	reached the following learning results			
Professional Competence						
Knowledge	The students can d	escribe the basic principle	s of the regulatory framework related to the	e international and Eu	uropean water secto	
	They can explain	limnological processes, su	ubstance cycles and water morphology in	detail. They are abl	e to assess comple	
			as ecosystem service and wastewater trea	tment with a specia	l focus on innovativ	
	solutions, remediat	ion measures as well as co	onceptual approaches.			
Skills	Students can accu	rately assess current prob	lems and situations in a country-specific or	local context. They	can suggest concre	
			morrow's urban water cycle. Furthermore,			
	administrative and	legislative solutions to sol	ve these problems.			
Personal Competence						
-	The students can w	ork together in internation				
Social competence			lai groups.			
Autonomy			v to prepare presentations and discussions.	They can acquire ap	opropriate knowledg	
	by making enquirie	es independently.				
Workload in Hours	Independent Study	Time 96, Study Time in Le	ecture 84			
Credit points		e so, seddy fille lli E				
Course achievement	Compulsory Bonus	Form	Description			
etarbe aemevement	Yes 20 %	Presentation	10-minütige Präsentation von Arbeits	ergebnissen		
Examination	Written exam					
Examination duration and	150 minutes					
scale						
Assignment for the	Civil Engineering: S	pecialisation Coastal Engi	neering: Elective Compulsory			
Following Curricula						
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	• •	•	raffic: Elective Compulsory			
	-		ater Quality and Water Engineering: Elective			
			Specialisation II. Civil Engineering: Elective C	Compulsory		
			alisation Cities: Elective Compulsory			
	Water and Environ		alisation Environment: Compulsory			

Course L3459: Water Protect	tion
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	WiSe
Content	
Literature	

Courses						
Fitle	a (L 2 4 5 0)			Typ	Hrs/wk	СР
Uncertainty Modelling for Engineers				Integrated Lecture	6	6
Module Responsible		apaiexiou				
Admission Requirements Recommended Previous						
Knowledge	 General familia Elementary pro Basic computer 	bability and statist skills for handling	ics, and mathematic data.			
	4. Interest in solvi	ng engineering pro	blems using statistic	al and probabilistic metho	as.	
Educational Objectives	After taking part succe	essfully, students h	nave reached the foll	owing learning results		
Professional Competence						
Skills	probability distribution uncertainty in engine decision-making and and disutility and lear By the end of the cour problems. They will g inference to real-wor enabling them to anal	ns, extreme value ering problems. Th predictive modelin n how to apply Bay rse, students will b ain expertise in fil Id engineering cha lyze complex engir	theory, joint probab ne course also cover g. Additionally, stud resian Decision Theo e able to apply proba- tting probability dist allenges. Students we neering datasets and	g frequency-based metho ility distributions, and sto is linear and nonlinear reg ents will gain insight into in ry to optimize engineering ubilistic models to quantify ributions, performing extra vill also develop skills in improve risk predictions. zation techniques to suppor	chastic optimization to pression methods, essen risk assessment as a fu solutions under uncerta uncertainty and assess eme value analysis, and linear and nonlinear re Through hands-on comp	model and quar ntial for data-dri nction of probab inty. risks in enginee d applying Bayes egression model putational exerci
	decision-making.					
Personal Competence						
	uncertainty quantifica challenges.	ation, ensuring th	at engineering anal	ey will engage in discussion yses are both rigorous a		-
Autonomy	distributions, regressi		stochastic technique	ineering uncertainties, sel s for various applications. uring they can make inforr	They will also gain the	e ability to evalu
Autonomy	distributions, regressi	natural and humar	stochastic technique	s for various applications.	They will also gain the	e ability to evalu
	distributions, regressi risks associated with r	natural and humar ster mitigation.	stochastic technique n-made hazards, ens	s for various applications.	They will also gain the	e ability to evalu
	distributions, regressi risks associated with assessment, and disas Independent Study Tir	natural and humar ster mitigation.	stochastic technique n-made hazards, ens	s for various applications.	They will also gain the	e ability to evalu
Workload in Hours	distributions, regressi risks associated with assessment, and disas Independent Study Tir 6	natural and humar ster mitigation.	stochastic technique n-made hazards, ens	s for various applications. uring they can make inforr	They will also gain the	e ability to evalu
Workload in Hours Credit points	distributions, regressi risks associated with assessment, and disas Independent Study Tir 6	natural and humar ster mitigation. me 96, Study Time	in Lecture 84	s for various applications. uring they can make inforr	They will also gain the ned engineering decision	e ability to evalu
Workload in Hours Credit points Course achievement	distributions, regressi risks associated with r assessment, and disas Independent Study Tir 6 Compulsory Bonus Yes 20 %	natural and humar ster mitigation. me 96, Study Time Form	in Lecture 84	s for various applications. uring they can make inforr	They will also gain the ned engineering decision	e ability to evalu
Workload in Hours Credit points Course achievement Examination Examination duration and	distributions, regressi risks associated with r assessment, and disas Independent Study Tir 6 Compulsory Bonus Yes 20 % Written exam	natural and humar ster mitigation. me 96, Study Time Form	in Lecture 84	s for various applications. uring they can make inforr	They will also gain the ned engineering decision	e ability to evalu
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Workload in Hours Credit points Course achievement Examination Examination duration and scale	distributions, regressi risks associated with i assessment, and disas Independent Study Tir 6 Compulsory Bonus Yes 20 % Written exam 150 min Civil Engineering: Spe Civil Engineering: Spe	natural and humar ster mitigation. me 96, Study Time Form Presentation cialisation Coastal cialisation Geotech	in Lecture 84 Description 10-minüti Engineering: Electivu nical Engineering: E	s for various applications. uring they can make inforr ge Präsentation von Arbeit compulsory ective Compulsory	They will also gain the ned engineering decision	e ability to evalu
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	distributions, regressi risks associated with i assessment, and disas Independent Study Tir 6 Compulsory Bonus Yes 20 % Written exam 150 min Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	natural and humar ster mitigation. me 96, Study Time Form Presentation cialisation Coastal cialisation Geotech cialisation Structur	in Lecture 84 Description 10-minüti Engineering: Elective nical Engineering: Elective al Engineering: Elective	s for various applications. uring they can make inforr ge Präsentation von Arbeit e Compulsory ective Compulsory ive Compulsory	They will also gain the ned engineering decision	e ability to evalu
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Course L3458: Uncertainty M	lodelling for Engineers
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	SoSe
Content	Engineering decisions are rarely made with complete certainty—uncertainty affects material properties, environmental conditions, structural performance, and risk assessments. This course provides students with theoretical foundations and practical tools to quantify uncertainty, assess risks, and enhance decision-making in civil, structural, geotechnical, and environmental engineering applications. Students will begin with fundamental probability concepts, learning how Bayes' Theorem, probability distributions, and extreme value theory help evaluate engineering uncertainties. They will explore linear and nonlinear regression methods for analyzing complex datasets, as well as joint probability distributions and stochastic optimization to improve predictive modeling and reliability assessments. The course also introduces Bayesian Decision Theory, offering a structured approach to decision-making under uncertainty. With a focus on real-world engineering problems, students will apply probabilistic models, extreme value analysis, and stochastic techniques to assess risks in infrastructure design, system reliability, and disaster resilience. Hands-on computational exercises will reinforce key concepts, preparing students to work with data-driven models and uncertainty quantification techniques used in engineering practice. This course is ideal for students interested in engineering risk assessment, reliability analysis, and data-driven modeling. By the end of the course, students will have developed critical analytical and problem-solving skills, equipping them for careers in structural safety, geotechnical engineering, environmental risk management, and beyond.
Literature	

Specialization Structural Engineering

Skills Students will be able to • dimension vertical drains for soil improvement of soft soils, • calculate depth compaction using various appropriate methods, • apply principles of horizontal bearing capacity of piles, • verify the internal and external stability of fluid-supported diaphragm wall • evaluate the boundary conditions for the design of a deep excavation • evaluate the boundary conditions for the description and classification • computationally implement numerical algorithms to solve boundary value • select and apply the types of analyses depending on the degree of satura • determine appropriate model parameters for different possibilities and line of soils. Personal Competence Students are able to assess their own strengths and weaknesses and, based on and think in terms of processes. Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points 6						
Numerical Methods in Geotechnics (L0375) Letture Advanced Foundation Engineering (L0497) Letture Advanced Foundation Engineering (L0498) Recitation Sectit Module Responsible Prof. Jürgen Grabe Admission Requirements None Recommended Previous Geotechnics I and II, Mathematics I-III Knowledge Educational Objectives Professional Competence After taking part successfully, students have reached the following learning resu Professional Competence Knowledge After successfully completing the module, students will be able to describe individual procedures for the geotechnical monitoring of civil engineering use state the differences between various stress and deformation states and and distortion tensor, outline the standard and special soil mechanics tests used to determine till describe continuum models and the resulting boundary value problems, as well as define boundary value problems from the field of geotechnical unambiguously. Skills Students will be able to verify the internal and external stability of fuid-supported diaphragm wall evaluate the boundary conditions for the design of a deep excavatic excavation, perform, evaluate and interpret tests for the description and classification computationally implement numerical algorithms to solve boundary value select and apply the types of analyses depending						
Numerical Methods in Geotechnics (L0375) Letture Advanced Foundation Engineering (L0497) Letture Advanced Foundation Engineering (L0498) Recitation Sectit Module Responsible Prof. Jürgen Grabe Admission Requirements None Recommended Previous Geotechnics I and II, Mathematics I-III Knowledge Educational Objectives Professional Competence After taking part successfully, students have reached the following learning resu Professional Competence Knowledge After successfully completing the module, students will be able to describe individual procedures for the geotechnical monitoring of civil engineering use state the differences between various stress and deformation states and and distortion tensor, outline the standard and special soil mechanics tests used to determine till describe continuum models and the resulting boundary value problems, as well as define boundary value problems from the field of geotechnical unambiguously. Skills Students will be able to verify the internal and external stability of fuid-supported diaphragm wall evaluate the boundary conditions for the design of a deep excavatic excavation, perform, evaluate and interpret tests for the description and classification computationally implement numerical algorithms to solve boundary value select and apply the types of analyses depending		Hrs/wk	СР			
Advanced Foundation Engineering (L0497) Lecture Recitation Section Advanced Foundation Engineering (L0498) Prof. jürgen Grabe Recitation Section Admission Requirements None Recommended Previous Geotechnics 1 and II, Mathematics I-III Knowledge Professional Competence After successfully, students have reached the following learning resu Professional Competence Knowledge After successfully completing the module, students will be able to describe individual procedures for the geotechnical monitoring of civil engineering (L0497) select suitable types of field and laboratory tests for subsoil investigation state the differences between various stress and deformation states and and distortion tensor, outline the standard and special soil mechanics tests used to determine th describe continuum models and the resulting boundary value problems, as well as define boundary value problems from the field of geotechnical unambiguously. Skills Students will be able to dimension vertical drains for soil improvement of soft soils, calculate depth compaction using various appropriate methods, apply principles of horizontal bearing capacity of piles, verify the internal and external stability of fluid-supported diaphragm wall excluate the boundary conditions for the design of a deep excavatici excavation, perform, ev		3	3			
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Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points 6	this, organize th	neir time and le	earning management			
Credit points 6						
Course achievement Name						
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						
Civil Engineering: Specialisation Computational Engineering: Compulsory						
International Management and Engineering: Specialisation II. Civil Engineering: E	lective Compule	sory				

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:
	 Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering)
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn

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

Course L0498: Advanced Fou	urse 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			

	rete Structure	.5				
Courses						
Fitle			T	/p	Hrs/wk	СР
Concrete Structures (L0579)				eminar	1	1
Structural Concrete Members (L05)	77)			cture	2	3
Structural Concrete Members (L05)			Re	ecitation Section (large)	2	2
Module Responsible	NN					
Admission Requirements	None					
Recommended Previous	Basics of structural	analysis, conception ar	nd dimensioning of struct	ural concrete		
Knowledge						
	Modules: Reinforce	d Concrete Structures I	+II, Structural Analysis I+	II, Mechanics I+II		
Educational Objectives	After taking part su		ve reached the following	learning results		
Professional Competence			<u> </u>	J		
	The students broad	len their skills in structu	ural engineering, especial	ly in the field of buildings	(houses, roofs, h	alls). They dispose
		The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dis 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 engineering					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing and					
	execution. Moreove	er, they can make desig	n and construction sketch	hes and draw up technica	l descriptions.	
Personal Competence						
	The students are al	hle to obtain results of l	nigh quality in teamwork.			
Social competence	The students are a		ingit quality in countrolic.			
Autonomy	The students are al	ble to carry out complex	x conception and dimensi	oning tasks of structures	under the guidan	ce of tutors.
Workload in Hours	Independent Study	Time 110, Study Time	in Lecture 70			
Credit points						
Course achievement		Form	Description			
	No None	Presentation	Es werden 2 Ref	erate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: S	pecialisation Structural	Engineering: Compulsory	/		
-	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
i onoming curriculu	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
r onothing curricula						
	Civil Engineering: S	pecialisation Water and	d Traffic: Elective Compule	sory		
i showing curreate		•	d Traffic: Elective Compul ional Engineering: Electiv	-		

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

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

Module M0963: Steel	and Composite Structures			
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Courses				
Fitle		Тур	Hrs/wk	СР
Steel and Composite Structures (LI		Lecture	2	2
Steel and Composite Structures (LI Steel Bridges (L1097)	205)	Recitation Section (large) Lecture	2	2
Module Responsible	Prof. Marcus Putner	Lecture	Z	Z
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I an			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	Arter taking part successionly, students have reached	The following learning results		
	After successful completition, students can			
	·			
	 describe the phenomenon of local buckling 			
	 explain warping torsion 			
	 illustrate the behaviour of composite structure 	25		
	 specify the principles in design of composite s 	ttructures		
	 sketch the contructions of steel and composite 	e bridges		
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structu 	res		
	 recognize and verify warping tosion in strucure 	es		
	 design composite structures 			
	design bridges and o perform the detailing			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	ng: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic: El			
	Civil Engineering: Specialisation Water and Tranc. En			
	International Management and Engineering: Specialis		ulcon/	
	incernational management and Engineering: Specials	sation if. Civil Engineering: Elective Comp	Jui501 y	

Course L1204: Steel and Composite 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	 Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction 	
Literature	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag	

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

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

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

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

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

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

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

Module M0756: Soil N	1echanics and -Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L0374) Soil Dynamics (L0452)		Lecture	2	2
		Lecture	2	2
Experimental Researches in Geote	chnics (L0706)	Practical Course	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules: Mathematics I-III, Mechanics I-II, Geotechni	cs l		
Knowledge	Courses: Soil laboratory course, (Applied structural d	ynamics)		
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	Students will be able to,			
	 describe wave propagation in the ground under 	er dynamic excitation and define the	e relevant narameters	
	 to measure vibrations and to interpret the dat 			
	 justify when elastodynamic methods are sufficient sufficiency of the suffici			
	 to reproduce the collapse theorems of plastici 			
	describe the viscous behavior of cohesive s	oils and computationally account f	or creep deformation	and rate-depende
	shear strengths			
	 as well as to determine the effect of partial satisfies 	turation on the seepage flow and th	e shear strength.	
Skills	After the successful completion of the module the st	udents should be able to:		
	 to derive and apply the basic equation of a simple mass oscillator, 			
	 to understand the wave propagation in the soil under dynamic excitation and to detect the relevant param 			
	• to know the essential laboratory and field test	s to determine soil dynamic charact	teristics and to evaluat	te them,
	• to design machine foundations to dynamic loa	ıd,		
	• to measure shocks to perform vibration foreca	ast,		
	 to evaluate shocks in terms of their effect on provide the shocks in terms of terms of	people and buildings,		
	 to evaluate possibilities of isolation, 			
	 to understand mechanisms that cause earthquild 			de and intensity,
	 to know methods to determine axial pile capa 			
	 to know the mechanisms that lead to a deform mathematically, 	mation accumulation due to cyclic l	oading and to estimate	e these deformatio
	 to distinguish the area of application of the me 			
	 to detect the undrained shear strength as a full 			
	 to capture the visous behaviour of cohesive s 	oils and to consider the effects of c	reep and rate-depend	ent shear strength
	calculations, • to consider the impact of the partly saturated	of a seenage and shear strength		
	• to consider the impact of the party saturated			
Personal Competence				
Social Competence	Students will be able to work in teams to achieve r	esults on measurement and experi	mental principles and	present their resu
	together at the end of the semester.			
Autonomy	Students are able to assess their own strengths and	weaknesses and organize their time	e and learning manage	ement based on this
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
Credit points	6			
Course achievement		escription		
	Yes None Subject theoretical and practical work			
Examination	Written exam			
Examination duration and scale	135 min			
Assignment for the	Civil Engineering: Specialisation Structural Engineeri	ng: Elective Compulsorv		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine			
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Computational Engi	neering: Elective Compulsory		

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

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

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

Module M0827: Mode	ling in Water Management			
	,			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modfl		Lecture	1	1
Groundwater Modeling using Modfl Modeling of Water Supply Network		Recitation Section (small) Project-/problem-based Learning	2 2	2 3
		Project-/problem-based Learning	Z	2
Module Responsible Admission Requirements				
Recommended Previous				
Knowledge	Groundwater			
ieuge	 groundwater hydraulics and transport of 	substances		
	Pipe Systems			
		res, in particular drinking water systemsand	urban drainag	je systems includin
	special structures			
	Hydraulics of drinking water supply system Pasis knowledge on water management	ms and sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling	of groundwater flow and transport as well as url	oan water infr	astructures. They ca
	carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the			
	are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.			
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios			
	and can compare or assess different solutions for existing problems by application of selected software products. The students are			
	able to use different software solutions (e.g. EPANET, EPA-SWMM).			
Personal Competence				
	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			-
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		
	Civil Engineering: Specialisation Computational	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Speciali	sation Environment: Elective Compulsory		
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Specialis	sation Water: Elective Compulsory		

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

Course L0544: Groundwater	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 Network		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Klaus Johannsen		
Language	DE		
Cycle	SoSe		
Content			
Literature	Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014.		

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on Urban planning Knowledge on measures for climate protection			
	 Knowledge on measures for climate protection General knowledge of scientific writing/working 			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as c	urrent and future urban environr	mental probler	ns. They are able
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical 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-ill-				
SKIIIS	s Students are able to develop specific solutions for correcting existing or future environment-related problems of urb development. They can define a range of conceptual and technical solutions for environmental problems for different developme			
	paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urba			
	context.	in select technical innovations a	nu integrate t	
Personal Competence				
	The students can work together in international groups.			
boelar competence				
Autonomy	Students are able to organize their work flow to prepare thems	elves for presentations and cont	ributions to th	e discussions. Th
	can acquire appropriate knowledge by making enquiries indeper	ndently.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	Environmental Engineering: Core Qualification: Elective Compute	sory		
	Joint European Master in Environmental Studies - Cities and Sust	ainability: Core Qualification: Cor	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructur	re and Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Environme	nti Electivo Compulsory		
	water and Environmental Engineering. Specialisation Environme	enc. Elective Compulsory		

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Harbour Engineering (L0809)		Lecture	2	2	
Harbour Engineering (L1414)		Project-/problem-based Learning	1	2	
Port Planning and Port Construction	n (L0378)	Lecture	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Basics of coastal engineering				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results			
Professional Competence					
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply then				
	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					
Social Competence	The students are able to deploy their gained knowledge in a	pplied problems such as the funct	tional design	of ports. Addition	
,	they will be able to work in team with engineers of other disci		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.	j	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Electiv	e Compulsory			
-	Civil Engineering: Specialisation Geotechnical Engineering: Ele				
2	Civil Engineering: Specialisation Coastal Engineering: Compuls				
	Civil Engineering: Specialisation Water and Traffic: Elective Co	•			
	International Management and Engineering: Specialisation II. (

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

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

Hrs/wk 2 CP 2 Workload in Hours Inc Lecturer Fra Language DE	dependent Study Time 32, Study Time in Lecture 28
Workload in Hours Ind Lecturer Fra	Jependent Study Time 32, Study Time in Lecture 28
Lecturer Fra	lependent Study Time 32, Study Time in Lecture 28
	ank Feindt
Language	
Cycle So	Se
Content	 Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Biological Wastewater Treatment (Lecture	2	2
Biological Wastewater Treatment (Recitation Section (large)	1	1
Advanced Wastewater Treatment (Lecture	2	2
Advanced Wastewater Treatment (Recitation Section (large)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management an	d the key processes involved in wastewater tre	atment.	
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of t	he full range of treatment systems in waste wa	ter management, a	s well as their mut
	dependence for sustainable water protecti	on. They can describe relevant economic, envir	onmental and social	factors.
Chille	Chudanta and able to and design and supl			
SKIIIS		ain the available wastewater treatment proces	ses and the scope of	of their applicatio
	municipal and for some industrial treatment	nt plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module	2.		
,	5			
Autonomy	Students are in a position to work on a	subject and to organize their work flow indep	endently. They can	also present on
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechni			
i chowing curricula	Civil Engineering: Specialisation Coastal Er			
	Civil Engineering: Specialisation Water and			
	• • •	General Bioprocess Engineering: Elective Comp	ulcon	
		Water Quality and Water Engineering: Elective		
				Compulsor
		g: Specialisation II. Process Engineering and Bio		
	• •	g: Specialisation II. Energy and Environmental E		Compulsory
		nmental Process Engineering: Elective Compuls	ory	
	Process Engineering: Specialisation Proces			
	Water and Environmental Engineering: Spe			
	• • •	ecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	ecialisation Cities: Compulsory		

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

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

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

Course L0357: Advanced Wastewater Treatment			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Joachim Behrendt		
Language	EN		
Cycle	SoSe		
Content	Survey on advanced wastewater treatment		
	reuse of reclaimed municipal wastewater		
	Precipitation		
	Flocculation		
	Depth filtration		
	Membrane Processes		
	Activated carbon adsorption		
	Ozonation		
	"Advanced Oxidation Processes"		
	Disinfection		
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003		
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987		
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007		
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006		
	memorannu ation, quantatssichefung, W. Roeske, Oldenbourg-verlag, Munchen 2000		
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003		

Course L0358: Advanced Wa	stewater Treatment			
Тур	Recitation Section (large)			
Hrs/wk				
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	
Fitle	Typ Hrs/wk CP
City Planning (L1066)	Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous	for "Principles of Urban Planning": none
Knowledge	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "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
	 appraise such concepts in the context of competing requirements.
	 design, justify and reflect their own solutions for concrete examples.
Personal Competence	
	Students are able to:
Social competence	
	discuss intermediate results with each other.
	 constructively accept feedback on their own work.
	provide constructive feedback to others.
Autonomy	Students are able to:
	 independently complete a written report including drawings following a broadly pre-defined process.
	 assess the consequences of their proposed solutions. independently acquire knowledge and apply this to new issues or problem areas.
	Independency acquire knowledge and apply this to new issues of problem areas.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
	Written elaboration
Examination duration and	written assignment, designwork during the semester
scale	· · · · · · · · · · · · · · · · · · ·
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Compulsory

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

Courses				
Courses				
Title	Тур		Hrs/wk	СР
Construction Logistics (L1163)	Lectu		1	2
Construction Logistics (L1164) Project Development and Managen		tation Section (small)	1	2
Project Development and Managen			1	1
Module Responsible		,	_	
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence	······································			
	Students can			
Skills Personal Competence Social Competence	 give definitions of the main terms of construction logistics and in name advantages and disadvantages of internal or external contexplain characteristics of products, demand and production of specific supply chains differentiate constructions logistics from other logistics systems Students can carry out project life cycle assessments apply methods and instruments of construction logistics apply methods and instruments of conflict management design supply and waste removal concepts for a construction p Students can hold presentations in and for groups 	nstruction logistics construction objects and th s anagement		nces for constructio
	 apply methods of conflict solving skills in group work and case 	studies		
Autonomy	Students can • solve problems by holistic, systemic and flow oriented thinking			
	 improve their creativity, negotiation skills, conflict and crises studies 	solution skills by applying	methods of	moderation in cas
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
scale	Two written papers with presentations			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Comp Civil Engineering: Specialisation Geotechnical Engineering: Elective Co Civil Engineering: Specialisation Coastal Engineering: Elective Comput Civil Engineering: Specialisation Water and Traffic: Elective Compulso International Management and Engineering: Specialisation II. Civil Eng International Management and Engineering: Specialisation II. Logistics	ompulsory sory ry jineering: Elective Compulso	ory	

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in steel structures (L0564)		Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis	of statically determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
	After successful completion of this mod	ule, the student can explain the basic aspects of d	lynamic effects o	on structures and f
	respective methods.		.,	
Skills	After successful completion of this mo	odule, the students will be able to predict the res	sponse of mater	ial and structures
	dynamics loading using the appropriate of			
Personal Competence				
Social Competence	Students can			
boelar competence				
	 participate in subject-specific and 	interdisciplinary discussions,		
	defend their own work results in front of others			
	promote the scientific development of colleagues			
	 Furthermore, they can give and ac 	ccept professional constructive criticism		
Autonomy	Students are able to gain knowledge of t	he subject area from given and other sources and a	nnly it to now an	oblems Eurthorma
Autonomy		ocess for problems in the area of Structural Analysis		oblemis. Fui thermo
	they are able to structure the solution pr			
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structure	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water an	nd Traffic: Elective Compulsory		
	Civil Engineering: Specialisation Compute	ational Engineering: Elective Compulsory		

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

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

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

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	

Module M0593: Building Materials and Building Preservation

Courses						
Title			Тур		Hrs/wk	СР
Repair of Structures (L0255)			Lecture		1	1
Mineral Building Materials (L0253)			Lecture		2	2
Technology of mineral Building Mat	erials (L0256)		Project-/problem-	based Learning	1	2
Transport Processes in Building Ma	erials and Damage Processes (L02	254)	Lecture		1	1
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
Recommended Previous	Basic knowledge about buildin	ng materials, buildir	ng physics and building chem	nistry, for examp	ole by the m	odules Principles
Knowledge	Building Materials and Building	Physics and Buildin	g Materials and Building Chem	istry.		
Educational Objectives	After taking part successfully,	students have reach	ed the following learning result	ts		
Professional Competence						
Knowledge	The students are able to descr	ibe the components	of mineral building materials a	nd their function	in detail and	d to use them for t
	manufacture of special minera	l building materials.	They are able to show the cha	racteristics of mi	neral building	g materials. They a
	able to describe the manufactu	ire, properties and f	ields of application of special n	nortars and spec	ial concretes	and the correlation
	of their material parameters. T	hey are able to show	v the principles of anchor techr	nology and desig	n.	
Chille	The students are able to perfe	m on optimization of	of aronulomotry of a minoral h	uilding material	They are abl	a ta dacian a chac
SKIIIS	s The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a specia					
	mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to access possible causes to use the fundamentals of construction preservation and to select reparations.					
	able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repa and strengthening measures.					
Personal Competence						
Social Competence						
	other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their specie					
	building material on the basis of	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, 9	Study Time in Lectur	re 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
	Yes 20 % Subject	theoretical and	1			
	practica	al work				
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	Civil Engineering: Specialisatio	n Geotechnical Engi	neering: Compulsory			
Following Curricula	Civil Engineering: Specialisatio	n Coastal Engineerin	g: Elective Compulsory			
	Civil Engineering: Specialisatio	n Structural Enginee	ring: Elective Compulsory			
	Civil Engineering: Specialisatio					

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

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

Course L0256: Technology of	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 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				
Гitle		Тур	Hrs/wk	СР
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the	ne whole project and explain it to the others.		
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reactio			
	changing conditions resulting from othe	r participants of the project.		
Personal Competence				
Social Competence	Students can present their results to oth	ner members of the group.		
	They have the ability to work for a broad	d agreement with respect to intergroup depen	dencies.	
	They can distribute and process tasks in	dependently.		
Autonomy	Students can handle their part of the pro	oject on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotec	hnical Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structu	ral Engineering: Compulsory		
	Civil Engineering: Specialisation Comput	tational Engineering: Elective Compulsory		

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

Courses						
Title		Тур	Hrs/wk	СР		
Marine Geotechnics (L0548)		Lecture	1	2		
Marine Geotechnics (L0549) Steel Structures in Foundation and	Hydraulic Engineering (11146)	Recitation Section (large) Lecture	2	2		
Module Responsible		20000	-	-		
Admission Requirements						
	Complete modules: Geotechnics I-III, Math	ematics I-III				
Knowledge	•					
	Courses: Soil laboratory course					
Educational Objectives	After taking part successfully, students have	ve reached the following learning results				
Professional Competence						
Knowledge	The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay wa					
	Furthermore, the students get all the nece	essary knowledge to design singular construction e	elements for shee	et pile walls and th		
	know how to choose the right construction	elements depending on the influencing conditions				
Skille	Furthermore, the students are able to din	pension sheet nile wall construction regarding all	construction eler	ments to choose t		
JKIIIS	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					
		valls and combined sheet pile walls) and to dimension all construction elements and connections.				
Personal Competence						
Social Competence						
Autonomy	Students are able to assess their own stren	ngths and weaknesses and organize their time and	learning manage	ement based on th		
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70				
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	90 min					
scale						
Assignment for the	Civil Engineering: Specialisation Geotechni	ical Engineering: Compulsory				
Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Coastal Er	ngineering: Compulsory				
	Civil Engineering: Specialisation Computat	ional Engineering: Elective Compulsory				

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

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

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

C				
Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762) Smart Monitoring (L2763)		Integrated Lecture Recitation Section (small)	2	2 4
Module Responsible	Prof. Kay Smarch	Reclation Section (shall)	2	7
-	Prof. Kay Smarsly			
Admission Requirements Recommended Previous	None Basic knowledge or interest in object-oriented mod	deling programming and concer technolog	aioc ara halaful	Interact in mas
Knowledge	research and teaching areas, such as Internet of T		•	
hitemedge	skills of scientific working, are required. Basic knowl			
	After taking part successfully, students have reache	d the following learning results		
Professional Competence	The state of the second for the state of the			
Kilowiedye	The students will become familiar with the princip decentralized smart systems to be applied for c			
	environment. In addition, the students will learn to			
	analysis techniques, modern software design conce	• • •		
	also part of this module, which will be conducted t			
	students will design smart monitoring systems that	•	-	• •
	Specific focus will be put on the application of ma			
	real-world (built or natural) systems, such as bridge	s or slopes, or on scaled lab structures for	validation purpo	ses. The outcom
	every group will be documented in a paper. All stud	ents of this module will "automatically" pa	articipate with th	eir smart monito
	system in the annual "Smart Monitoring" competitio	n. The written papers and oral examinatio	ns form the final	grades. The mo
	will be taught in English. Limited enrollment.			
Skille	The students will gain insights into operating state-	of the art smart sensor systems used for	monitoring a wi	de range of phys
SKIIIS	processes relevant to engineering, such as enviro			
	devising monitoring strategies of physical processe			
	implement the strategies in smart wireless sensor r		-	÷
	be able to document the findings of their projects in		5 5	
Personal Competence				
	The students will be able to work in groups, share	parts of the work for their projects, and de		ation skills towa
Social competence	achieving the common project goals.	saits of the work for their projects, and ac		
Autonomy	The students will be able to gain a solid basis on a	approaching and solving problems in eng	ineering, as well	as on documen
	results, through their involvement in their monitorin	g group projects.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
	10 pages of work with 15-minute oral presentation			
scale	Civil Engineering, Specialization Water and Traffic F	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and Traffic: E Civil Engineering: Specialisation Geotechnical Engin			
ronowing curricula	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Structural Engineering			
	Computer Science: Specialisation II: Intelligence End			
	Environmental Engineering: Specialisation Energy a			
	Environmental Engineering: Specialisation Environm			
	Environmental Engineering: Specialisation Water Qu		pulsory	
	Mechatronics: Technical Complementary Course: Ele			
	Mechatronics: Core Qualification: Elective Compulso	ry		
	Theoretical Mechanical Engineering: Specialisation F	Robotics and Computer Science: Elective C	ompulsory	
	Water and Environmental Engineering: Specialisatio	n Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio			

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Offshore Geotechnical Engineering	(L0067)	Lecture	1	1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011)		Lecture	2	3	
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1	
Module Responsible	Dr. Marvin Scherzinger				
Admission Requirements	None				
Recommended Previous	Module: Technical Thermodynamics I,				
Knowledge	Module: Technical Thermodynamics II,				
	Module: Fundamentals of Fluid Mechanics				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results			
Professional Competence					
	By ending this module students can explain in offshore conditions and can critical comment the to describe fundamentally the use of water powe in the implementation of renewable energy project	ese aspects in consideration of curre r to generate electricity. The student cts in countries outside Europe.	nt developments. Furthe ts reproduce and explair	ermore, they are a n the basic proced	
	Through active discussions of various topics within the seminar of the module, students improve their understanding 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 theored assess technically the resulting relationships in t compare critically the special procedure for the ir in principle applied approach in Europe and can a	the context of dimensioning and oper mplementation of renewable energy	eration of these energy projects in countries ou	systems. They car	
Personal Competence					
Social Competence	Students can discuss scientific tasks subjet-speci	ificly and multidisciplinary within a se	eminar.		
Autonomy	Students can independently exploit sources in t lecture and to acquire the particular knowledge a		lecture material to clea	r the contents of	
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	180 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	gineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory			
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory				
	International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Product Development, Materials and Production:	Specialisation Materials: Elective Cor	npulsory		
	Renewable Energies: Core Qualification: Compuls				
	Renewable Energies: Core Qualification: Compuls Theoretical Mechanical Engineering: Specialisatio	ory	ory		
		ory n Energy Systems: Elective Compuls			
	Theoretical Mechanical Engineering: Specialisatio	ory n Energy Systems: Elective Compuls al Process Engineering: Elective Com			
	Theoretical Mechanical Engineering: Specialisatio Process Engineering: Specialisation Environmenta	ory n Energy Systems: Elective Compuls al Process Engineering: Elective Com tion Cities: Elective Compulsory	pulsory		

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Digital Twinning in Civil Engineerin	g (L3136)	Lecture	2	2
Digital Twinning in Civil Engineering (L3137)		Seminar	2	4
Module Responsible	Alexander Chmelnizkij			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
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	Presentation			
Examination duration and	20 min presentation and 5 pages hando	put		
scale				
Assignment for the	Civil Engineering: Specialisation Compu	itational Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coasta	l Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Geotec	hnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	ural Engineering: Elective Compulsory		

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

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

Module M0858: Coast	tal Hydraulic Engineering I				
Courses					
Title		Тур	Hrs/wk	СР	
Basics of Coastal Engineering (L08	07)	Lecture	3	4	
Basics of Coastal Engineering (L14		Project-/problem-based Learni	ng 1	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Basics of hydraulic engineering, hydrolog	gy and hydromechanics			
Knowledge					
Educational Objectives	After taking part successfully, students h	nave reached the following learning results			
Professional Competence					
Knowledge	The students are able to define and explain the basic concepts of coastal engineering and port engineering. They are able to apply				
	the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design and				
	dimensioning of coastal engineering con-	structions.			
Skills	The students are capable to apply basic	design approaches to selected and pre-defined desig	ın tasks in coasta	l engineering.	
Personal Competence					
Social Competence	The students are able to deploy their ga	ained knowledge in applied problems such as the de	esign of coastal p	protection structure	
	Additionaly, they will be able to work in t	team with engineers of other disciplines, for instance	designing of coa	stal breakwaters.	
Autonomy	The students will be able to independent	tly extend their knowledge and applyit to new problem	ms.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 2 h	nours. The examination includes tasks with respect	to the general u	understanding of t	
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Coastal	Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotech	nnical Engineering: Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
	Environmental Engineering: Specialisation Environment and Climate: Elective Compulsory				
	Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory				
	International Management and Engineer	ing: Specialisation II. Civil Engineering: Elective Comp	oulsory		
	Water and Environmental Engineering: S	Specialisation Environment: Elective Compulsory			
	Water and Environmental Engineering: S	Specialisation Water: Elective Compulsory			

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

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

Module M1845: Thin-	walled structures			
	which structures			
Courses				
Title		Тур	Hrs/wk	СР
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)		Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	 Structural Analysis I Structural Analysis II Finite Element Methods 			
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the students can express the basic aspects of the load-carrying behaviour of thir walled structures.			
Skills	After successful completion of this module, the students will be able to predict load-carrying behaviour of thin-walled structure using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and inf 	terdisciplinary discussions,		
	 defend their own work results in from 	t of others		
	promote the scientific development	of colleagues		
	• Furthermore, they can give and acce	pt professional constructive criticism		
Autonomy		e subject area from given and other sources and a ess for problems in the area of modelling and anal		
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Computation	onal Engineering: Compulsory		
	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
	Theoretical Mechanical Engineering: Specia	lisation Simulation Technology: Elective Compulso	ory	

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 Structural behaviour of plates loaded in-plane
	• finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results
	Plates in bending
	 Governing equations (equilibrium, kinematics, constitutive law)
	Differential equation
	Navier solution / Fourier series expansion
	Approximation procedures
	Circular and rectangular plates
	Structural behaviour of plates in bending
	 finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results
	Shells
	Phenomenona of the structural behaviour of shells
	Membrane and bending theory
	Equilibrium equations of shells of revolution
	 Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell
	finite elements for shells
	Stability problems (overview)
	Plate buckling Shall 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		

Courses					
Title		Тур	Hrs/wk	СР	
Nonlinear Structural Analysis (L027	7)	Lecture	3	4	
Nonlinear Structural Analysis (L027	9)	Recitation Section (small)	1	2	
Module Responsible	Prof. Alexander Düster				
Admission Requirements	None				
Recommended Previous	Knowledge of partial differential equations is reco	ommended.			
Knowledge					
Educational Objectives	After taking part successfully, students have read	hed the following learning results			
Professional Competence					
Knowledge	Students are able to				
	+ give an overview of the different nonlinear phe	nomena in structural mechanics.			
	+ explain the mechanical background of nonlinea	ar phenomena in structural mechanics.			
	+ to specify problems of nonlinear structural and	alysis, to identify them in a given situation a	ind to explain the	eir mathematical a	
	mechanical background.				
Skille	Students are able to				
SKIIIS	+ model nonlinear structural problems.				
	+ select for a given nonlinear structural problem	a suitable computational procedure			
	+ apply finite element procedures for nonlinear s				
	 + critically verify and judge results of nonlinear finite elements. + to transfer their knowledge of nonlinear solution procedures to new problems. 				
	+ to transfer their knowledge of nonlinear solutio	in 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 oth	ers.			
	+ give and accept professional constructive critic	ism.			
Autonomy	Students are able to				
	+ assess their knowledge by means of exercises				
	+ acquaint themselves with the necessary knowl				
	+ to transform the acquired knowledge to similar	problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Computational E	ngineering: Compulsory			
	Computational Engineering: Core Qualification: E	ective Compulsory			
	International Management and Engineering: Spec	ialisation II. Civil Engineering: Elective Comp	oulsory		
	Mechanical Engineering - Product Development a	nd Production: Core Qualification: Elective C	ompulsory		
	Materials Science and Engineering: Specialisation	Modeling: Elective Compulsory			
	Materials Science: Specialisation Modeling: Electi	ve Compulsory			
	Mechatronics: Technical Complementary Course:	Elective Compulsory			
	Mechatronics: Core Qualification: Elective Compu	lsory			
	Product Development, Materials and Production:	Core Qualification: Elective Compulsory			
	Naval Architecture and Ocean Engineering: Core	Qualification: Elective Compulsory			
	Naval Architecture and Ocean Engineering: Core	Qualification: Elective Compulsory			
	Ship and Offshore Technology: Core Qualification	: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisation	n Simulation Technology: Elective Compulso	orv		

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Chemistry of Drinking Water Treatr		Lecture	2	1	
Chemistry of Drinking Water Treatr		Recitation Section (large)	1	2	
Nater Resource Management (L04 Nater Resource Management (L04		Lecture Recitation Section (small)	2 1	2 1	
Module Responsible		Recitation Section (smail)	Ŧ	1	
Admission Requirements					
Recommended Previous		key processes involved in water treatment.			
Knowledge	knowledge of water management and the	key processes involved in water treatment.			
Educational Objectives	After taking part successfully, students ha	we reached the following learning results			
Professional Competence	After taking part successfully, students ha	ve reached the following learning results			
	Students will be able to outline key areas	of conflict in water management, as well as th	air mutual danan	dance for custoins	
Knowledge		s of conflict in water management, as well as th			
		ant economic, environmental and social factors.			
		ter companies. They will be able to explain the av	allable water trea	atment processes	
	the scope of their application.				
Skills	Students will be able to assess compl	ex problems in drinking water production an	d establish solut	ions involvina wa	
	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 and				
	standards to these processes.				
	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 management				
	and treatment of drinking water. They will be able to take an appropriate professional position, for example representing us				
	interests. They will be able to develop join	t solutions in teams of diverse experts and preser	t these solutions t	to others.	
Autonomy	Students will be in a position to work on a	subject independently and present on this subject	-		
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	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	Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechn	ical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Compulsory				
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Tec	hnical Complementary Course: Elective Compulse	iry		
	Chemical and Bioprocess Engineering: Tec	hnical Complementary Course: Elective Compulse	iry		
	International Management and Engineerin	g: Specialisation II. Energy and Environmental Eng	jineering: Elective	Compulsory	
	• •	nmental Process Engineering: Elective Compulsor			
	Process Engineering: Specialisation Proces		-		
		• • • •			
	Water and Environmental Engineering: Spe	• • • •			

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

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

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

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

Courses				
Title	т	Гур	Hrs/wk	СР
Integrated Transportation Planning	(L1068) P	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	some knowledge of transport planning, e.g. through taking the und	Jergraduate class "Transport Pl	anning and T	raffic Engineerin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students are able to:			
	describe interdependencies between land-use/location choic	ce and transportation/mobility I	pehaviour	
	explain and evaluate the social, ecological and economic eff	fects of transport and land-use	policy measu	res.
	relate current issues in the area of integrated transport plan	ining and formulate an opinion	on them.	
Skills	Students are able to:			
	quantify important parameters, which influence travel dema	and or are influenced by it.		
	comprehensively examine a pre-defined or self-selected top	pic from a transportation studi	es perspectiv	e and document t
	results in accordance with scientific conventions.			
Personal Competence				
Social Competence	Students are able to:			
	 provide feedback on topical contents and their teaching. 			
	 constructively handle feedback on their own work. 			
	 produce results in group work and document these. 			
Autonomy	Students are able to:			
	assess potential consequences of their future professional a	ctivities		
	 independently plan working on a pre-defined project topic, a 		ge and use a	propriate means
	its execution.			
	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement				
Examination	Written elaboration			
Examination duration and	written assignment with presentation during the semester			
scale	Civil Engineering: Engelation Structural Engineering: Station C			
•	Civil Engineering: Specialisation Structural Engineering: Elective Co			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective			
	Civil Engineering: Specialisation Coastal Engineering: Elective Com	puisory		
	Civil Engineering: Specialisation Water and Traffic: Compulsory Logistics, Infrastructure and Mobility: Specialisation Infrastructure a	and Mobility: Elective Compute	orv	
	Water and Environmental Engineering: Specialisation Cities: Comp		. <i>y</i>	

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

Courses					
Title			Тур	Hrs/wk	СР
Applied Tunnel Constructions (L24	17)		Lecture	2	3
Introduction to tunnel construction	(L0707)		Lecture	1	2
Introduction to tunnel construction	(L1811)		Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules from Bachelor studie	Civil and environmental engin	eering:		
Knowledge	Geotechnics I-II				
Educational Objectives	After taking part successfully	students have reached the follo	wing learning results		
Professional Competence					
Knowledge	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction.				
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis.				
Personal Competence					
Social Competence	Capacity for teamwork concerning project management and design of tunnels.				
Autonomy	Promotion of independent and creative work flow in the framework of a design exercise.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 5% Excer	ses			
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisati	n Structural Engineering: Electi	ve Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory				
	Civil Engineering: Specialisation Coastal Engineering: Compulsory				
	Civil Engineering: Specialisati	n Water and Traffic: Elective Co	ompulsory		
	Civil Engineering: Specialisati	n Computational Engineering: I	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		
СР			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Dr. Julian Bubel		
Language	DE		
Cycle	WiSe		
Content	Definitions		
	 Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements 		
Literature	Construction Contract Literature and sources Vorlesung/Übung s. www.tu-harburg.de/gbt		

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

Courses	
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 Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They ca 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 structural and construction engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view poin of science and society.
	Scientific work techniques that are used can be described and critically reviewed.
Skills	The students are able to independently select methods for the project work and to justify this choice. They can explain how the methods relate to the field of work and how the context of application has to be adjusted. General findings and furth developments may essentially be outlined.
Personal Competence	
	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems f the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to the colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the give deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedbac from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Course achievement	None
Examination	Study work
Examination duration and scale	see FSPO
	Civil Engineering: Specialisation Structural Engineering: Compulsory

Courses				
Title		Тур	Hrs/wk	СР
Design of Composite Bridges (L309	2)	Integrated Lecture	2	3
Analysis of Offshore Structures (L1	867)	Lecture	1	1
Solid Matter Process Technology fo	r Biomass (L0052)	Lecture	2	3
Innovative Timber Construction (L2	(666)	Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Sustainable landfill design and ope	ration (L3270)	Integrated Lecture	3	3
Special Topics in Steel Design (L30	91)	Integrated Lecture	2	3
Special topics of civil engineering 1			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			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	 edge Students are able to find their way through selected special areas within civil and structural engineering. Students are able to explain basic models and procedures in selected special areas of civil and structural engineering. 			
	Students are able to interrelate scientific and technical knowledge.			
Skills				
	 Students are able to apply basic methods in selected areas of civil and structural engineering. 			
Porconal Competence				
Personal Competence				
Social Competence				
Autonomy	 Students can chose independently, in wh 	ich fields they want to deepen their knowle	dae and skills th	rough the election
	courses.	·····	- 9	
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traff	ic: Elective Compulsory		

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

Module Manual M.Sc. "Civil Engineering"

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

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

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

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

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

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

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

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

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

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

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

Courses				
Title Adaptation to climate change in hyd	fraulic engineering (L2291)	Typ Project-/problem-based Learning	Hrs/wk	CP 6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	 Hydrology, Hydraulic Engineering Hydromechanic, Hydraulics Fundamentals of Coastal Engineering, Coastal- and Flor Hydrological Systems 	od Protection		
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence <i>Knowledge</i> <i>Skills</i>	 Climate protection and climate adaptation Insights into climate change and its regional characteria Impacts of climate change on the components of the reference of the impact of the climate change Fundamentals of analysis of climate data Consequences of the impact of the climate change Measures for climate adaptation Assessment, prioritization and communication of adapt Fundamentals of the analysis of hydrometeorological a Critical thinking: analysis of processes and relations, as Creative thinking: inclusion of restrictions, application methods Consideration of complex tasks 	gional hydrological cycle ation measures nd hydrological data sessment of needs for action s and adaptation measures		
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	 Working in heterogenous groups Working with different scientific / non-scientific disciplin Self reflection Application oriented use of knowledge and skills 	nes		
	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 Assignment for the	Preparation of a written report and a presentation of a complete Civil Engineering: Specialisation Coastal Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Ele Civil Engineering: Specialisation Structural Engineering: Electi Civil Engineering: Specialisation Water and Traffic: Elective Co Water and Environmental Engineering: Specialisation Cities: E Water and Environmental Engineering: Specialisation Environ	ve Compulsory ompulsory lective Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Joining of Polymer-Metal Lightweight Structures (L0500)		Lecture	2	2
Joining of Polymer-Metal Lightweight Structures (L0501)		Practical Course	1	1
Metallic Light-weight Materials (L16	660)	Lecture	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	45 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structur	al Engineering: Elective Compulsory		
Following Curricula	Materials Science and Engineering: Spec	ialisation Engineering Materials: Elective Compu	Ilsory	
-	Materials Science: Specialisation Engine	ering Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Spe	cialisation Materials Science: Elective Compulse	m (

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

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

Тур	Lecture
Hrs/wk	2
СР	3
	Independent Study Time 62, Study Time in Lecture 28
	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
	Examples of applications

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

Courses				
Гitle		Тур	Hrs/wk	СР
Scientific Working in Computational	Engineering (L2764)	Project-/problem-based Learning	6	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in scientific writing. String interest in to	pics related to computing in civil engine	ering.	
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
	course instructors and in collaboration with each other, thinking, being able to accurately plan, implement and will be conducted throughout the semester, which will c this course, a scientific paper will be developed based, based on the project conducted within this course. Pro- scientific publications are further key activities.	analyze scientific projects, such as pro ontribute to the grade. Since scientific w which is a prerequisite for the final exan	spective mast iting is of part nination. The p	er theses. A projector theses and projector theses are a projector to the second secon
Skills	The students will be capable (i) of solving a scientific p effectively in the form of a paper, and (iii) of sharing the	-	gy, (ii) of doci	umenting their wo
Personal Competence				
Social Competence	The students will be able to work in a multidisciplinary to	eam and develop communication skills no	ecessary for p	roblem solving.
Autonomy	The students will be able to extend their knowledge and	apply it to solve scientific problems by w	orking indepe	ndently in a proje
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
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: Elect	ve Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Structural Engineering:			
	Civil Engineering: Specialisation Computational Engineer			
	Computer Science: Specialisation II: Intelligence Enginee	ring: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory			

Course L2764: Scientific Wor	rking in Computational Engineering
Тур	Project-/problem-based Learning
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.
Literature	Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany.

Courses				
Title		Тур	Hrs/wk	СР
Sustainable Nature-based Coastal	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	 Hydraulic Engineering Hydromechanics, Hydraulics Fundamentals of Coastal Engineering, Coastal- and Coastal Engineering, Coastal Enginee	d Flood Protection		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence Knowledge	 Climate and Climate Change General Impacts of Climate Change on Wind Regi Consequences of Climate Change for Coastal Procedure Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-based Solutions (NBS) for Coastal Protection 	esses		
Skills	 Critical thinking: analysis of processes and relatio Creative thinking: development of adaptation stra Practical thinking: inclusion of restrictions, appl methods Consideration of complex tasks 	tegies and adaptation measures	iods, numerica	al models, plannii
Personal Competence Social Competence	 Working in heterogenous groups Working in international groups Working with different scientific / non-scientific di Self reflection 	sciplines		
Autonomy	Application oriented use of knowledge and skillsAutonomous work on complex tasks			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	on the complex ta
scale	happens in the course of the lecture.			
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Ele Civil Engineering: Specialisation Geotechnical Engineering Civil Engineering: Specialisation Structural Engineering: Civil Engineering: Specialisation Water and Traffic: Elect Environmental Engineering: Specialisation Environment Water and Environmental Engineering: Specialisation Cit	ng: Elective Compulsory Elective Compulsory ve Compulsory and Climate: Elective Compulsory	_	
	5 5 1	ies: Elective Compulsory vironment: Elective Compulsory		

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

Module M1044: Mode	rn discretization methods in str	uctural mechanics			
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	Finite Element Methods				
Knowledge					
	Flächentragwerke				
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge	After successful completion of this module, st	udents can express the basic aspects of moder	n discretization r	methods in structu	
	mechanics.				
Chille	After successful completion of this module, th	a students will be able to use and further impre-	ve medern dicer	tization mathada	
SKIIIS	Is After successful completion of this module, the students will be able to use and further improve modern discretization mo				
	problems in structural mechanics.				
Personal Competence					
Social Competence	Students can				
	participate in subject specific and interdisciplinary discussions				
	 participate in subject-specific and interdisciplinary discussions, defend their own work results in front of others 				
	 promote the scientific development of colleagues Furthermore, they can give and accept professional constructive criticism 				
	• Furthermore, they can give and accept				
Autonomy	Students are able to gain knowledge of the su	bject area from given and other sources and ap	oply it to new pro	blems. Furthermo	
	they are able to structure the solution process	for problems in the area of modern discretization	on methods.		
Workload in Hours	Independent Study Time 124, Study Time in L	acture 56			
Credit points					
Course achievement					
Examination					
Examination duration and	90 min				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal Engin	eering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory			
	Civil Engineering: Specialisation Computationa	I Engineering: Elective Compulsory			
	Computational Engineering: Core Qualification	: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisa	ation Simulation Technology: Elective Compulso	ry		

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

Course L3044: Modern discre	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		

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Coastal- and Flood Protection (L08	8)	Lecture	2	3	
Coastal- and Flood Protection (L14)	5)	Project-/problem-based Learning	1	1	
Maintenance and Defence of Flood	Protection Structures (L1411)	Lecture	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	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 erosi	on protection	and flood protection	
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension i				
	coastal protection measures from the functional and from the constructional point of view.				
Skills	kills The students are able to select design approaches for the functional and constructional design of erosion a				
Skiis	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 fun	ctional and co	onstructive design	
	coastal and flood protection structures. Additionaly, they	will be able to work in team with engine	eers of other d	lisciplines.	
Autonomy	The students will be able to independently extend their ki	nowledge and apply it to new problems			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 130 min. The exami	nation includes tasks with respect to	the general ι	understanding of th	
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Con	pulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
	Environmental Engineering: Specialisation Environment a	nd Climate: Elective Compulsory			
	Environmental Engineering: Specialisation Water Quality	and Water Engineering: Elective Compu	Ilsory		
	Water and Environmental Engineering: Specialisation Env	ronment: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Wat	an Elective Compulson			

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	EN
Cycle	WiSe
Content	Protection of sandy coasts
	 Sediment transport Morphology Technical solution for the protection of sandy coasts Construction in direction of the coast Constructions perpendicular to the coast Other Concepst Calculation approaches and numerical models Flood Protection Classification of constructions / measures Dikes Dunes Foreland - constructions Flood-Protection Walls Drainage of the hinterland
Literature	Vorlesungsumdruck
	Coastal Engineering Manual CEM

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

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

Courses	
ſitle	Typ Hrs/wk CP
Vaste and Environmental Chemist	-
Biological Waste Treatment (L0318	
Module Responsible	
Admission Requirements Recommended Previous	
Knowledge	
	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to explain design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treatment plants for biological waste treatment plants and explain different methods for waste analytics.
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and qu control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der mo and plan additional tests. They are capable of reflecting and evaluating findings in the group.
Personal Competence	
	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their
	work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give accept professional constructive criticism.
Autonomy	
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. T are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact.
	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with
	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70
Workload in Hours	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6
Workload in Hours Credit points	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work
Workload in Hours Credit points Course achievement Examination	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups)
Workload in Hours Credit points Course achievement Examination Examination duration and	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups)
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups)
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Mater and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation General Process Engineering: Elective Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Mater and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Atter and Traffic: Elective Compulsory Civil Engineering: Specialisation Atter and Traffic: Elective Compulsory Civil Engineering: Specialisation A- General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engin
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Environmental Engineering: Core Qual
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Atter and Traffic: Elective Compulsory Civil Engineering: Specialisation Atter and Traffic: Elective Compulsory Civil Engineering: Specialisation A- General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engin
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define fur steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 70 6 Compulsory Bonus Form Description Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in groups) Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Environmental Engineering: Core Qualification: Co

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

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

Courses				
Title		Тур	Hrs/wk	СР
Finite element modeling of structu	res (L3046)	Lecture	2	3
Finite element modeling of structu	res (L3047)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	Finite Element MethodsThin-walled structures			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, students	can express the basic aspects of mode	lling of structures	with finite elements
Skills	After successful completion of this module, the students will be able to model structures with finite elements and to analys structures using appropriate computational methods.			
Personal Competence				
Social Competence Autonomy	 Students can participate in subject-specific and interdiscipli defend their own work results in front of other promote the scientific development of colleag Furthermore, they can give and accept profes Students are able to gain knowledge of the subject a they are able to structure the solution process for pro- 	s ues sional constructive criticism area from given and other sources and		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and	written elaboration of a project work (10-15 pages)			
scale				
Assignment for the	Civil Engineering: Specialisation Computational Engin	neering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering	Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineeri	ng: Elective Compulsory		
	Computational Engineering: Core Qualification: Elect	ive Compulsory		
	Theoretical Mechanical Engineering: Specialisation S	imulation Technology: Elective Compuls	sory	

Hrs/wk 2 cp 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Bastian Oesterle Languaga EN 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 	Тур	Lecture
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 	Hrs/wk	2
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 	CP	3
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 	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
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 	Lecturer	Prof. Bastian Oesterle
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	Language	EN
 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 	Cycle	WiSe
 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 	Content	phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-based
		 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

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

Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes (L2731)	Recitation Section (small)	3	3
Subsurface Solute Transport (L2728	;)	Lecture	2	2
Subsurface Solute Transport (L2729))	Recitation Section (large)	1	1
Module Responsible	Dr. Milad Aminzadeh			
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 s	tudents will understand the mechanisms controll	ing solute transpor	t in soil and nat
	porous media and will be able to work w	ith the equations that govern the fate and transpo	rt of solutes in porc	ous media. Analyt
	numerical and experimental tools and te	echniques will be used in this module.		
o				
Skills		students will be exposed to analytical, experimenta		
		excellent opportunity to improve their skills on m	litiple fronts which	will be useful in t
	future career.			
Personal Competence				
,	Teamwork & problem solving			
Autonomy		ng individual reports and presentation. This will	contribute to the	students' ability
	willingness to work independently and r			
	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report			
scale				
Assignment for the	Civil Engineering: Specialisation Structu	ral Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory		
	Civil Engineering: Specialisation Comput	ational Engineering: Elective Compulsory		
	Chemical and Bioprocess Engineering: T	echnical Complementary Course: Elective Compuls	ory	
	Chemical and Bioprocess Engineering: T	echnical Complementary Course: Elective Compuls	ory	
	Environmental Engineering: Core Qualifi	cation: Compulsory		
	Process Engineering: Specialisation Envi	ronmental Process Engineering: Elective Compulso	ry	
	Process Engineering: Specialisation Proc	ess Engineering: 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	Mohammad Aziz Zarif	
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	Course L2728: Subsurface Solute Transport		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Milad Aminzadeh		
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	Dr. Milad Aminzadeh		
Language	EN		
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			
Recommended Previous	Basic knowledge about building materials or m	aterial science, for example by the mo-	dule Building Ma	aterials and Buildi
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tra	ading, use and marking of construction pr	oducts in Germar	ny. They know whi
	methods for the testing of building material proper	rties 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	ules for trading and using of building produ	icts in Germany	
JKIIIS	If 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 dam the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of dama are able to describe an examination in form of a test report or expert opinion.			
Personal Competence				
Social Competence	The students can describe the different roles of n	nanufacturers as well as testing, superviso	ory and certificati	ion bodies within
···· ,···	framework of material testing. They can describe t	• •	-	
Autonomy	The students are able to make the timing and the	operation steps to learn the specialist knov	ledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Enginee	ering: Elective Compulsory		
	International Management and Engineering: Specia	alisation II. Civil Engineering: Elective Com	oulsory	
	Materials Science: Specialisation Engineering Mate	rials: Elective Compulsory		

Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 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
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M2076: Intro	duction to Climate Informed Engin	eering		
Courses				
Title		Тур	Hrs/wk	СР
Methods in Climate Informed Engin	eering (L3347)	Lecture	3	3
Topics in Climate Informed Enginee	ering (L3348)	Lecture	3	3
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Students are expected to have a foundational	understanding of environmental scie	ence, basic engineering	g principles, and ar
Knowledge	interest in sustainability. Recommended knowledge includes climate science, data analysis, and familiarity with engineering des processes. Analytical and critical thinking and creative problem-solving skills are also beneficial			h engineering desigr
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence		5 5		
Knowledge	This module explores next-generation climate models and high-resolution data, emphasizing their impact on environmental and engineering products and processes. It covers how various engineering disciplines can benefit from climate information. Research based learning activities, expert talks, and presentations will expose students to state-of-the-art modeling, measurement, and analysis in climate-informed engineering.			
Skills	Climate data analysis, engineering adaptation strategies, problem-solving, research-based learning, and interdisciplinar collaboration.			
Personal Competence				
Social Competence	Collaboration, interdisciplinary teamwork, comm climate-resilient engineering.	unication skills, problem-solving, eth	nical responsibility, and	l decision-making ir
Autonomy	Time management, self-directed learning, critical thinking, accountability, initiative, and the ability to conduct independen research and make informed decisions in climate-informed engineering.			
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineeri	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	•		
	Civil Engineering: Specialisation Structural Engine			
	Civil Engineering: Specialisation Water and Traffic			
	Civil Engineering: Specialisation Computational Er	igineering: Elective Compulsory		
	Data Science: Specialisation III. Applications: Elect	tive Compulsory		
	Environmental Engineering: Core Qualification: Ele	ective Compulsory		
	Process Engineering: Specialisation Process Engin	eering: Elective Compulsory		
	Water and Environmental Engineering: Specialisat	ion Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisat	ion Environment: Elective Compulsor	у	
	Water and Environmental Engineering: Specialisat	ion Water: Elective Compulsory		

Course L3347: Methods in Cl	imate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nima Shokri, Prof. Cathy Hohenegger, Prof. Irina Smirnova
Language	EN
Cycle	WiSe
Content	Students will learn techniques for incorporating climate data and environmental factors into engineering design. It covers climate modelling and the use of sensors and devices to measure climate-related parameters and engineering processes. Students will have the opportunity to conduct their own measurements, analyze the collected data, and write a report on their findings. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Course L3348: Topics in Clim	ate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova, Prof. Cathy Hohenegger, Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Exploring specific applications of climate data in various engineering disciplines. Invited speakers will present their research and discuss the relevance of climate-informed engineering to their work. Additionally, there will be a segment on effective communication, covering how to give impactful presentations and write research papers. Students will also give presentations on their own class projects related to climate-informed engineering, applying the concepts they've learned. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Courses					
Title			Тур	Hrs/wk	СР
Water Protection (L3459)			Integrated Lecture	6	6
Module Responsible	Prof. Simon Mich	ael Papalexiou			
Admission Requirements	None				
Recommended Previous	Basic know	vledge in water manageme	ent.		
Knowledge		vledge in urban drainage;			
		vledge of wastewater treat	ment techniques;		
	 Good know 	vledge of pollutants (e.g. C	OD, BOD, TS, N, P) and their properties;		
	A.G	· · · · · · · · · · · · · · · · · · ·			
	After taking part	successfully, students have	e reached the following learning results		
Professional Competence	The students can	describe the basis princip	les of the regulatory framework related to the	international and F	reneen water cost
Knowledge			les of the regulatory framework related to the substance cycles and water morphology in		
			as ecosystem service and water morphology in		
		ation measures as well as	•	and a specia	
Skills			blems and situations in a country-specific or		
			omorrow's urban water cycle. Furthermore,	they can suggest a	ppropriate technica
	administrative ar	nd legislative solutions to so	bive these problems.		
Personal Competence					
Social Competence	The students can	work together in internation	onal groups.		
Autonomy	Students are abl	e to organize their work flo	ow to prepare presentations and discussions.	They can acquire an	opropriate knowledg
,		ries independently.		5 1 1	
Workload in Hours	Independent Stu	dy Time 96, Study Time in	Lecture 84		
Credit points					
Course achievement	Compulsory Bonus	Form	Description		
	Yes 20 %	Presentation	10-minütige Präsentation von Arbeitse	ergebnissen	
Examination	Written exam				
Examination duration and	150 minutes				
scale	Civil Engineeri	Consigligation Constal 5	vincering, Flective Computer		
Assignment for the Following Curricula	• •		gineering: Elective Compulsory al Engineering: Elective Compulsory		
Following Curricula	5 5	•	Engineering: Elective Compulsory		
	• •	•	Traffic: Elective Compulsory		
	• •	•	Vater Quality and Water Engineering: Elective	Compulsory	
			: Specialisation II. Civil Engineering: Elective		
			cialisation Cities: Elective Compulsory		
			cialisation Environment: Compulsory		
			cialisation Water: Elective Compulsory		

Course L3459: Water Protect	tion
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	WiSe
Content	
Literature	

Courses								
Title	c (124E9)			Тур	tod Lactura	Hrs/wk		CP
Uncertainty Modelling for Engineer		analoviou		Integra	ted Lecture	6		6
Module Responsible Admission Requirements		apalexiou						
Recommended Previous	None							
Knowledge	 Elementary pro Basic computer 	arity with engineeri obability and statist r skills for handling ing engineering pro	tics, and math data.		babilistic method	ls.		
Educational Objectives	After taking part succ	essfully, students l	have reached	the following learr	ning results			
Professional Competence								
	Students will develop introduces probability probability distributio uncertainty in engine decision-making and and disutility and lear By the end of the cou	y as a measure of ons, extreme value eering problems. T predictive modelin m how to apply Bay	uncertainty, theory, joint he course also g. Additionally yesian Decisio	covering frequency probability distrib o covers linear ar y, students will ga n Theory to optim	cy-based method nutions, and stoc ad nonlinear reg hin insight into ri ize engineering s	ds. Students will e hastic optimization ression methods, sk assessment as solutions under une	explor n to r essen a fun certai	e Bayes' Th model and q itial for data action of prol nty.
	problems. They will g inference to real-wor enabling them to ana they will learn to imp decision-making.	rld engineering ch Ilyze complex engin	allenges. Stud	dents will also de ets and improve ri	evelop skills in l isk predictions. T	inear and nonline Through hands-on o	ar re	gression mo utational exe
Personal Competence								
,	Students will develop effectively with peers	s, engineers, and						
Autonomy	uncertainty quantific challenges. Students will learn to distributions, regressi risks associated with assessment, and disa:	independently an ion methods, and natural and humar	alyze and more stochastic tec	ng analyses are l del engineering u chniques for vario	ncertainties, sele us applications.	nd applicable to ecting and applying They will also gai	real-w g app n the	vorld infrast ropriate pro ability to ev
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Workload in Hours	challenges. Students will learn to distributions, regressi risks associated with assessment, and disa Independent Study Tii 6	independently an ion methods, and natural and humar ster mitigation.	alyze and mod stochastic tec n-made hazard in Lecture 84	ng analyses are i del engineering un chniques for vario ds, ensuring they	ncertainties, sele us applications. can make inform	nd applicable to ecting and applying They will also gai ned engineering de	real-w g app n the	vorld infrast ropriate pro ability to ev
Workload in Hours Credit points Course achievement	challenges. Students will learn to distributions, regressi risks associated with assessment, and disa Independent Study Til 6 Compulsory Bonus	independently and ion methods, and natural and humar ster mitigation. me 96, Study Time Form	alyze and mod stochastic tec n-made hazard in Lecture 84	ng analyses are i del engineering un chniques for vario ds, ensuring they scription	ncertainties, sele us applications. can make inform	nd applicable to ecting and applying They will also gai ned engineering de	real-w g app n the	vorld infrast ropriate pro ability to ev
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Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	challenges. Students will learn to distributions, regressi risks associated with assessment, and disa: Independent Study Til 6 Compulsory Bonus Yes 20 % Written exam 150 min Civil Engineering: Spe Civil Enginee	independently and ion methods, and natural and human ster mitigation. me 96, Study Time Form Presentation ecialisation Coastal ecialisation Geotech ecialisation Structur ecialisation Comput ecialisation Geotech ecialisation Geotech ecialisation Geotech ecialisation Structur ecialisation Structur ecialisation Structur ecialisation Structur ecialisation Water a ecialisation Structur ecialisation Water a entil Engineering: S ental Engineering: S ental Engineering: S	alyze and more stochastic tech- made hazard in Lecture 84 Decision In Lecture 84 In L	del engineering un chniques for vario ds, ensuring they scription -minütige Präsent Elective Compulsor g: Elective Compu- g: Elective Compulsor ring: Elective Com- g: Elective Compulsor g: Elective Com g: Elective Compulsor g: Elective Compul	ation von Arbeits ation von Arbeits ation von Arbeits ation von Arbeits pry spulsory lsory spulsory lsory spulsory spulsory spulsory spulsory spulsory spulsory spulsory spulsory spulsory spulsory mpulsory mpulsory mpulsory mpulsory mpulsory mpulsory mpulsory mpulsory mpulsory	nd applicable to recting and applying They will also gained engineering de sergebnissen	real-w g app n the	vorld infrast ropriate pro ability to ev

Course L3458: Uncertainty M	lodelling for Engineers
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	SoSe
Content	Engineering decisions are rarely made with complete certainty—uncertainty affects material properties, environmental conditions, structural performance, and risk assessments. This course provides students with theoretical foundations and practical tools to quantify uncertainty, assess risks, and enhance decision-making in civil, structural, geotechnical, and environmental engineering applications. Students will begin with fundamental probability concepts, learning how Bayes' Theorem, probability distributions, and extreme value theory help evaluate engineering uncertainties. They will explore linear and nonlinear regression methods for analyzing complex datasets, as well as joint probability distributions and stochastic optimization to improve predictive modeling and reliability assessments. The course also introduces Bayesian Decision Theory, offering a structured approach to decision-making under uncertainty. With a focus on real-world engineering problems, students will apply probabilistic models, extreme value analysis, and stochastic techniques to assess risks in infrastructure design, system reliability, and disaster resilience. Hands-on computational exercises will reinforce key concepts, preparing students to work with data-driven models and uncertainty quantification techniques used in engineering practice. This course is ideal for students interested in engineering risk assessment, reliability analysis, and data-driven modeling. By the end of the course, students will have developed critical analytical and problem-solving skills, equipping them for careers in structural safety, geotechnical engineering, environmental risk management, and beyond.
Literature	

Specialization Computational Engineering

Module M0699: Geote	chnics III			
Courses				
Title Numerical Methods in Geotechnics	(10275)	Typ Lecture	Hrs/wk 3	СР 3
Advanced Foundation Engineering		Lecture	2	2
Advanced Foundation Engineering		Recitation Section (large)	1	1
Module Responsible	Prof. lürgen Grabe			
Admission Requirements				
-	Geotechnics I and II, Mathematics I-III			
Knowledge				
	After taking part successfully, students have reached the fo	ollowing learning results		
Professional Competence				
Knowledge	After successfully completing the module, students will be	able to		
	 describe individual procedures for the geotechnical r 	monitoring of civil engineering me	asures,	
	 reproduce exploration and investigation methods of 	the subsoil,		
	 select suitable types of field and laboratory tests for 			
	 state the differences between various stress and def 	formation states and the physical	significance of inv	variants of the stress
	and distortion tensor,			
	 outline the standard and special soil mechanics tests 		ain behavior of soi	il,
	describe continuum models and the resulting bounda		in an also a man allo	
	 as well as define boundary value problems from the unambiguously. 	neid of geotechnical engineering	in such a way tha	at they can be solved
Skills	Students will be able to			
	 dimension vertical drains for soil improvement of sof 	t soils,		
	 calculate depth compaction using various appropriat 	e methods,		
	apply principles of horizontal bearing capacity of piles,			
	 verify the internal and external stability of fluid-supported diaphragm walls, 			
	 evaluate the boundary conditions for the design 	of a deep excavation and design	gn the individual	components of the
	excavation,			
	• perform, evaluate and interpret tests for the description and classification of soils according to applicable standards,			
	computationally implement numerical algorithms to solve boundary value problems,			
	 select and apply the types of analyses depending on determine appropriate model parameters for difference 			
	 determine appropriate model parameters for different of soils. 	ne possibilities and inflitations of i	naterial models it	or the grain structure
	01 50115.			
Personal Competence				
Social Competence	Students can work in groups and support each other in find	ing solutions.		
Autonomy	Students are able to assess their own strengths and weakn and think in terms of processes.	esses and, based on this, organiz	e their time and le	earning management
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement				
Examination				
Examination duration and	120 min			
scale				
-	Civil Engineering: Specialisation Structural Engineering: Con			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:			
	Civil Engineering: Specialisation Coastal Engineering: Comp Civil Engineering: Specialisation Water and Traffic: Elective			
	Civil Engineering: Specialisation Water and Traffic: Elective Civil Engineering: Specialisation Computational Engineering			
	International Management and Engineering: Specialisation		pulsory	
	incontrational management and Engineering. Specialisation	e.th Engineering. Elective com	P 4.501 J	

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:
	 Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering)
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn

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

Course L0498: Advanced Fou	urse 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	

Module M0963: Steel	and Composite Structures			
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	204)	Lecture	2	2
Steel and Composite Structures (L1	205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I an	d II, BUBC)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
	After successful completition, students can			
5	·			
	 describe the phenomenon of local buckling 			
	 explain warping torsion 			
	 illustrate the behaviour of composite structure 			
	 specify the principles in design of composite s 			
	 sketch the contructions of steel and composite 	e bridges		
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structure 	res		
	 recognize and verify warping tosion in strucur 			
	design composite structures			
	design bridges and o perform the detailing			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
Credit points				
-	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineeri	ng: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine			
2	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic: E			
	Civil Engineering: Specialisation Computational Engin			
	International Management and Engineering: Speciali	• • •	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	 Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction
Literature	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag

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

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

Module M0713: Conci	rete Structures	5				
Courses						
Title			Ту	p	Hrs/wk	СР
Concrete Structures (L0579)			Ser	ninar	1	1
Structural Concrete Members (L05	77)		Lec	ture	2	3
Structural Concrete Members (L05	78)		Rec	itation Section (large)	2	2
Module Responsible	NN					
Admission Requirements	None					
Recommended Previous	Basics of structural a	analysis, conception ar	nd dimensioning of structu	ral concrete		
Knowledge	Modulos, Doinforcod	Concrete Structures I		Machanica III		
	Modules: Reinforced	Concrete Structures I-	+II, Structural Analysis I+I	I, Mechanics I+II		
Educational Objectives	After taking part suc	cessfully, students hav	ve reached the following le	earning results		
Professional Competence			5	5		
•	The students broade	n their skills in structu	Iral engineering, especially	/ in the field of buildings	(houses, roofs, h	alls). They dispose
			gn of concrete buildings a			
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering.					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing and					
	execution. Moreover	, they can make desig	n and construction sketch	es and draw up technica	l descriptions.	
Personal Competence						
		le te obtain reculte of k	high quality in teamwork			
Social Competence	The students are abi	e to obtain results of r	nigh quality in teamwork.			
Autonomy	The students are abl	le to carry out comple>	conception and dimensio	ning tasks of structures	under the guidan	ce of tutors.
	<u> </u>					
Workload in Hours		Time 110, Study Time i	in Lecture 70			
Credit points						
Course achievement		Form	Description			
	No None	Presentation	Es werden 2 Refe	rate ausgegeben		
Examination						
Examination duration and	120 minutes					
Examination duration and						
scale						
scale	Civil Engineering: Sp	ecialisation Structural	Engineering: Compulsory			
scale	• • •		Engineering: Compulsory cal Engineering: Elective C	Compulsory		
scale Assignment for the	Civil Engineering: Sp	ecialisation Geotechni				
scale Assignment for the	Civil Engineering: Sp Civil Engineering: Sp	pecialisation Geotechni pecialisation Coastal Er	cal Engineering: Elective C	ulsory		
scale Assignment for the	Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp	pecialisation Geotechni pecialisation Coastal Er pecialisation Water and	cal Engineering: Elective Computing	ulsory		

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

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

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

Courses			
itle onstruction Robotics (L2867)	TypHiProject-/problem-based Learning6	rs/wk	CP 6
Module Responsible	Prof. Kay Smarsly		
Admission Requirements	None		
Recommended Previous	Basics of project-oriented programming		
Knowledge			
-	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Basics of robotics		
	Applications in civil engineering		
	Kinematics		
Skills	Use of specific hardware		
	Development of software routines		
	Python programming language		
	Image processing		
	Basics of localization (LIDAR, SLAM)		
Personal Competence			
Social Competence	Teamwork		
	Communication skills		
Autonomy	Independent work		
	Independent decisions		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and	ca. 10 Seiten		
scale			
-	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
Following Curricula			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory		

Tvn	ect-/problem-based Learning		
Hrs/wk			
CP			
-	and art Chudu Time OC Chudu Time in Lasture 04		
	Independent Study Time 96, Study Time in Lecture 84		
	Prof. Kay Smarsly, Jan Stührenberg		
Language			
Cycle	WiSe		
Content	 Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization 		
	Bock/Linner: Construction Robotics Verl et al.: Soft Robotics Pasquale: New Laws of robotics		

Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes	(L2731)	Recitation Section (small)	3	3
Subsurface Solute Transport (L272	8)	Lecture	2	2
Subsurface Solute Transport (L272	9)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Basic Mathematics, Hydrology			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	Upon completion of this module, the st	udents will understand the mechanisms contro	lling solute transpo	rt in soil and natu
5		th the equations that govern the fate and transp	•	
	numerical and experimental tools and teo	chniques will be used in this module.		
Skills	In addition to the physical insights, the st	udents will be exposed to analytical, experiment	tal and numerical to	ols 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.			
Personal Competence				
Social Competence	Teamwork & problem solving			
Autonomy	y The students will be involved in writing individual reports and presentation. This will contribute to the students' abilit		students' ability a	
	willingness to work independently and re-	sponsibly.		
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water an	d Traffic: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory			
	Chemical and Bioprocess Engineering: Te	chnical Complementary Course: Elective Compu	sory	
	Environmental Engineering: Core Qualific	ation: Compulsory		
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory			
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp			

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	Mohammad Aziz Zarif	
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	Course L2728: Subsurface Solute Transport		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Milad Aminzadeh		
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	Dr. Milad Aminzadeh		
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			
Recommended Previous				
Knowledge				
	Structural Analysis II			
	Finite Element Methods			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the	e 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	hebaviour of th	nin-walled structure
Skiis	using appropriate analytical and coputational me			in wance scructure
		chous.		
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdis 	ciplinary discussions,		
	 defend their own work results in front of c 	others		
	 promote the scientific development of col 	leagues		
	• Furthermore, they can give and accept pr	•		
Autonomy	Students are able to gain knowledge of the subj			
	they are able to structure the solution process for	or problems in the area of modelling and analy	sis of thin-walled	d structures.
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Er	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Computational	Engineering: Compulsory		
	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisati	on Simulation Technology: Elective Compulso	гy	

Course L1199: Thin-walled st	tructures	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	rof. Bastian Oesterle	
Language)E	
Cycle	SoSe	
Content	Plates loaded in-plane	
	Governing equations (equilibrium, kinematics, constitutive law)	
	Differential equation	
	Airy stress function	
	Plane stress / plane strain	
	Structural behaviour of plates loaded in-plane	
	finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results	
	Plates in bending	
	Governing equations (equilibrium, kinematics, constitutive law)	
	Differential equation	
	Differential equation Navier solution / Fourier series expansion	
	Navier solution / Fourier series expansion Approximation procedures	
	Circular and rectangular plates	
	Structural behaviour of plates in bending	
	• finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results	
	Shells	
	Phenomenona of the structural behaviour of shells	
 Phenomenona of the structural behaviour of shells Membrane and bending theory Equilibrium equations of shells of revolution 		
	 finite elements for shells 	
	Stability problems (overview)	
	Plate buckling Shall buckling	
	Shell buckling	
Literature	Vorlesungsmanuskript	
	 Voriesungsmanuskript Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden 	
	 Basar, T., Kratzig, W.B. (1963). Mechanik der Plachendagwerke. Vieweg-Verlag, Bradischweig, Wesbaden 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 	
	2. Lienwerner, etc. (2017). The finite element mentor in Engineering Science, Productini, Editori	
	1	

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	

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		Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	dge Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engi		ydraulic engineerir	
	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows and			
	waves.			
Skills	Students are able to apply hydrodynamic-numerical models to	practical hydraulic engineering ta	ckc	
SKIIS		proceeding and and engineering to	51(5).	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in sin	mple applied problems. Additionaly	, they will be	able to work in tea
	with others.			
Autonomy	The students will be able to independently extend their knowl	edge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 3 hours. The examination	on includes tasks with respect to	the general u	understanding of t
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Electi	ve Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Computational Engineering: O	Compulson		

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	 Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models 	
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer	

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

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548) Marine Geotechnics (L0549)		Lecture Recitation Section (large)	1 2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible				
Admission Requirements				
Recommended Previous	Complete modules: Geotechnics I-III, Math	ematics I-III		
Knowledge				
	Courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	e The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning qu			oncerning quay wa
	Furthermore, the students get all the necessary knowledge to design singular construction elements for sheet pile walls and the			
	know how to choose the right construction	elements depending on the influencing condition	5.	
Skills	Furthermore, the students are able to dir	nension sheet nile wall construction regarding all	construction eler	ments to choose t
Skiiis	Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to choose the suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile			
		to dimension all construction elements and connec	•	
Personal Competence				
Social Competence				
Autonomy	Students are able to assess their own stre	ngths and weaknesses and organize their time and	a learning manage	ement based on th
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechn	ical Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structura			
	Civil Engineering: Specialisation Coastal E			
	Civil Engineering: Specialisation Computat	ional Engineering: Elective Compulsory		
		alisation Maritime Technology: Elective Compulsor		

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

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Numerical Algorithms in Structural	Mechanics (L0284)	Lecture	2	3
Numerical Algorithms in Structural	Mechanics (L0285)	Recitation Section (small)	2	3
Module Responsible	Prof. Alexander Düster			
Admission Requirements	None			
Recommended Previous	Knowledge of partial differential equations	is recommended.		
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
		nms that are used in finite element programs.		
	+ explain the structure and algorithm of fin			
		is, to identify them in a given situation and to ex	plain their mather	natical and comput
	science background.			
Skills	Students are able to			
	+ construct algorithms for given numerica	l methods.		
	+ select for a given problem of structural r	nechanics a suitable algorithm.		
	+ apply numerical algorithms to solve prob	plems of structural mechanics.		
	+ implement algorithms in a high-level pro	gramming languate (here C++).		
	+ critically judge and verfiy numerical algo	prithms.		
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups	i.		
	+ present and discuss their results in front	of others.		
	+ give and accept professional constructiv	e criticism.		
Autonomy	Students are able to			
	+ assess their knowledge by means of exe	rcises and E-Learning.		
	+ acquaint themselves with the necessary	knowledge to solve research oriented tasks.		
	+ to transform the acquired knowledge to	similar problems.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	2h			
	Civil Engineering: Specialisation Computation	ional Engineering: Elective Compulsory		
Following Curricula	Materials Science: Specialisation Modeling:			
. che shing curricula	Naval Architecture and Ocean Engineering			
	Technomathematics: Specialisation III. Eng			
		alisation Simulation Technology: Elective Compu	sony	

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

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

_				
Courses				
Title	(10000)	Тур	Hrs/wk	СР
Computational Structural Dynamics Computational Structural Dynamics		Lecture Recitation Section (small)	3 1	4
		Recitation Section (Smail)	T	Z
-	Prof. Alexander Düster			
Admission Requirements				
	Knowledge of partial differential equation	s is recommended.		
Knowledge				
	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
		procedures for problems of structural dynamics.		
		t programs to solve problems of structural dynam		
		ictural dynamics, to identify them in a given situ	ation and to expla	in their mathemation
	and mechanical background.			
Skills	Students are able to			
	+ model problems of structural dynamics			
	+ select a suitable solution procedure for			
	+ apply computational procedures to solv			
	+ verify and critically judge results of con			
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous group	05.		
	+ present and discuss their results in from	t of others.		
	+ give and accept professional constructi	ve criticism.		
Autonomy	Students are able to			
	+ assess their knowledge by means of ex	ercises and E-Learning.		
	+ acquaint themselves with the necessar	y knowledge to solve research oriented tasks.		
	+ to transform the acquired knowledge to	similar problems.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			-
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Computa	tional Engineering: Elective Compulsorv		
-		ng: Specialisation II. Mechatronics: Elective Comp	ulsory	
	Materials Science: Specialisation Modeling		- 2	
	Mechatronics: Technical Complementary			
		g: Core Qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Spec		leon	

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

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

Module M0604: High-(Order FEM				
Courses					
Title			Тур	Hrs/wk	СР
High-Order FEM (L0280)			Lecture	3	4
High-Order FEM (L0281)			Recitation Section (large	e) 1	2
Module Responsible	Prof. Alexander Düs	ter			
Admission Requirements	None				
Recommended Previous	Knowledge of partia	l differential equations	is recommended.		
Knowledge					
Educational Objectives	After taking part suc	cessfully, students hav	ve reached the following learning results		
Professional Competence					
-	Students are able to	1			
			p) finite element procedures.		
		r finite element proced			
			cedures, to identify them in a given situati	on and to explain the	eir mathematical ar
	mechanical backgro		, , , , , , , , , , , , , , , , , , , ,		
	5				
Skills	Students are able to				
	+ apply high-order f	inite elements to probl	ems of structural mechanics.		
			mechanics a suitable finite element procedure	2.	
	+ critically judge res	sults of high-order finite	e elements.		
	+ transfer their know	wledge of high-order fi	nite elements to new problems.		
Personal Competence					
Social Competence	Students are able to	1			
Social competence		heterogeneous groups			
		ss their results in front			
		rofessional constructiv			
	i give and decept p				
Autonomy	Students are able to	1			
	+ assess their know	ledge by means of exe	rcises and E-Learning.		
	+ acquaint themselv	ves with the necessary	knowledge to solve research oriented tasks.		
	+ to transform the a	acquired knowledge to	similar problems.		
Workload in Hours	Independent Study	Time 124, Study Time i	in Lecture 56		
	6	Time 124, Study Time			
Course achievement	Compulsory Bonus	Form	Description		
	No 10 %	Presentation	Forschendes Lernen		
Examination	Written exam				
Examination duration and					
scale					
	Civil Engineering: Sr	ocialisation Computat	ional Engineering: Elective Compulsory		
5	• • •		g: Specialisation II. Product Development and	Production: Elective (ompulsory
-	-	pecialisation Modeling:			
			Specialisation Product Development and Pro	duction: Elective Com	pulsory
	•	• •	Course: Elective Compulsory		
			action: Core Qualification: Elective Compulsor	v	
			: Core Qualification: Elective Compulsor	3	
			ineering Science: Elective Compulsory		
	recumornatinematics	. specialisation III. Eng	meening science. Liective Compuisory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in	steel structures (L0564)	Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis	of statically determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics
Knowledge	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 respective methods.	ule, the student can explain the basic aspects of c	dynamic effects o	n structures and
Skills	After successful completion of this mo dynamics loading using the appropriate c	odule, the students will be able to predict the re- computational approaches and methods.	sponse of mater	ial and structures
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and 	interdisciplinary discussions		
	 defend their own work results in fr 			
	 promote the scientific development 			
		ccept professional constructive criticism		
		•••		
Autonomy		he subject area from given and other sources and a		oblems. Furthermo
	they are able to structure the solution pro	ocess for problems in the area of Structural Analysis	5.	
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Compulsory		
-				
Following Curricula		5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		
Following Curricula	Civil Engineering: Specialisation Coastal B	Engineering: Elective Compulsory		
Following Curricula				
Following Curricula	Civil Engineering: Specialisation Coastal E Civil Engineering: Specialisation Water ar Civil Engineering: Specialisation Computa	nd Traffic: Elective Compulsory		

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

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

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

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 M0827: Mode	ling in Water Management					
	, , , , , , , , , , , , , , , , , , ,					
Courses						
Title		Тур	Hrs/wk	СР		
Groundwater Modeling using Modfl		Lecture	1	1		
Groundwater Modeling using Model		Recitation Section (small)	2 2	2 3		
Modeling of Water Supply Network		Project-/problem-based Learning	Z	3		
Module Responsible						
Admission Requirements						
Recommended Previous Knowledge	Groundwater					
Kilowiedge	 groundwater hydraulics and transport of su 	bstances				
	Pipe Systems					
	· Knowledge on urban water infrastructure	, in particular drinking water systemsand .	rhan drainac	o sustana includia		
	 Knowledge on urban water infrastructure special structures 	s, in particular drinking water systemsand u		je systems includin		
	 Hydraulics of drinking water supply system: 	s and sewer systems				
	 Basic knowledge on water management 					
	After taking part successfully, students have reach	ned the following learning results				
Professional Competence						
Knowledge	The students are able to describe the modelling of					
	carry out systems analyses and can detect techni		tems in case	studies. Besides the		
	are able to analyse interdependencies of hydraulie	and toxic phenomena in son and water.				
Skille	The students are able to construct and apply sci	antific groundwater models indipendently. The	w can work o	n different scenario		
JKIIIS	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare or assess different solutions for existing problems by application of selected software products. The students are					
	able to use different software solutions (e.g. EPAN		produ	ets. The students un		
	(-g					
Personal Competence						
Social Competence	Wird nicht vermittelt.					
Autonomy	Wird nicht vermittelt.					
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70				
Credit points	6					
Course achievement	None					
Examination	Oral exam					
Examination duration and	30 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 Engineeri	ng: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic	: Elective Compulsory				
	Civil Engineering: Specialisation Computational Er	gineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisat	ion Environment: Elective Compulsory				
	Water and Environmental Engineering: Specialisat					
	Water and Environmental Engineering: Specialisat	ion Water: Elective Compulsory				

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

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

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

Module M0871: Hydro	blogical Systems					
Courses						
Title		Тур	Hrs/wk	СР		
Applied Surface Hydrology (L0289)		Lecture	2	2		
Applied Surface Hydrology (L1412)		Project-/problem-based Learning	1	2		
nteraction Water - Environment in	Fluvial Areas (L0295)	Project-/problem-based Learning	1	2		
Module Responsible	Prof. Peter Fröhle					
Admission Requirements	None					
Recommended Previous	Fundamentals of Hydromechanics and H	lydraulic Engineering: Hydraulic Engineering I and Hydra	ulic Engineeri	ng II		
Knowledge						
Educational Objectives	After taking part successfully, students h	nave reached the following learning results				
Professional Competence						
Knowledge	The students are able to define the bas	ic concepts of hydrology and water management. They	are able to d	lescribe and qua		
	the relevant processes of the hydrologic	al water cycle. Besides, the students know the main as	pects of rainfa	Ill-run-off-models		
	are able to theoretically derive establish	ed reservoir / storage models and a unit-hydrograph.				
Skills	s The students are able to use the basic hydrological concepts and approaches and are able to theoretically derive established					
	reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the basis					
	concepts of measurements of hydrological and hydrodynamic values in nature and are able to perform, analyze and statistical					
	assess these measurements. Furthermor	re, they are able to apply a hydrological model to basic l	hydrological pi	roblems.		
Personal Competence						
Social Competence	The students are able to deploy their gai	ined knowledge in applied problems of the hydrology an	id water mana	gement. Additior		
	they will be able to work in team with en	igineers of other disciplines.				
Autonomy	-	tly extend their knowledge and apply it to new problems				
	Independent Study Time 124, Study Time	e in Lecture 56				
Credit points						
Course achievement						
	Written exam					
Examination duration and	The duration of the examination is 90 mi	in. The examination includes tasks with respect to the g	eneral underst	tanding of the lec		
scale	contents and calculations tasks.					
Assignment for the	Civil Engineering: Specialisation Compute	ational Engineering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Compulsory					
	Environmental Engineering: Core Qualification: Elective Compulsory					
	Joint European Master in Environmental S	Studies - Cities and Sustainability: Core Qualification: Co	ompulsory			
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory					
	Water and Environmental Engineering: S	Specialisation Environment: Elective Compulsory				

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

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

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

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

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

Course L0604: Design of Pre	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	NN		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0756: Soil N	-L					
Courses						
Title				Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L	0374)			Lecture	2	2
Soil Dynamics (L0452) Experimental Researches in Geotechnics (L0706)				Lecture Practical Course	2	2
				Flactical Course	Ζ	2
Module Responsible Admission Requirements	None					
Recommended Previous		I-III, Mechanics I-II, Geot	echnics I			
Knowledge		y course, (Applied struct				
Educational Objectives	After taking part succe	ssfully, students have re	eached the followi	ng learning results		
Professional Competence						
Knowledge	Students will be able to	р,				
Skills	 describe wave propagation in the ground under dynamic excitation and define the relevant parameter to measure vibrations and to interpret the data obtained with regard to their effect on people and si justify when elastodynamic methods are sufficient and when plastodynamic effects must be taken in to reproduce the collapse theorems of plasticity theory, describe the viscous behavior of cohesive soils and computationally account for creep deformation shear strengths as well as to determine the effect of partial saturation on the seepage flow and the shear strength. <i>Skills</i> After the successful completion of the module the students should be able to: to derive and apply the basic equation of a simple mass oscillator, to understand the wave propagation in the soil under dynamic excitation and to detect the relevant to know the essential laboratory and field tests to determine soil dynamic characteristics and to evaluate shocks to perform vibration forecast, to evaluate shocks in terms of their effect on people and buildings, to evaluate possibilities of isolation, to understand mechanisms that cause earthquakes and evaluate earthquakes in terms of their mage to know methods to determine axial pile capacity, integrity, and the dynamic bedding modulus, to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estiti 			ct on people and struct its must be taken into a for creep deformation he shear strength. detect the relevant para teristics and to evaluat terms of their magnitud Iding modulus,	ures, account, and rate-depende ameters, e them, de and intensity,	
	 to detect the un to capture the v calculations, 	e area of application of i drained shear strength a isous behaviour of cohe mpact of the partly satu	as a function of a r sive soils and to c	number of state variable consider the effects of c	es,	nt shear strength
Personal Competence						
Social Competence		to work in teams to ach	ieve results on m	easurement and experi	mental principles and	present their resul
Autonomy	together at the end of Students are able to as	the semester. ssess their own strength	s and weaknesses	and organize their time	e and learning manage	ment based on thi
Workload in Hours	Independent Study Tim	ne 96, Study Time in Lec	ture 84			
Credit points	6					
Course achievement	Compulsory Bonus Yes None	Form Subject theoretical practical work	Description and			
Examination	Written exam					
Examination duration and scale	135 min					
Assignment for the	Civil Engineering: Spec	ialisation Structural Eng	ineering: Elective	Compulsory		
Following Curricula	• • •	ialisation Geotechnical I	• • •	-		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
i onowing curricula	Civil Engineering: Spec		eering: Elective Co	ompulsory		

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

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

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

Module M0854: Mathe	ematics IV			
Courses				
Title		Tour	Line (mile	CD.
	incontial Equations) (11042)	Typ Lecture	Hrs/wk 2	CP 1
Differential Equations 2 (Partial Diff Differential Equations 2 (Partial Diff		Recitation Section (small)	2	1
Differential Equations 2 (Partial Diff		Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof Marko Lindner			
Admission Requirements				
Recommended Previous				
Knowledge				
-	After taking part successfully, students have reach	and the following learning results		
2	Arter taking part successionly, students have reach			
Professional Competence				
Knowledge	 Students can name the basic concepts in Ma 	athematics IV. They are able to explain ther	n using appropri	ate examples.
	 Students can discuss logical connections be 			
	the help of examples.		or material and g an	
	 They know proof strategies and can reprodu 	ice them		
	• They know proof strategies and carreprode	ice them.		
Skills	 Students can model problems in Mathemat 	tics IV with the help of the concepts studie	d in this course	. Moreover, they a
	capable of solving them by applying establis			,,
	 Students are able to discover and verify furt 		ats studied in the	COURSE
	 For a given problem, the students can dev 			
	results.	velop and execute a suitable approach, a		inclairy evaluate ti
	results.			
Personal Competence				
Social Competence	 Students are able to work together in teams 	They are canable to use mathematics as	common langu	200
	 Students are able to work together in teams. They are capable to use mathematics as a common language. In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they ca 			
	 In doing so, they can communicate new con design examples to check and deepen the u 		erating partners	. Moreover, they ca
	design examples to thete and deepen the t	inderstanding of their peers.		
Autonomy	 Students are capable of checking their understanding of complex concepts on their own. They can specify open questions 			
	precisely and know where to get help in solv			
	Students have developed sufficient persister	•	in a goal-orien	ted manner on har
	problems.	ence to be able to work for longer period	s in a goal-orien	
	problems.			
	Independent Study Time 68, Study Time in Lecture	2 1 1 2		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential	Equations 2)		
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Electrical Enginee	ring: Compulsor	y
Following Curricula	General Engineering Science (German program	, 7 semester): Specialisation Mechanica	l Engineering,	Focus Mechatronic
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engin	eering, Focus Th	neoretical Mechanic
	Engineering: Elective Compulsory	-		
	Civil Engineering: Specialisation Computational En	gineering: Elective Compulsory		
	Electrical Engineering: Core Qualification: Compuls			
	Electrical Engineering and Information Technology			
	• • •		ing: Compulser	
	General Engineering Science (English program, 7 s			
	Computer Science in Engineering: Specialisation II.			
	Mechanical Engineering: Specialisation Theoretical		ory	
	Mechanical Engineering: Specialisation Mechatroni	cs: Compulsory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	1		
	Theoretical Mechanical Engineering: Technical Con			

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

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

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

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

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

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

Courses					
Title		Тур		Hrs/wk	СР
Modeling Processes in Vadose Zone	e (L2735)	Recitation Sect	ion (small)	2	2
Vadose Zone Hydrology (L2732)		Lecture		2	2
Vadose Zone Hydrology (L2733)		Recitation Sect	ion (large)	2	2
Module Responsible	Prof. Nima Shokri				
Admission Requirements	None				
Recommended Previous	Basic knowledge in water and soil				
Knowledge					
	Comfortable with math and physics, critic	cal thinking, creative problem solving			
	Analytic skills				
Educational Objectives	After taking part successfully, students h	ave reached the following learning res	ults		
Professional Competence					
Knowledge	The students will learn about soil cha	racterization (solid and liquid phase), the energy	state of soil wa	ater, the soil wa
	characteristic curve, flow in saturated an	d unsaturated soil as well as about sol	ute transport ir	ı soil	
Skills	Students will work on practical examp	les modelling transport processes in	n soil using d	ifferent quantita	ative tools includ
	computer simulations and analytical tool	s. This will help them to apply knowled	ge in order to s	solve problems a	nd tasks.
Personal Competence					
•	The module aims at raising awareness	and enthusiasm for new knowledge	related to wa	ater soil and en	wironment This
Social competence	positively contribute to shape their work	-	Telated to wa	iter, son and en	vironnent. mis
	positively contribute to shape their work	and me environment.			
Autonomy	The students will be involved in mar	ny problem solving exercises. This	will contribute	toward their	willingness to w
	independently and responsibly.				
Workload in Hours					
Credit points					
Course achievement					
Examination					
Examination duration and	Report and Presentation				
scale					
-	Civil Engineering: Specialisation Compute		ry		
Following Curricula	Civil Engineering: Specialisation Water an				
	Environmental Engineering: Core Qualific				
	Water and Environmental Engineering: S	pecialisation Water: Elective Compulso	ry		

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Nonlinear Structural Analysis (L027		Lecture	3	4	
Nonlinear Structural Analysis (L027		Recitation Section (small)	1	2	
Module Responsible					
Admission Requirements					
	Knowledge of partial differential equations is	recommended.			
Knowledge					
-	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	Students are able to	and the second state of the second state of the			
	+ give an overview of the different nonlinear				
	+ explain the mechanical background of nonl				
		analysis, to identify them in a given situation	and to explain the	er mathematical a	
	mechanical background.				
Skills	Students are able to				
	+ model nonlinear structural problems.				
	+ select for a given nonlinear structural problem a suitable computational procedure.				
	+ apply finite element procedures for nonline	ar structural analysis.			
	+ critically verify and judge results of nonlinear finite elements.				
	+ to transfer their knowledge of nonlinear sol	ution procedures to new problems.			
Deveenal Commetence					
Personal Competence	Students are able to				
Social Competence	Students are able to				
	+ solve problems in heterogeneous groups.+ present and discuss their results in front of	othors			
	+ give and accept professional constructive of				
Autonomy	Students are able to				
	+ assess their knowledge by means of exercise	ses and E-Learning.			
	+ acquaint themselves with the necessary kn	owledge to solve research oriented tasks.			
	+ to transform the acquired knowledge to sin	nilar problems.			
	Independent Study Time 124, Study Time in L	Lecture 56			
Credit points Course achievement					
	Written exam				
Examination duration and scale	120 min				
	Civil Engineering: Engialization Structural En	gingering: Elective Compulson			
-	Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Computation				
ronowing curricula	Computational Engineering: Core Qualification				
	1 5 5 .	Specialisation II. Civil Engineering: Elective Com	pulsory		
		nt and Production: Core Qualification: Elective Con			
	Materials Science and Engineering: Specialisa		Jonipulsory		
	Materials Science: Specialisation Modeling: El				
	Mechatronics: Technical Complementary Cou				
	Mechatronics: Core Qualification: Elective Cor				
	Product Development, Materials and Producti				
	Naval Architecture and Ocean Engineering: C				
	Naval Architecture and Ocean Engineering: C				
	Ship and Offshore Technology: Core Qualifica				

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

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

Courses				
Fitle Scientific Working in Computationa	Engineering (L2764)	Typ Project-/problem-based Learning	Hrs/wk 6	CP 6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in scientific writing. String interest	in topics related to computing in civil engined	ering.	
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
	The students will learn to apply concepts and meth course instructors and in collaboration with each oth thinking, being able to accurately plan, implement will be conducted throughout the semester, which w this course, a scientific paper will be developed base based on the project conducted within this course scientific publications are further key activities.	ner, the students will also learn to understand and analyze scientific projects, such as pro vill contribute to the grade. Since scientific wr sed, which is a prerequisite for the final exam	I the complex spective mast iting is of part nination. The p	process of scienti ter theses. A proje ticular importance paper will be writte
Skills	The students will be capable (i) of solving a scient effectively in the form of a paper, and (iii) of sharing		gy, (ii) of doc	umenting their wo
Personal Competence				
Social Competence	The students will be able to work in a multidisciplina	ry team and develop communication skills ne	ecessary for p	roblem solving.
Autonomy	The students will be able to extend their knowledge	and apply it to solve scientific problems by w	orking indepe	endently in a proje
Workload in Hours	Independent Study Time 96, Study Time in Lecture	34		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: E	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Structural Engineer	• • •		
	Civil Engineering: Specialisation Computational Engi	• • •		
	Computer Science: Specialisation II: Intelligence Eng			
	Mechatronics: Core Qualification: Elective Compulso Mechatronics: Technical Complementary Course: Ele	r y		

Course L2764: Scientific Wor	rking in Computational Engineering
Тур	Project-/problem-based Learning
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.
Literature	Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany.

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

Courses					
Title			Тур	Hrs/wk	СР
Applied Tunnel Constructions (L24	17)		Lecture	2	3
Introduction to tunnel construction	(L0707)		Lecture	1	2
Introduction to tunnel construction	(L1811)		Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules from Bachelor studies Civil and environmental engineering:				
Knowledge	Geotechnics I-II				
Educational Objectives	After taking part successfully,	tudents have reached the follo	owing learning results		
Professional Competence					
Knowledge	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction.				
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis.				
Personal Competence					
Social Competence	Capacity for teamwork concerning project management and design of tunnels.				
Autonomy	Promotion of independent and creative work flow in the framework of a design exercise.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 5 % Excerci	es			
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisatio	Structural Engineering: Elect	ve Compulsory		
Following Curricula	Civil Engineering: Specialisatio	n Geotechnical Engineering: Co	ompulsory		
	Civil Engineering: Specialisation	n Coastal Engineering: Compul	sory		
	Civil Engineering: Specialisation	Water and Traffic: Elective Co	ompulsory		
	Civil Engineering: Specialisatio	Computational Engineering:	Elective Compulsory		

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

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

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

Courses				
Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in structural mechanics (L3043) Modern discretization methods in structural mechanics (L3044)		Lecture Recitation Section (small)	2	3
Module Responsible	· · ·	Recitation Section (small)	2	5
Admission Requirements				
Recommended Previous Knowledge				
	Finite Element Methods			
	Flächentragwerke			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stu	idents can express the basic aspects of moder	n discretization r	nethods in structu
	mechanics.			
Skills	After successful completion of this module, the	students will be able to use and further impro	we modern discre	stization methods f
Skiis	problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interd 	isciplinary discussions,		
	 defend their own work results in front of 			
	promote the scientific development of colleagues			
	Furthermore, they can give and accept	professional constructive criticism		
Autonomy	Students are able to gain knowledge of the su	plact area from given and other sources and a	pply it to pow pr	blome Eurthormo
Autonomy	Students are able to gain knowledge of the subject area from given and other sources and apply it to new problems. Furthermor they are able to structure the solution process for problems in the area of modern discretization methods.			
	they are able to structure the solution process	To problems in the area of modern discretization	on methods.	
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 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 Computationa	l Engineering: Elective Compulsory		
	Computational Engineering: Core Qualification	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisa	tion Simulation Technology: Elective Compulso	ory	

Course L3043: Modern discretization methods in structural mechanics			
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	 The course covers variational formulations, various locking phenomena and alternative formulations for finite elements and modern discretization schemes in the context of structural mechanics, like isogeometric analysis. variational formulation of finite elements, mixed variational principles geometrical and material locking effects in structural and solid mechanics hybrid-mixed and enhanced assumed strain finite element formulations, reduced integration and stabilization, DSG method, u-p formulations patch test, stability, convergence linear and non-linear analyses introduction to isogeometric analysis isogeometric beam, plate and shell formulations locking effects and their avoidance in modern, smooth discretization schemes, like isogeometric analysis 		
Literature	 lecture notes and selected scientific papers O.C. Zienkiewicz, R.L. Taylor, and J.Z. Zhu: Finite Element Method: Its Basis and Fundamentals. Elsevier, 2013. J. Austin Cottrell, Thomas J. R Hughes, Yuri Bazilevs: Isogeometric Analysis: Toward Integration of CAD and FEA. Wiley, 2009. 		

Course L3044: Modern 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
Design of Composite Bridges (L309	2)	Integrated Lecture	2	3
Analysis of Offshore Structures (L1	867)	Lecture	1	1
Solid Matter Process Technology for Biomass (L0052)		Lecture	2	3
Innovative Timber Construction (L2	666)	Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Sustainable landfill design and ope	ration (L3270)	Integrated Lecture	3	3
Special Topics in Steel Design (L30	91)	Integrated Lecture	2	3
Special topics of civil engineering 1	.CP (L2378)		1	1
Special topics of civil engineering 2	2 LP (L2379)		2	2
Special topics of civil engineering 3	3 LP (L2380)		3	3
Structural Design (L2789)		Seminar	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge				
	 Students are able to find their way through 	selected special areas within civil and struc	tural engineering	J.
	 Students are able to explain basic models and the students are able to explain basic models are able to explain basic models. 	and procedures in selected special areas of	civil and structur	al engineering.
	Students are able to interrelate scientific a	nd technical knowledge.		
Skills				
SKIIIS	 Students are able to apply basic methods in 	n selected areas of civil and structural engir	eering.	
Personal Competence				
Social Competence				
Autonomy				
, ,	 Students can chose independently, in which 	ch fields they want to deepen their knowle	dge and skills th	rough the electior
	courses.			
Workload in Hours	Depends on choice of courses			
Credit points	'			
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechnical Engine	•		
i onowing curricula	Civil Engineering: Specialisation Coastal Engineer	•		
	Civil Engineering: Specialisation Water and Traffic			
	Civil Engineering: Specialisation Computational Er	Igineering' Elective Compulsory		

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

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

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

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

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

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

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

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

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

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	Fachtheoretisch-fachpraktische Arbeit
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe/SoSe
Content	The course occurs only if required. The content is defined at short notice.
Literature	Die Literatur wird kurzfristig festgelegt.

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

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Finite element modeling of structures (L3046)		Lecture	2	3
Finite element modeling of structu	res (L3047)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	Einite Element Methods			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, students	can express the basic aspects of modell	ing of structures	with finite elements
Skills	After successful completion of this module, the students will be able to model structures with finite elements and to analy structures using appropriate computational methods.			
Personal Competence				
Social Competence	Students can			
Autonomy	 participate in subject-specific and interdisciplin defend their own work results in front of other promote the scientific development of colleage Furthermore, they can give and accept profest Students are able to gain knowledge of the subject a	s Jes sional constructive criticism	pply it to new pro	oblems. Furthermo
	they are able to structure the solution process for pro	oblems in the area of finite element mod	elling of structure	es.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	written elaboration of a project work (10-15 pages)			
scale				
Assignment for the	Civil Engineering: Specialisation Computational Engir	eering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering			
	Computational Engineering: Core Qualification: Election			
	Theoretical Mechanical Engineering: Specialisation Si	mulation Technology: Elective Compulse	ory	

ourse L3046: Finite elemen	
	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bastian Oesterle
Language	EN
Cycle	WiSe
Content	Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of th
	phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-base
	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 M2076: Intro	duction to Climate Informed Engin	neering		
Courses				
Title		Тур	Hrs/wk	СР
Methods in Climate Informed Engir	eering (L3347)	Lecture	3	3
Topics in Climate Informed Engine	ering (L3348)	Lecture	3	3
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Students are expected to have a foundational	understanding of environmental scie	ence, basic engineerin	g principles, and a
Knowledge				h engineering desig
	processes. Analytical and critical thinking and cre	eative problem-solving skills are also b	eneficial	
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	This module explores next-generation climate models and high-resolution data, emphasizing their impact on environmental an engineering products and processes. It covers how various engineering disciplines can benefit from climate information. Research based learning activities, expert talks, and presentations will expose students to state-of-the-art modeling, measurement, an analysis in climate-informed engineering.			
Skills	Climate data analysis, engineering adaptation strategies, problem-solving, research-based learning, and interdisciplina collaboration.			
Personal Competence				
Social Competence	Collaboration, interdisciplinary teamwork, comm climate-resilient engineering.	nunication skills, problem-solving, eth	nical responsibility, and	d decision-making
Autonomy	Time management, self-directed learning, critical thinking, accountability, initiative, and the ability to conduct independe research and make informed decisions in climate-informed engineering.			
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineer	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	• • •		
_	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic			
	Civil Engineering: Specialisation Computational E	ngineering: Elective Compulsory		
	Data Science: Specialisation III. Applications: Elec	tive Compulsory		
	Environmental Engineering: Core Qualification: El	lective Compulsory		
	Process Engineering: Specialisation Process Engir	neering: Elective Compulsory		
	Water and Environmental Engineering: Specialisa	tion Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisa	tion Environment: Elective Compulsor	у	
	Water and Environmental Engineering: Specialisa	tion Water: Elective Compulsory		

Course L3347: Methods in Cl	imate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nima Shokri, Prof. Cathy Hohenegger, Prof. Irina Smirnova
Language	EN
Cycle	WiSe
	Students will learn techniques for incorporating climate data and environmental factors into engineering design. It covers climate modelling and the use of sensors and devices to measure climate-related parameters and engineering processes. Students will have the opportunity to conduct their own measurements, analyze the collected data, and write a report on their findings. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Course L3348: Topics in Clim	ate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova, Prof. Cathy Hohenegger, Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Exploring specific applications of climate data in various engineering disciplines. Invited speakers will present their research and discuss the relevance of climate-informed engineering to their work. Additionally, there will be a segment on effective communication, covering how to give impactful presentations and write research papers. Students will also give presentations on their own class projects related to climate-informed engineering, applying the concepts they've learned. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Courses					
Title	rc (1 2 4 5 9)		Typ	Hrs/wk	CP
Uncertainty Modelling for Engineer		analoviou	Integrated Lecture	6	6
Admission Requirements	Prof. Simon Michael P	apalexiou			
Recommended Previous					
Knowledge	 General familia Elementary pro Basic compute 	r skills for handling dat	, and mathematical skills.	ods.	
Educational Objectives	After taking part succ	essfully, students hav	e reached the following learning results		
Professional Competence					
	Students will develop a strong foundation in uncertainty, probability, and risk analysis in engineering applications. The course introduces probability as a measure of uncertainty, covering frequency-based methods. Students will explore Bayes' Theorem probability distributions, extreme value theory, joint probability distributions, and stochastic optimization to model and quantiti uncertainty in engineering problems. The course also covers linear and nonlinear regression methods, essential for data-drive decision-making and predictive modeling. Additionally, students will gain insight into risk assessment as a function of probabiliti and disutility and learn how to apply Bayesian Decision Theory to optimize engineering solutions under uncertainty. By the end of the course, students will be able to apply probabilistic models to quantify uncertainty and assess risks in engineering				
	problems. They will gain expertise in fitting probability distributions, performing extreme value analysis, and applying Bayesia inference to real-world engineering challenges. Students will also develop skills in linear and nonlinear regression modeline enabling them to analyze complex engineering datasets and improve risk predictions. Through hands-on computational exercise they will learn to implement stochastic methods and optimization techniques to support reliability-based design and engineering decision-making.				
Personal Competence					
Autonomy	Students will develop the ability to work collaboratively on engineering risk assessments, communicating technical resule effectively with peers, engineers, and decision-makers. They will engage in discussions on risk perception, safety factors, and uncertainty quantification, ensuring that engineering analyses are both rigorous and applicable to real-world infrastructur challenges. Students will learn to independently analyze and model engineering uncertainties, selecting and applying appropriate probabili distributions, regression methods, and stochastic techniques for various applications. They will also gain the ability to evaluar risks associated with natural and human-made hazards, ensuring they can make informed engineering decisions in design, safe assessment, and disaster mitigation.				
Workload in Hours	Independent Study Ti	ime 96. Study Time in	Lecture 84		
Credit points		ine so, study time in			
Course achievement		Form	Description		
	Yes 20 %	Presentation	10-minütige Präsentation von Arbei	itsergebnissen	
Examination	Written exam				
Examination duration and	150 min				
scale					
Assignment for the	5 5 1		gineering: Elective Compulsory		
E a ll a su da an Comulas da	5 5 1		al Engineering: Elective Compulsory		
Following Curricula	UVILEngineering, Spe		-naineering: Elective Compulsory		
Following Curricula			Engineering: Elective Compulsory onal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Spe		Engineering: Elective Compulsory onal Engineering: Elective Compulsory Traffic: Elective Compulsory		
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe	ecialisation Water and	onal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	ecialisation Water and ecialisation Coastal Eng	onal Engineering: Elective Compulsory Traffic: Elective Compulsory		
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory		
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic ecialisation Structural E ecialisation Computatio	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory cal Engineering: Elective Compulsory Engineering: Elective Compulsory onal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic ecialisation Structural E ecialisation Computatic ecialisation Water and	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory cal Engineering: Elective Compulsory Engineering: Elective Compulsory onal Engineering: Elective Compulsory Traffic: Elective Compulsory		
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic ecialisation Structural E ecialisation Structural E ecialisation Computatio ecialisation Water and eering: Core Qualificati	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory cal Engineering: Elective Compulsory Engineering: Elective Compulsory onal Engineering: Elective Compulsory Traffic: Elective Compulsory ion: Elective Compulsory		
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Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine Environmental Engine Water and Environme	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic ecialisation Structural E ecialisation Computatio ecialisation Water and eering: Core Qualificati eering: Core Qualificati ental Engineering: Spec	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory cal Engineering: Elective Compulsory Engineering: Elective Compulsory onal Engineering: Elective Compulsory Traffic: Elective Compulsory ion: Elective Compulsory ion: Elective Compulsory cialisation Cities: Elective Compulsory	v	
Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine Environmental Engine Water and Environme Water and Environme	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic ecialisation Structural E ecialisation Computatio ecialisation Water and eering: Core Qualificati eering: Core Qualificati ental Engineering: Spec ental Engineering: Spec	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory cal Engineering: Elective Compulsory Engineering: Elective Compulsory onal Engineering: Elective Compulsory Traffic: Elective Compulsory ion: Elective Compulsory ion: Elective Compulsory	'n	
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Following Curricula	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine Water and Environme Water and Environme Water and Environme Water and Environme	ecialisation Water and ecialisation Coastal Eng ecialisation Geotechnic ecialisation Structural E ecialisation Computatio ecialisation Water and eering: Core Qualificati eering: Core Qualificati ental Engineering: Spec ental Engineering: Spec ental Engineering: Spec ental Engineering: Spec ental Engineering: Spec ental Engineering: Spec	onal Engineering: Elective Compulsory Traffic: Elective Compulsory gineering: Elective Compulsory cal Engineering: Elective Compulsory Engineering: Elective Compulsory onal Engineering: Elective Compulsory Traffic: Elective Compulsory ion: Elective Compulsory ion: Elective Compulsory cialisation Cities: Elective Compulsory cialisation Environment: Elective Compulsory cialisation Water: Elective Compulsory		

Course L3458: Uncertainty M	lodelling for Engineers
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	SoSe
Content	Engineering decisions are rarely made with complete certainty—uncertainty affects material properties, environmental conditions, structural performance, and risk assessments. This course provides students with theoretical foundations and practical tools to quantify uncertainty, assess risks, and enhance decision-making in civil, structural, geotechnical, and environmental engineering applications. Students will begin with fundamental probability concepts, learning how Bayes' Theorem, probability distributions, and extreme value theory help evaluate engineering uncertainties. They will explore linear and nonlinear regression methods for analyzing complex datasets, as well as joint probability distributions and stochastic optimization to improve predictive modeling and reliability assessments. The course also introduces Bayesian Decision Theory, offering a structured approach to decision-making under uncertainty. With a focus on real-world engineering problems, students will apply probabilistic models, extreme value analysis, and stochastic techniques to assess risks in infrastructure design, system reliability, and disaster resilience. Hands-on computational exercises will reinforce key concepts, preparing students to work with data-driven models and uncertainty quantification techniques used in engineering practice. This course is ideal for students will have developed critical analytical and problem-solving skills, equipping them for careers in structural safety, geotechnical engineering, environmental risk management, and beyond.
Literature	

Specialization Water and Traffic

Madula MOOCA, Unda		Consta					
Module M0964: Unde	rground	Consti	ructions				
Courses							
Title					Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	07)				Lecture	2	3
Introduction to tunnel construction	(L0707)				Lecture	1	2
Introduction to tunnel construction	(L1811)				Recitation Section (large)	1	1
Module Responsible	Prof. Jürge	n Grabe					
Admission Requirements	None						
Recommended Previous	Modules fr	om Bachel	or studies Civil a	d environmental enginee	ring:		
Knowledge	• Geo	technics I-	11				
Educational Objectives	After takin	g part suc	cessfully, studen	s have reached the follow	ing learning results		
Professional Competence							
Knowledge	Knowledge	of differe	nt tunnel constru	tion types as well as spe	cial 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 management and design of tunnels.						
Autonomy	Promotion of independent and creative work flow in the framework of a design exercise.						
Workload in Hours	Independe	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	No	5 %	Excercises				
Examination	Written ex	am					
Examination duration and	120 minute	es					
scale							
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
Following Curricula	Civil Engin	eering: Sp	ecialisation Geot	chnical Engineering: Corr	pulsory		
	Civil Engin	eering: Sp	ecialisation Coas	al Engineering: Compulso	ry		
	Civil Engin	eering: Sp	ecialisation Wate	and Traffic: Elective Com	npulsory		
	Civil Engin	eering: Sp	ecialisation Com	utational Engineering: Ele	ective Compulsory		
	Internation	al Manage	ement and Engine	ering: Specialisation II. Ci	vil Engineering: Elective Com	pulsory	

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. Julian Bubel		
Language	DE		
Cycle	WiSe		
Content			
Literature	 Surveying for tunneling Safety requirements Construction Contract 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. Julian Bubel	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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			
Recommended Previous	Basic knowledge about building materials or	material science, for example by the mod	dule Building Ma	terials and Buildi
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for t methods for the testing of building material prop testing methods.	• • •		
Skills	The students are able to responsibly discover the rules for trading and using of building products in Germany. They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages are the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. Th are able to describe an examination in form of a test report or expert opinion.			
Personal Competence				
Social Competence	The students can describe the different roles of framework of material testing. They can describe		-	on bodies within t
Autonomy	The students are able to make the timing and the	e operation steps to learn the specialist know	ledge of a very e	xtensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory		
Following Curricula				
-	Civil Engineering: Specialisation Coastal Engineer			
	Civil Engineering: Specialisation Water and Traffi			
	International Management and Engineering: Spec	ialisation II. Civil Engineering: Elective Comp	oulsory	
	Materials Science and Engineering: Specialisation	Engineering Materials: Elective Compulsory		
	Materials Science: Specialisation Engineering Mat	erials: Elective Compulsory		

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

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

_				
Courses				
Title		Typ	Hrs/wk	СР
Integrated Transportation Planning		Project-/problem-based Learning	4	6
Module Responsible				
Admission Requirements	None			
Recommended Previous	some knowledge of transport planning, e.g. through taking the un	idergraduate class "Transport P	lanning and Ti	affic Engineerin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence	Chudanta ana akia ta			
Knowledge	Students are able to:			
	describe interdependencies between land-use/location choice	ice and transportation/mobility	behaviour	
	 explain and evaluate the social, ecological and economic effective explain and economic explain and economic effective explain and economic explain	ffects of transport and land-use	policy measu	res.
	 relate current issues in the area of integrated transport pla 	nning and formulate an opinion	on them.	
Skills	Students are able to:			
	 quantify important parameters, which influence travel dem 	and or are influenced by it.		
	comprehensively examine a pre-defined or self-selected to	pic from a transportation studi	es perspective	e and document t
	results in accordance with scientific conventions.			
Personal Competence				
Social Competence	Students are able to:			
	 provide feedback on topical contents and their teaching. 			
	 constructively handle feedback on their own work. 			
	 produce results in group work and document these. 			
Autonomy	Students are able to:			
	assess potential consequences of their future professional	activities		
	 independently plan working on a pre-defined project topic, 		de and use ar	propriate means
	its execution.	acquire the necessary knowled	ge and use ap	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	written assignment with presentation during the semester			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective C	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Electiv	ve Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Cor	npulsory		
	Civil Engineering: Specialisation Water and Traffic: Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure		ory	
	Water and Environmental Engineering: Specialisation Cities: Comp	oulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treat	nent (L0311)	Lecture	2	1
Chemistry of Drinking Water Treat		Recitation Section (large)	1	2
Water Resource Management (L04		Lecture	2	2
Water Resource Management (L04	03)	Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Knowledge of water management and 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				
Knowledge	Students will be able to outline key area	as of conflict in water management, as well as th	eir mutual depen	dence for sustaina
	water supply. They will understand relev	vant economic, environmental and social factors	. Students will be	able to explain a
		ater companies. They will be able to explain the a		•
	the scope of their application.	ater companies. They will be able to explain the a		finenc processes
	the scope of their application.			
Skills	Students will be able to assess comp	lex problems in drinking water production an	d establish solut	ions involving w
		ney will be able to assess the evaluation methods		
	5	ns for selected treatment processes and apply		
	standards to these processes.	is for selected treatment processes and apply	generally decepted	
	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 p	osition. for exami	ole representing u
	• •	nt 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 subject	t.	
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structure	I Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water an	d Traffic: Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
		chnical Complementary Course: Elective Compuls	ory	
		ng: Specialisation II. Energy and Environmental En	-	Compulsory
	• •	onmental Process Engineering: Elective Compulso		-5
			3	
	Process Engineering: Specialisation Proce			
	Water and Environmental Engineering: Sp			
		pecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Cities: Elective Compulsory		

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

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

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

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

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

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

itle nvironmental Analysis (L0354) nvironmental microbiology (L3223)		Тур		
nvironmental Analysis (L0354) nvironmental microbiology (L3223)			Hrs/wk	СР
		Lecture	2	3
Madula Deservatible)	Lecture	2	3
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic ch	nemistry and biology (knowledge acquired at scho	ool).	
Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning results		
Professional Competence				
	On completion of this module, students will be able to describe the mechanisms of biological systems. They will know the methological metabolic routes and can categorise their influence on global metabolic routes. They will be familiar with the base analytical methods for investigating and assessing the quality of various environmental compartments.			
	On completion of this module, students will be able to categorise which metabolism will predominate under which environmer conditions. Students will be able to apply the theoretical principles they have learnt to exemplary sites and assess the resulting relationsh from a technical and conceptual perspective. They will be able to draw comparisons on different investigation strategies a techniques. Model projects can be devised and treated.			
Personal Competence				
Social Competence	The students are able to organize wo	rking processes within a team in a targeted way a	and based on the divisor	n of labour.
Autonomy	Students can independently exploit so	ources, acquire the particular knowledge of the s	subject and apply it to ne	w problems.
Workload in Hours	Independent Study Time 124, Study T	Fime in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Wate	er and Traffic: Elective Compulsory		

Course L0354: Environmenta	l Analysis
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach, Dr. Henning Mangels
Language	EN
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
Literations	Quality assurance in environmental analysis Roger Reeve, Introduction to Environmental Analysis, John Wiley & Sons Ltd., 2002 (TUB: USD-728)
	Pradyot Patnaik, Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes, CRC Press, Boca Raton, 2010 (TUB: USD-716)
	Chunlong Zhang, Fundamentals of Environmental Sampling and Analysis, John Wiley & Sons Ltd., Hoboken, New Jersey, 200 (TUB: USD-741)
	Miroslav Radojević, Vladimir N. Bashkin, Practical Environmental Analysis RSC Publ., Cambridge, 2006 (TUB: USD-720)
	Werner Funk, Vera Dammann, Gerhild Donnevert, Sarah Iannelli (Translator), Eric Iannelli (Translator), Quality Assurance in Analytical Chemistry: Applications in Environmental, Food and Materials Analysis, Biotechnology, and Medical Engineering, 2nd Edition, WILEY-VCH Verlag GmbH & Co. KGaA,Weinheim, 2007 (TUB: CHF-350)
	STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 21st Edition, Andrew D. Eaton, Leonore S. Clesceri, Eugene W. Rice, and Arnold E. Greenberg, editors, 2005 (TUB:CHF-428)
	K. Robards, P. R. Haddad, P. E. Jackson, Principles and Practice of Modern Chromatographic Methods, Academic Press
	G. Schwedt, Chromatographische Trennmethoden, Thieme Verlag
	H. M. McNair, J. M. Miller, Basic Gas Chromatography, Wiley
	W. Gottwald, GC für Anwender, VCH
	B. A. Bidlingmeyer, Practical HPLC Methodology and Applications, Wiley
	K. K. Unger, Handbuch der HPLC, GIT Verlag
	G. Aced, H. J. Möckel, Liquidchromatographie, VCH
	Charles B. Boss and Kenneth J. Fredeen, Concepts, Instrumentation and Techniques in Inductively Coupled Plasma Optical Emissio
	Spectrometry Perkin-Elmer Corporation 1997, On-line available at: http://files.instrument.com.cn/bbs/upfile/2006291448.pdf
	Atomic absorption spectrometry: theory, design and applications, ed. by S. J. Haswell 1991 (TUB: 2727-5614)
	Royal Society of Chemistry, Atomic absorption spectometry (http://www.kau.edu.sa/Files/130002/Files/6785_AAs.pdf)

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

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

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

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

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

Course L0357: Advanced Wa	stewater Treatment
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	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			

Title		Тур	Hrs/wk	СР
Noise Protection (L1109)	I	Lecture	2	2
Urban Infrastructures (L0874)	F	Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	. Knowledge en likken slevning			
Knowledge	Knowledge on Urban planning Knowledge on measures for slimate protection			
	 Knowledge on measures for climate protection General knowledge of scientific writing/working 			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as cur	rrent and future urban environr	nental probler	ms. They are able
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovations and explain why these contribute to the improvement of urban			
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skills	Students are able to develop specific solutions for correcting existing or future environment-related problems of ur development. They can define a range of conceptual and technical solutions for environmental problems for different developm			problems of urb
en me				
	paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urb			
	context.			
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomy	Chudents are able to erganize their work flow to propage themsel	was far procentations and cont	ributions to th	a discussions. Th
Autonomy	Students are able to organize their work flow to prepare themsel can acquire appropriate knowledge by making enquiries independ			le discussions. In
	can acquire appropriate knowledge by making enquiries independ	lentry.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective C	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Electiv	e Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Con	npulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compu	-		
	Environmental Engineering: Core Qualification: Elective Compulso	-		
	Joint European Master in Environmental Studies - Cities and Sustai			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure		ory	
	Water and Environmental Engineering: Specialisation Environment Water and Environmental Engineering: Specialisation Cities: Comp			

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	rse 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	
Ecological Town Design - Water, Er	ergy, Soil and Food Nexus (L1229)	Seminar	2	2	
Water & Wastewater Systems in a	Global Context (L0939)	Lecture	2	4	
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge of the global situation with rising poverty, soil degradation, migration to cities, lack of water resources an sanitation				
Educational Objectives	After taking part successfully, students have re	ached the following learning results			
Professional Competence					
Knowledge	Students can describe the facets of the global water situation. Students can judge the enormous potential of the implementation synergistic systems in Water, Soil, Food and Energy supply.				
Skills	Students are able to design ecological settlements for different geographic and socio-economic conditions for the main climate around the world.				
Personal Competence					
Social Competence	The students are able to develop a specific topic in a team and to work out milestones according to a given plan.				
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on th subject.				
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56			
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	During the course of the semester, the studen	ts work towards mile stones. The work	includes presentations	and papers. Detai	
scale	information can be found at the beginning of th	e smester in the StudIP course module	handbook.		
Assignment for the	Civil Engineering: Specialisation Water and Tra-	ffic: Elective Compulsory			
Following Curricula	Bioprocess Engineering: Specialisation A - Gene	eral Bioprocess Engineering: Elective C	ompulsory		
	Chemical and Bioprocess Engineering: Specialisation General Process Engineering: Elective Compulsory				
	Environmental Engineering: Core Qualification: Elective Compulsory				
	Joint European Master in Environmental Studies	- Cities and Sustainability: Core Quali	fication: Compulsory		
	Process Engineering: Specialisation Environment	ntal Process Engineering: Elective Com	pulsory		
	Process Engineering: Specialisation Process Eng	gineering: Elective Compulsory			
	Water and Environmental Engineering: Speciali	sation Water: Elective Compulsory			
	Water and Environmental Engineering: Speciali	sation Environment: Elective Compulso	ory		
	Water and Environmental Engineering: Speciali	sation Cities: Elective Compulsory			

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

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

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

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	 "Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include: legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2021) Stadtplanung: Eine illustrierte Einführung. 4. überarbeitete Auflage. Primus Verlag. Darmstadt.
	Frick, Dieter (2011) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 3. veränderte Auflage. Wasmuth- Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen
	Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.
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Courses				
Title	Тур		Hrs/wk	СР
Construction Logistics (L1163)	Lect		1	2
Construction Logistics (L1164)		tation Section (small)	1	2
Project Development and Management (L1161) Project Development and Management (L1162)		ure ect-/problem-based Learning	1	1
Module Responsible		eet (problem bused Learning	1	1
Admission Requirements				
Recommended Previous	none			
Knowledge	hone			
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence	site taking part successivily, stadents have reached the following let			
	Students can			
Knowledge				
	• give definitions of the main terms of construction logistics and	project development and m	anagement	
	 name advantages and disadvantages of internal or external co 	nstruction logistics		
	explain characteristics of products, demand and production of	construction objects and the	eir consequer	nces for constructio
	specific supply chains			
	differentiate constructions logistics from other logistics systems			
Skills	Students can			
	 carry out project life cycle assessments 			
	 apply methods and instruments of construction logistics 			
	 apply methods and instruments of project development and methods 	anagement		
	 apply methods and instruments of conflict management 			
	 design supply and waste removal concepts for a construction p 	project		
Personal Competence				
Social Competence	Students can			
	hold presentations in and for groups			
	 apply methods of conflict solving skills in group work and case 	studies		
Autonomy	Students can			
	solve problems by holistic, systemic and flow oriented thinking			
	 improve their creativity, negotiation skills, conflict and crises studies 	s solution skills by applying	methous of	moderation in cas
	studies			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Com	pulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	ompulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu	lsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso	ry		
	International Management and Engineering: Specialisation II. Civil Eng	gineering: Elective Compulso	ory	
	International Management and Engineering: Specialisation II. Logistics	s: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	ogistics: Elective Compulsory	/	

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

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

Course L1161: Project Devel	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 Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises.
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.

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

Module M0593: Building Materials and Building Preservation

Courses						
Title				Тур	Hrs/wk	СР
Repair of Structures (L0255)				Lecture	1	1
Mineral Building Materials (L0253)				Lecture	2	2
Technology of mineral Building Mat				Project-/problem-based Learning	1	2
Transport Processes in Building Ma	erials and Damage Processes (L0	254)		Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
Recommended Previous	Basic knowledge about buildi	ng materials, bu	ilding physics an	d building chemistry, for exan	nple by the m	nodules Principles
Knowledge	Building Materials and Building	g Physics and Buil	lding Materials an	d Building Chemistry.		
Educational Objectives	After taking part successfully,	students have re	ached the followir	ng learning results		
Professional Competence						
Knowledge	The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They are able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlations of their material parameters. They are able to show the principles of anchor technology and design.					
Skills	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair and strengthening measures.					
Personal Competence						
Social Competence		iscussion they de		special mortar. They present ti their results. The students are		
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 Le	cture 70			
Credit points	6					
Course achievement		t theoretical al work	Description and			
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	Civil Engineering: Specialisatio		• • •	•		
Following Curricula	Civil Engineering: Specialisatio					
	Civil Engineering: Specialisatio	on Structural Engi	neering: Elective	Compulsory		
	Civil Engineering: Specialisatio	on Water and Traf	fic: Elective Comp	oulsory		

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in	steel structures (L0564)	Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis of	f statically determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics
	Differential equations I			
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module respective methods.	e, the student can explain the basic aspects of d	iynamic effects o	n structures and
Skills	After successful completion of this mode dynamics loading using the appropriate co	ule, the students will be able to predict the res mputational approaches and methods.	sponse of mater	ial and structures
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and in 			
	defend their own work results in from			
	promote the scientific development	•		
	 Furthermore, they can give and acce 	epi professional constructive criticism		
Autonomy	Students are able to gain knowledge of the	e subject area from given and other sources and a	pply it to new pr	oblems. Furthermo
	they are able to structure the solution proc	ess for problems in the area of Structural Analysis		
Workload in Hours	Independent Study Time 96, Study Time in	lecture 84		
Credit points				
Course achievement				
	Written exam			
Examination duration and				
scale				
	Civil Engineering: Specialisation Structural	Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural Civil Engineering: Specialisation Geotechni			
Following Curricula	Civil Engineering: Specialisation Geotechni Civil Engineering: Specialisation Coastal En			
	Civil Engineering: Specialisation Water and			
	Civil Engineering: Specialisation Computati		nulcon	
	International Management and Engineering	g: Specialisation II. Civil Engineering: Elective Com	pulsory	

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

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

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

Course L0565: Fracture mec	Course L0565: Fracture mechanics and fatigue in steel structures	
Тур	Recitation Section (large)	
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	See interlocking course	
Literature	See interlocking course	

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

Course L1180: Transportatio	n 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	 Principles of transport modelling Role of transport modelling in the planning process Fundamentals of mobility behaviour Design and evaluation of transport/mobility surveys mode of operation and data requirements for different stages of modelling Forecasting and scenarios in the transport planning The range of model applications (from transport infrastructure planning over simulation of traffic flows to integrated land-use and transport models as well as the use of models for evaluating locations) Practice-oriented project for assessing consequences of infrastructure projects and changes in land-use
Literature	Lohse, Dieter und Schnabel, Werner (2011): Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung – Band 2. 3. Auflage. Beuth. Ortúzar, Juan de Dios und Willumsen, Luis G. (2011): Modelling Transport. 4. Auflage. John Wiley & Sons.

Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modfl		Lecture	1	1
Groundwater Modeling using Modfl		Recitation Section (small)	2 2	2 3
Modeling of Water Supply Network		Project-/problem-based Learning	Z	3
Module Responsible				
Admission Requirements Recommended Previous				
Kecommended Previous Knowledge	Groundwater			
Knowledge	 groundwater hydraulics and transport 	of substances		
	Pipe Systems			
	 Knowledge on urban water infrastruction 	tures, in particular drinking water systemsand ι	ırban drainag	e systems includir
	special structures		5	
	Hydraulics of drinking water supply sys	stems and sewer systems		
	Basic knowledge on water managemer	nt		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelli	ng of groundwater flow and transport as well as urb	an water infra	astructures. They c
	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	y scientific groundwater models indipendently. The	y can work o	n different scenario
	and can compare or assess different solutions for existing problems by application of selected software products. The students ar			
	able to use different software solutions (e.g. EPANET, EPA-SWMM).			
Personal Competence				
	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in L	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
-	Civil Engineering: Specialisation Structural En			
Following Curricula	Civil Engineering: Specialisation Geotechnical			
	Civil Engineering: Specialisation Coastal Engin	5 1 5		
	Civil Engineering: Specialisation Water and Tr			
	Civil Engineering: Specialisation Computation	al Engineering: Elective Compulsory		
		alisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia Water and Environmental Engineering: Specia			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Modelling of Flow in Rivers and Est		Lecture	3	4
	ring / Integrated Flood Protection (L0961)	Project-/problem-based Learnin	g 2	2
Module Responsible				
Admission Requirements				
	Fundamentals of Hydromechanics, Hydraulics,	Hydrology and Hydraulic Engineering; Hyd	Iraulic Engineer	ing I and Hydrau
	Engineering II			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic	•		-
	Besides, they can describe the basic aspects of	numerical modelling and actual numerical m	odels for the sir	nulation of flows a
	waves. They can also depict the concepts of nature oriented hydraulic engineering.			
Skills	Students are able to apply hydrodynamic-numer	ical models to practical hydraulic engineering	tasks Furtherm	ore the students
SKIIS	Skills Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. Furthermore, t able to set up flood-risk management concepts and are able to apply basic concepts of renaturation to practical pro			
				ai problemoi
Personal Competence				
Social Competence	The students are able to deploy their gained kr	owledge in applied problems of the practical	nature-based h	ydraulic engineeri
	Additionaly, they will be able to work in team with	th engineers of other disciplines.		
Autonomy	The students will be able to independently exter	nd their knowledge and apply it to new probler	ns.	
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. T	he examination includes tasks with respect	to the general u	understanding of
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Water and Traff	ic: Compulsory		
Following Curricula	Environmental Engineering: Core Qualification: E	Elective Compulsory		
	Joint European Master in Environmental Studies	- Cities and Sustainability: Core Qualification:	Compulsory	
	Water and Environmental Engineering: Specialis	ation Water: Compulsory		
	Water and Environmental Engineering: Specialis	ation Environment: Compulsory		
	Water and Environmental Engineering: Specialis			

Course L0810: Modelling of I	Flow in Rivers and Estuaries
Тур	
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Edgar Nehlsen, Prof. Peter Fröhle
Language	EN
Cycle	SoSe
Content	Introduction to numerical flow modelling
	 Processes affecting tht flow Examples and applications of numerical models Procedure of numerical modelling Model concept Basic equations of hydrodynamics Saint-Venant equations Euler Equations Navier-Stokes equations
	Reynolds-averaged Navier-Stokes equations
	Shallow water equations
	Solving schemes
	Numerical discretization
	Solution algorithms Convergence
Literature	Vorlesungsskript
	Literaturempfehlungen
	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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Natasa Manojlovic, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Regime-Theory and application for the development of environmental guiding priciples of rivers Engineering - biological measures for the stabilization of rivers Risk management in flood protection Design techniques in technical flood protection Methods for the assessment of flood caused damages
Literature	Vorlesungsumdruck

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414)		Project-/problem-based Learning	1	2
Port Planning and Port Construction	n (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	ollowing learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply then design tasks. They can design the fundamental elements of 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 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	 Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors 	
Literature	Brinkmann, B.: Seehäfen, Springer 2005	
Literature	uninkinanii, b Seenaren, Springel 2005	

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

ent Study Time 32, Study Time in Lecture 28	
ndt	
nning and implementation of major projects rket analysis and traffic relations nning process and plan t planning in urban neighborhood velopment of the logistics center "Port of Hamburg" in the metropolis ays and waterfront structure ecial planning Law Harbor - securing of a flexible use of the port nensioning of quays od protection structures t of Hamburg - Infrastructure and development eparation of areas our formation in front of shore structures	
eparation our forma	of areas

Courses				
Title		Typ	Hrs/wk	СР
Smart Monitoring (L2762)		Typ Integrated Lecture	2	2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge or interest in object-oriented mo	deling, programming, and sensor technology	ogies are helpful	. Interest in mo
Knowledge	research and teaching areas, such as Internet of		•	
_	skills of scientific working, are required. Basic know	ledge in scientific writing and good English	skills.	
	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	The students will become femilies with the suite			
Knowledge	The students will become familiar with the princi			
	decentralized smart systems to be applied for environment. In addition, the students will learn to			
	analysis techniques, modern software design conce			
	also part of this module, which will be conducted			
	students will design smart monitoring systems that	•	-	• •
	Specific focus will be put on the application of ma			
	real-world (built or natural) systems, such as bridge	- ·		
	every group will be documented in a paper. All stud			
	system in the annual "Smart Monitoring" competition	on. The written papers and oral examinatio	ns form the final	grades. The mo
	will be taught in English. Limited enrollment.			
CL ///.				1
Skills	The students will gain insights into operating state			
	processes relevant to engineering, such as environmental, structural, or comfort monitoring. The students will be capable devising monitoring strategies of physical processes as part of group projects, tailored to their knowledge backgrounds, and			
	implement the strategies in smart wireless sensor nodes, using embedded computing and programming. Finally, the students w			
	be able to document the findings of their projects in		ogramming. mia	iny, the students
	be able to accument the infantigs of their projects in			
Personal Competence				
Social Competence	The students will be able to work in groups, share	parts of the work for their projects, and de	evelop communio	cation skills, tow
	achieving the common project goals.			
Autonomy	The students will be able to gain a solid basis on	approaching and solving problems in eng	ineering, as well	as on documen
, aconomy	results, through their involvement in their monitorin		incenng, as nen	
	Independent Study Time 124, Study Time in Lecture	e 56		
Credit points				
Course achievement				
	Written elaboration			
examination duration and scale	10 pages of work with 15-minute oral presentation			
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engir			
	Civil Engineering: Specialisation Coastal Engineerin			
	Civil Engineering: Specialisation Structural Engineer			
	Computer Science: Specialisation II: Intelligence En			
	Environmental Engineering: Specialisation Energy a			
	Environmental Engineering: Specialisation Environm			
	Environmental Engineering: Specialisation Water Q		pulsory	
	Mechatronics: Technical Complementary Course: El		-	
	Mechatronics: Core Qualification: Elective Compulso			
	Theoretical Mechanical Engineering: Specialisation		ompulsory	
	Water and Environmental Engineering: Specialisatio			
	Water and Environmental Engineering: Specialisation	n Environment, Elective Compulsory		
	water and Environmental Engineering. Specialisatio	on Environment: Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Water and Environment (L2754)		Project-/problem-based Learning	3	3
Water and Environment (L2753)		Lecture	3	3
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Basic knowledge in water and environmental research, Hydr	rology		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	Common research tools and techniques together with the fundamental knowledge relevant to multi-scale and multi-phat challenges present in water and environmental research will be discussed in this module. Both theory and application will considered.			
Skills	In addition to the fundamental knowledge, the students w and techniques relevant to water and environmental resea opportunity to improve their skills on multiple fronts which w	rch at different scales. This will prov		
Personal Competence				
Social Competence	Developing teamwork and problem solving skills through Re	search-Based Teaching approaches v	will be at the c	ore of this module
Autonomy	The students will be involved in writing individual report willingness to work independently and responsibly.	s and presentation. This will contri	bute to the s	tudents' ability a
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Electiv	ve Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		
	Environmental Engineering: Specialisation Environment and	Climate: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities:	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	mmonte Compulsor		

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

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

Courses						
ītle				Тур	Hrs/wk	СР
Waste management (L3261)				Project-/problem-based Learning	3	3
nternational waste concepts (L32)				Lecture	2	2
nternational waste concepts (L32)	1			Recitation Section (small)	1	1
Module Responsible						
Admission Requirements						
Recommended Previous		gineering				
Knowledge						
Educational Objectives	After taking part suce	cessfully, students ha	ave reached the followi	ng learning results		
Professional Competence						
Knowledge	The students are abl	le to describe waste	as a resource as well	as advanced technologies for re	ecycling and re	ecovery of resou
	from waste in detail.	This covers collection	n, transport, treatment	and disposal in national and inte	ernational con	texts.
Skille	Students are able to	select suitable proce	sses for the treatment	with respect to the national or c	ultural and de	velopmental cont
SKIIIS				of different technologies and material		
	They can evaluate th			of unreferit technologies and m	anagement sy	sterns.
Personal Competence						
Social Competence	Students can work together as a team of 2-5 persons, participate in subject-specific and interdisciplinary discussions, deve					
	cooperated solutions	and defend their ov	vn work results in fron	t of others and promote the sci	entific develop	oment of colleag
	Furthermore, they ca	an give and accept pr	ofessional constructive	e criticisms.		
A (
Autonomy		endently gain additio	nal knowledge of the	subject area and apply it in so	piving the give	en course tasks
	projects.					
Workload in Hours	Independent Study T	ïme 96, Study Time i	n Lecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 20 %	Written elaboration	n			
Examination	Presentation					
Examination duration and	PowerPoint presentat	tion (10-15 minutes)				
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Water an	d Traffic: Elective Com	pulsory		
Following Curricula	Chemical and Biopro	cess Engineering: Sp	ecialisation General Pro	ocess Engineering: Elective Com	pulsory	
	Chemical and Biopro	cess Engineering: Sp	ecialisation Bioprocess	Engineering: Elective Compulso	ry	
	Chemical and Biopro	cess Engineering: Sp	ecialisation Chemical P	Process Engineering: Elective Cor	mpulsory	
	Chemical and Biopro	cess Engineering: Sp	ecialisation Chemical a	nd Bio process Engineering: Elec	ctive Compulso	ory
	Chemical and Biopro	cess Engineering: Co	re Qualification: Electiv	ve Compulsory		
	Environmental Engin	eering: Specialisatior	n Energy and Resource	s: Elective Compulsory		
	International Manage	ement and Engineerir	ng: Specialisation II. Re	newable Energy: Elective Compu	ulsory	
	Process Engineering:	Specialisation Enviro	onmental Process Engir	neering: Elective Compulsory		
	Water and Environme	ental Engineering: Sp	ecialisation Cities: Elec	ctive Compulsory		
	Water and Environme	ental Engineering: Sp	a stationation. Environment			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Project-/problem-based Learning	1	2
nteraction Water - Environment in		Project-/problem-based Learning	1	2
Module Responsible				
Admission Requirements				
	Fundamentals of Hydromechanics and Hy	/draulic Engineering: Hydraulic Engineering I and Hydrau	ulic Engineerii	ng II
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students are able to define the basi	c concepts of hydrology and water management. They	are able to d	lescribe and quar
	the relevant processes of the hydrological water cycle. Besides, the students know the main aspects of rainfall-run-off-models and			
	are able to theoretically derive establishe	ed reservoir / storage models and a unit-hydrograph.		
Skille	The students are able to use the basic hydrological concepts and approaches and are able to theoretically derive established			
54113	reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the basis			
	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 problems.			
	ussess these measurements. Furthermore		iyarological pi	lobicitis.
Personal Competence				
Social Competence	The students are able to deploy their gain	ned knowledge in applied problems of the hydrology and	d water mana	gement. Additior
	they will be able to work in team with eng	gineers of other disciplines.		
Autonomy	The students will be able to independent	y extend their knowledge and apply it to new problems		
Workload in Hours	Independent Study Time 124, Study Time	a in Lecture 56		
Credit points				
Course achievement				
	Written exam			
Examination duration and	The duration of the examination is 90 min	n. The examination includes tasks with respect to the ge	eneral underst	tanding of the lec
	contents and calculations tasks.	, , ,		5
	Civil Engineering: Specialisation Computa	ational Engineering: Elective Compulsory		
	Following Curricula Civil Engineering: Specialisation Water and Traffic: Compulsory			
Assignment for the	Civil Engineering: Specialisation Water an	nd Traffic: Compulsory		
Assignment for the	Civil Engineering: Specialisation Water an Environmental Engineering: Core Qualific			
Assignment for the	Environmental Engineering: Core Qualific		mpulsory	
Assignment for the	Environmental Engineering: Core Qualific	ation: Elective Compulsory itudies - Cities and Sustainability: Core Qualification: Cor	mpulsory	
Assignment for the	Environmental Engineering: Core Qualific Joint European Master in Environmental S Water and Environmental Engineering: Sp	ation: Elective Compulsory itudies - Cities and Sustainability: Core Qualification: Cor	mpulsory	

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

Course L1412: Applied Surfa	urse L1412: Applied Surface Hydrology		
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	See interlocking course		
Literature	See interlocking course		

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

Courses					
litle .		Тур	Hrs/wk	СР	
Modeling Processes in Vadose Zone	e (L2735)	Recitation Section (small)		2	
Vadose Zone Hydrology (L2732)		Lecture	2	2	
Vadose Zone Hydrology (L2733)	1	Recitation Section (large)	2	2	
Module Responsible	Prof. Nima Shokri				
Admission Requirements	None				
Recommended Previous	Basic knowledge in water and soil				
Knowledge	Comfortable with math and physics, criti	cal thinking creative problem colving			
	Comfortable with math and physics, criti	cal thinking, creative problem solving			
	Analytic skills				
Educational Objectives	After taking part successfully, students h	nave reached the following learning results			
Professional Competence					
Knowledge	The students will learn about soil cha	aracterization (solid and liquid phase), the en	ergy state of soil w	water, the soil wa	
	characteristic curve, flow in saturated ar	nd unsaturated soil as well as about solute transp	oort in soil		
Skills	Students will work on practical exam	ples modelling transport processes in soil us	ing different quantit	ative tools includ	
	computer simulations and analytical tools. This will help them to apply knowledge in order to solve problems and tasks.				
Personal Competence					
•	The module sime at raising awareness	and enthusiasm for new knowledge related	to water coil and e	nvironment This	
Social competence	positively contribute to shape their work		to water, son and e	invironment. mis	
	positively contribute to shape their work	and me environment.			
Autonomy		ny problem solving exercises. This will cont	ribute toward their	willingness to w	
	independently and responsibly.				
	Independent Study Time 96, Study Time	in Lecture 84			
Credit points					
Course achievement					
Examination	Written elaboration				
Examination duration and	Report and Presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Comput	ational Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualifie	cation: Elective Compulsory			
	Water and Environmental Engineering: S	pecialisation Water: Elective Compulson			
	Water and Environmental Engineering. 5				

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Process Modelling of Wastewater T		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			
Recommended Previous	Knowledge of the most important processes in	drinking water and waste water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	Students are able to explain selected process	es of drinking water and waste water treatment i	n detail. The	y are able to expl
	basics as well as possibilities and limitations of	dynamic modeling.		
Skills	Students are able to use the most important t	eatures Modelica offers. They are able to transpo	ise selected r	processes in drinki
	s Students are able to use the most important features Modelica offers. They are able to transpose selected processes in drinkin water and waste water treatment into a mathematical model in Modelica with respect to equilibrium, kinetics and mass balance			
	They are able to set up and apply models and a			
	· · · · · · · · · · · · · · · · · · ·			
Personal Competence				
	Students are able to solve problems and docu	ment solutions in a group with members of differen	nt technical b	ackground They
		k constructively with feedback concerning their wo		actigiounar mey t
Autonomy	Students are able to define a problem, gain the	required knowledge and set up a model		
hatohomy	stadents are able to define a problem, gain the	required knowledge and set up a model.		
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points				
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
Following Curricula		al Complementary Course: Elective Compulsory		
	Chemical and Bioprocess Engineering: Technic	al Complementary Course: Elective Compulsory		
	Environmental Engineering: Specialisation Wat	er Quality and Water Engineering: Elective Compu	lsory	
	Process Engineering: Specialisation Environme	ntal Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process En	gineering: Elective Compulsory		
	Water and Environmental Engineering: Special	sation Water: Elective Compulsory		
	Water and Environmental Engineering: Special	sation Environment: Elective Compulsory		
	Water and Environmental Engineering: Special	sation Cities: Elective Compulsory		

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

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

Module M0713: Concr	oto Structurov	_				
Module M0715: Concr	ete Structures	\$				
Courses						
Title				Тур	Hrs/wk	СР
Concrete Structures (L0579)				Seminar	1	1
Structural Concrete Members (L057	7)			Lecture	2	3
Structural Concrete Members (L057	/8)			Recitation Section (large)	2	2
Module Responsible	Dr. Adrian Faron					
Admission Requirements	None					
Recommended Previous	Basics of structural a	analysis, conception ar	nd dimensioning of stru	uctural concrete		
Knowledge	Madulacy Dainfarcad	Concrete Structures I		LUL Machanica LUL		
	Modules: Reinforced	Concrete Structures I	+II, Structural Analysis	1+II, Mechanics I+II		
Educational Objectives	After taking part suc	cessfully, students hav	ve reached the followir	ng learning results		
Professional Competence				5 5		
•	The students broade	en their skills in structu	ural engineering, espec	cially in the field of buildings	(houses, roofs, h	alls). They dispose
	The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose a the knowledge for the conception and design of concrete buildings and structural members that are often used.					
	and knowledge for the conception and design of concrete bandings 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 engineering					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing an					
	execution. Moreover, they can make design and construction sketches and draw up technical descriptions.					
Personal Competence						
•	The students are ab	le to obtain results of h	high quality in teamwo	rk		
boerar competence	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 7	Time 110, Study Time i	in Lecture 70			
Credit points						
Course achievement		Form	Description			
course demotement	No None	Presentation	Es werden 2 F	Referate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Structural	Engineering: Compuls	ory		
-	• • •	pecialisation Geotechni	• • •	•		
2	• • •	pecialisation Coastal Er				
	• • •	pecialisation Water and				
	• • •	pecialisation Computation				
	• • •		• •		pulsory	
	International Manage	ement and Engineering	g: Specialisation II. Civ	il Engineering: Elective Com	pulsory	

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

Hrsiwk 2 CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer NN Language DE Cycle WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design of slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Vorlesungsunterlagen können im STUDIP heruntergeladen werden · Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Hef 600: Erläuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Hef 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vorstahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil 1, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992	Түр	Lecture
CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer NN Language DE Cycte WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Vorlesungsunterlagen können im STUDIP heruntergeladen werden • Zlich K., Zehetmaier G.: Bemessung Im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 1202 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil 1, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992		
Lecturer NN Language DE Cycle WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • truss models • reinforced and prestressed members Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen v. Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992		
Language DE Cycle WiSe Content	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Cycle WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Literature Vorlesungsunterlagen können im STUDIP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200. • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 200: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 200: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973	Lecturer	NN
Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Vorlesungsunterlagen können im STUDiP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200. • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973	Language	DE
 skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1973 	Cycle	WiSe
 Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2000 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 	Content	 actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models
 Schlaich J.; Schlarer K.: Konstruieren im Stanibetonbau. Betonkalender 1998, Ieli II, S. 721R, Verlag Ernst & Sonn, Berlin 1998 	Literature	 Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalende 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1973

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

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

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

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

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

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

Module M0802: Meml	orane Technology			
Courses				
Title		Тур	Hrs/wk	СР
Membrane Technology (L0399)		Lecture	2	3
Membrane Technology (L0400) Membrane Technology (L0401)		Recitation Section (small) Practical Course	1	2
Membrane recinitiogy (E0401)	Prof. Mathias Ernst	Flactical Course	I	1
Admission Requirements	None			
Recommended Previous	Basic knowledge of water chemistry. Knowledge o	f the core processes involved in water, gas	and steam treat	ment
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence		5 5		
	Students will be able to rank the technical applica	tions of industrially important membrane p	processes. They w	vill be able to expla
5	the different driving forces behind existing mem			
	membrane filtration and their advantages and di			
	membranes in water, other liquid media, gases an			
Skills	Students will be able to prepare mathematical ec			
	calculate key parameters in the membrane separ			
	available boundary data and provide recommend			•
	experiments, students will be able to classify the separation efficiency, filtration characteristics and application of or membrane materials. Students will be able to characterise the formation of the fouling layer in different waters and apply to			
	measures to control this.			
Personal Competence				
Social Competence	Students will be able to work in diverse teams on	tasks in the field of membrane technology	. They will be ab	le to make decisio
	within their group on laboratory experiments to be	e undertaken jointly and present these to ot	thers.	
Autonomy	y Students will be in a position to solve homework on the topic of membrane technology independently. They will be capable			ey will be capable
	finding creative solutions to technical questions.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Course achievement				
Examination				
Examination duration and	90 min			
scale				
•	Civil Engineering: Specialisation Water and Traffic:			
Following Curricula	Bioprocess Engineering: Specialisation A - General		-	
	Bioprocess Engineering: Specialisation B - Industria			
	Chemical and Bioprocess Engineering: Specialisati			
	Chemical and Bioprocess Engineering: Specialisati			
	Chemical and Bioprocess Engineering: Technical C		-	
	Chemical and Bioprocess Engineering: Technical C		-	
	Environmental Engineering: Specialisation Water C	. ,	npulsory	
	Process Engineering: Specialisation Process Engine	5 1 5		
	Process Engineering: Specialisation Environmental			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat	ion clues: Elective Compulsory		

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

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

Course L0401: Membrane Technology	
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 Adaptation to climate change in hy	draulic engineering (L2291) Typ Hrs/wk CP 6
Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous Knowledge	 Hydrology, Hydraulic Engineering Hydromechanic, Hydraulics Fundamentals of Coastal Engineering, Coastal- and Flood Protection Hydrological Systems
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge Skills	 Climate protection and climate adaptation Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle Fundamentals of analysis of climate data Consequences of the impact of the climate change Measures for climate adaptation Assessment, prioritization and communication of adaptation measures Fundamentals of the analysis of hydrometeorological and hydrological data Critical thinking: analysis of processes and relations, assessment of needs for action Creative thinking: development of adaptation strategies and adaptation measures Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, planni methods Consideration of complex tasks
Personal Competence Social Competence	 Working in heterogenous groups Working with different scientific / non-scientific disciplines Self reflection
Autonomy	 Application oriented use of knowledge and skills Autonomous work on complex tasks
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
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 Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory

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

Courses				
Title		Тур	Hrs/wk	СР
Environmental Research Trends (L	2752)	Seminar	2	2
Microplastics in Environment (L275	0)	Lecture	2	2
Scientific Communication and Meth	ods (L2751)	Lecture	1	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Basic knowledge on water, soil and env	vironmental research.		
Knowledge				
Educational Objectives	After taking part successfully, students	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 challen	iges with a particu
-	focus on the effects of microplastics i	n environment. Data analysis, data measurem	ent, curation and prese	entation will be ot
	skills that the students will develop in t	•		
Clille				
Skills	Students' research skills will be improved in this module. How to prepare and deliver an effective presentation, how to write			
	abstract, research paper and proposal	will be discussed in this module. Moreover, th	rough Research-Based L	earning approach
	the students will be exposed to current	t research trends in environmental engineering.		
Personal Competence				
Social Competence	Developing teamwork and problem sol	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
	willingness to work independently and			,
Workload in Hours	Independent Study Time 110, Study Time	me in Lecture 70		
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 Water	and Traffic: Elective Compulsory		
Following Curricula	Environmental Engineering: Specialisat	tion Environment and Climate: Elective Compuls	sory	
	Water and Environmental Engineering:	Specialisation Cities: Elective Compulsory		
	Water and Environmental Engineering:	Specialisation Environment: Elective Compulso	ry	

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

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

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

Courses				
Fitle Scientific Working in Computationa	Engineering (L2764)	Typ Project-/problem-based Learning	Hrs/wk 6	CP 6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in scientific writing. String interest	in topics related to computing in civil engined	ering.	
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
	The students will learn to apply concepts and methods of scientific working in computational engineering. In interaction with the course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientit 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.			
Skills	The students will be capable (i) of solving a scient effectively in the form of a paper, and (iii) of sharing		gy, (ii) of doc	umenting their wo
Personal Competence				
Social Competence	The students will be able to work in a multidisciplina	ry team and develop communication skills ne	ecessary for p	roblem solving.
Autonomy	The students will be able to extend their knowledge	and apply it to solve scientific problems by w	orking indepe	endently in a proje
Workload in Hours	Independent Study Time 96, Study Time in Lecture	34		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: E	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Structural Engineer	• • •		
	Civil Engineering: Specialisation Computational Engi	• • •		
	Computer Science: Specialisation II: Intelligence Eng			
	Mechatronics: Core Qualification: Elective Compulso Mechatronics: Technical Complementary Course: Ele	r y		

Course L2764: Scientific Wor	Course L2764: Scientific Working in Computational Engineering	
Тур	Project-/problem-based Learning	
Hrs/wk	6	
СР	6	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	
Lecturer	Prof. Kay Smarsly	
Language	EN	
Cycle	WiSe/SoSe	
	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.	
Literature	Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany.	

Title Design of Composite Bridges (L3092				
		Тур	Hrs/wk	СР
Analysis of Offshans Chryshynes (110	2)	Integrated Lecture	2	3
Analysis of Offshore Structures (L18	167)	Lecture	1	1
Solid Matter Process Technology for	Biomass (L0052)	Lecture	2	3
Innovative Timber Construction (L26	566)	Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Sustainable landfill design and oper		Integrated Lecture	3	3
Special Topics in Steel Design (L309		Integrated Lecture	2	3
Special topics of civil engineering 10			1	1
Special topics of civil engineering 2			2	2
Special topics of civil engineering 3 Structural Design (L2789)	LP (L2380)	Seminar	3 2	3 2
	Deef Frenk Cohesidt Dikl	Seminar	Z	Ζ
-	Prof. Frank Schmidt-Döhl			
Admission Requirements				
	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge				
	 Students are able to find their way through selected special areas within civil and structural engineering. Students are able to explain basic models and procedures in selected special areas of civil and structural engineer 		-	
	 Students are able to explain basic models and procedures in selected special areas of civil and structural eng Students are able to interrelate scientific and technical knowledge. 		ai engineering.	
	 Students are able to interrelate scientific and 	technical knowledge.		
Skills	. Students are able to apply basis methods in a	elected areas of sivil and structural engin	aaring	
	 Students are able to apply basic methods in s 	selected areas of civil and structural engin	leening.	
Personal Competence				
Social Competence				
Autonomy				
Autonomy	Students can chose independently, in which	fields they want to deepen their knowled	dge and skills th	rough the election
	courses.			
Workload in Hours	Depends on choice of courses			
Credit points	Depends on choice of courses			
		ing: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineer			
-	Civil Engineering: Specialisation Geotechnical Engin			
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic: E	lective Compulsory		

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

Module Manual M.Sc. "Civil Engineering"

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

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

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

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

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

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

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

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

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

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

Course L2789: Structural Design		
Тур	Seminar	
Hrs/wk	2	
СР		
Workload in Hours	dependent Study Time 32, Study Time in Lecture 28	
Examination Form	ündliche Prüfung	
Examination duration and	20 min	
scale		
Lecturer	Dr. Jan Mittelstädt	
Language	DE/EN	
Cycle	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	

Protection in a Changing Climate (SeaPiaC) (L2926) Prof. Peter Fröhle None • Hydraulic Engineering • Hydromechanics, Hydraulics • Fundamentals of Coastal Engineering, Coastal- ar After taking part successfully, students have reached th		Hrs/wk 4	СР б
None Hydraulic Engineering Hydromechanics, Hydraulics Fundamentals of Coastal Engineering, Coastal- ar 			
 Hydraulic Engineering Hydromechanics, Hydraulics Fundamentals of Coastal Engineering, Coastal- ar 			
 Hydromechanics, Hydraulics Fundamentals of Coastal Engineering, Coastal- ar 			
After taking part successfully, students have reached th			
	e following learning results		
 Climate and Climate Change General Impacts of Climate Change on Wind Regi Consequences of Climate Change for Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-based Solutions (NBS) for Coastal Protecti 	tesses		
 Critical thinking: analysis of processes and relations, assessment of needs for action Creative thinking: development of adaptation strategies and adaptation measures Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, plannin methods Consideration of complex tasks 			
 Working in heterogenous groups Working in international groups Working with different scientific / non-scientific di Self reflection 	sciplines		
Application oriented use of knowledge and skillsAutonomous work on complex tasks			
Independent Study Time 124, Study Time in Lecture 56			
6			
None			
Written elaboration			
Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	on the complex ta
happens in the course of the lecture.			
Civil Engineering: Specialisation Geotechnical Engineerin Civil Engineering: Specialisation Structural Engineering: Civil Engineering: Specialisation Water and Traffic: Elect Environmental Engineering: Specialisation Environment	ng: Elective Compulsory Elective Compulsory ive Compulsory and Climate: Elective Compulsory		
	 Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-based Solutions (NBS) for Coastal Protection Critical thinking: analysis of processes and relations transformed the transformed technologies of the consideration of complex tasks Working in heterogenous groups Working in international groups Working with different scientific / non-scientific di Self reflection Application oriented use of knowledge and skills Autonomous work on complex tasks Independent Study Time 124, Study Time in Lecture 56 None Written elaboration Preparation of a written report on a complex task with happens in the course of the lecture. Civil Engineering: Specialisation Coastal Engineering: Electivil Engineering: Specialisation Structural Engineering: Civil Engineering: Specialisation Water and Traffic: Election	 Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-based Solutions (NBS) for Coastal Protection Critical thinking: analysis of processes and relations, assessment of needs for action Creative thinking: development of adaptation strategies and adaptation measures Practical thinking: inclusion of restrictions, application of calculation approaches, metheds Consideration of complex tasks Working in heterogenous groups Working with different scientific / non-scientific disciplines Self reflection Application oriented use of knowledge and skills Autonomous work on complex tasks Independent Study Time 124, Study Time in Lecture 56 6 None Written elaboration Preparation of a written report on a complex task with a presentation and subsequent discussi	Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-based Solutions (NBS) for Coastal Protection Critical thinking: analysis of processes and relations, assessment of needs for action Creative thinking: development of adaptation strategies and adaptation measures Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerice methods Consideration of complex tasks Working in heterogenous groups Working in international groups Working with different scientific / non-scientific disciplines Self reflection Application oriented use of knowledge and skills Autonomous work on complex tasks Independent Study Time 124, Study Time in Lecture 56 Mone Written elaboration Preparation of a written report on a complex task with a presentation and subsequent discussion. The work of happens in the course of the lecture. Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Mater and Traffic: Elective Compulsory Civil Engineering: Specialisation Environment and Climate: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory

Course L2926: Sustainable N	ature-based Coastal Protection in a Changing Climate (SeaPiaC)	
Тур	Project-/problem-based Learning	
Hrs/wk	ł	
СР	5	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Peter Fröhle	
Language	EN	
Cycle	WiSe	
Content	 Climate and Climate Change General Impacts of Climate Change on Wind Regime and Water Cycle Consequences of Climate Change for Coastal Processes Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-Based Solutions (NBS) for Coastal Protection 	
Literature	 Materials provided on eLearning Platform (HOOU Platform) Depending on the main topics of the course in the respective year, the literature (recent papers) will be provided in the course-material or via StudIP. 	

	ng and Excavation Law			
Courses				
Title		Тур	Hrs/wk	СР
Construction law BGB and VOB - la	v in (excavation) practice (L3182)	Lecture	2	3
Construction disputes from constru	ction (excavation) practice (L3181)	Lecture	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students will gain knowledge of			
	 the history of civil engineering law, 			
	 basics of foundation and civil engineering 	ıg law,		
	 legal aspects of technical regulations in 	civil engineering (with case studies),		
	 the civil engineering contract, 			
	 the liability of the designer and contract 	or in civil engineering,		
	 the subsoil risk and the system risk, 			
	 the total debt in (civil) engineering law, 			
	 the (construction) conflict, dispute avoid 	lance models and the construction proce	ess,	
	 the systematics of construction contract 	law,		
	 the BGB construction contract law, 			
	 responsibilities on the construction site, 			
	 remuneration and contract managemen 	t,		
	 liability for defects, 			
	 public procurement law 			
	 Disturbed construction processes: How r 	much money am I entitled to?		
	Correct calculation of supplements.			
Skills	Students learn to apply legal aspects in planni	ing and construction in a legally balance	ed way. Students learn l	how to use legal a
	construction management aspects in practice			
	to manage the construction project optimally.			
Personal Competence				
Social Competence	Students can work in groups and support each	other in finding solutions.		
Autonomy	Students are able to assess their own strength	s and weaknesses and organize their tin	ne and learning manage	ement based on th
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points				
Course achievement				
Examination	Oral exam			
Examination duration and				
scale				
	Civil Engineering: Specialisation Coastal Engine	pering: Elective Compulsony		
Following Curricula	Civil Engineering: Specialisation Coastal Engine	• • •		
ronowing curricula	Civil Engineering: Specialisation Sectechnical Civil Engineering: Specialisation Structural Eng	• • • • •		
	Civil Engineering: Specialisation Structural Eng Civil Engineering: Specialisation Water and Tra			
	civit Engineering. Specialisation water allu Ha	inc. Elective compulsory		

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

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

	gical Waste Treatment			
Courses				
Гitle		Тур	Hrs/wk	СР
Waste and Environmental Chemistry (L0328)		Practical Course	2	2
Biological Waste Treatment (L0318		Project-/problem-based Learni	ng 3	4
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	chemical and biological basics			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	The module aims possess knowledge concernin design and layout of anaerobic and aerobic wa plants for biological waste treatment plants and	ste treatment plants in detail, describe differe	nt techniques for	
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and qua control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der mod and plan additional tests. They are capable of reflecting and evaluating findings in the group.			
D				
Personal Competence				
Social Competence	Students can participate in subject-specific an work results in front of others and promote t accept professional constructive criticism.			
Autonomy	Students can independently tap knowledge from are capable, in consultation with supervisors as steps on this basis. Furthermore, they can def potential social, economic and cultural impact.	s well as in the interim presentation, to assess fine targets for new application-or research-o	their learning lev	vel and define furt
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points				
Course achievement		Description and		
Examination	Presentation			
Examination duration and scale	Elaboration and Presentation (15-25 minutes in	i groups)		
Assignment for the	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engi	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra-	ffic: Elective Compulsory		
	Bioprocess Engineering: Specialisation A - Gene	eral Bioprocess Engineering: Elective Compuls	ory	
	Chemical and Bioprocess Engineering: Specialis	sation General Process Engineering: Elective C	Compulsory	
	Chemical and Bioprocess Engineering: Specialis	sation Chemical Process Engineering: Elective	Compulsory	
		sation Chemical and Bioprocess Engineering: F	Elective Compulso	
	Chemical and Bioprocess Engineering: Specialis			ory
	Chemical and Bioprocess Engineering: Specialis Chemical and Bioprocess Engineering: Specialis		ulsory	ory
		sation Bioprocess Engineering: Elective Compu	-	
	Chemical and Bioprocess Engineering: Specialis Chemical and Bioprocess Engineering: Specialis Environmental Engineering: Core Qualification:	sation Bioprocess Engineering: Elective Compu- sation Chemical and Bioprocess Engineering: E Compulsory	Elective Compulso	
	Chemical and Bioprocess Engineering: Specialis Chemical and Bioprocess Engineering: Specialis Environmental Engineering: Core Qualification: International Management and Engineering: Sp	sation Bioprocess Engineering: Elective Compu- sation Chemical and Bioprocess Engineering: E Compulsory pecialisation II. Renewable Energy: Elective Com	Elective Compulso	
	Chemical and Bioprocess Engineering: Specialis Chemical and Bioprocess Engineering: Specialis Environmental Engineering: Core Qualification: International Management and Engineering: Sp Process Engineering: Specialisation Environment	sation Bioprocess Engineering: Elective Compu- sation Chemical and Bioprocess Engineering: E Compulsory pecialisation II. Renewable Energy: Elective Com ntal Process Engineering: Elective Compulsory	Elective Compulso	
	Chemical and Bioprocess Engineering: Specialis Chemical and Bioprocess Engineering: Specialis Environmental Engineering: Core Qualification: International Management and Engineering: Sp	sation Bioprocess Engineering: Elective Compu- sation Chemical and Bioprocess Engineering: E Compulsory becialisation II. Renewable Energy: Elective Con- ntal Process Engineering: Elective Compulsory isation Cities: Elective Compulsory	Elective Compulso	

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Planning of waste treatment plants (L3267)		Project-/problem-based Learni		3	
Recycling technologies and thermal waste treatment (L3265)		Lecture	2	2	
Recycling technologies and therma	l waste treatment (L3266)	Recitation Section (small)	1	1	
Module Responsible	Prof. Kerstin Kuchta				
Admission Requirements	None				
Recommended Previous					
Knowledge	Basics of thermo dynamics				
	Basics of fluid dynamics				
	 fluid dynamics chemistry 				
Educational Objectives	After taking part successfully, students have reached	d the following learning results			
Professional Competence					
Knowledge	The students can name, describe current issue and	problems in the field of waste treatmen	t (mechanical, c	hemical and thern	
	and contemplate them in the context of their field.				
	The industrial application of unit enerations as part of	f process anging singly available by as		wasta tashnalasi	
	The industrial application of unit operations as part of Compostion, particle sizes, transportation and dosing			waste technologi	
	composition, particle sizes, transportation and dosing	g of wastes are described as important a	in operations .		
	Students will be able to design and design waste tre	eatment technology equipment.			
Skills	The students are able to select suitable processes for	or the treatment of wastes or raw materi	al with respect to	n their characteris	
Skins	and the process aims. They can evaluate the efforts				
	and the process ands. They can evaluate the enores		incurry reasisie	ciculinent concep	
Personal Competence					
Social Competence	Students can				
	respectfully work together as a team and discuss technical tasks				
	 participate in subject-specific and interdisciplinary discussions, 				
	develop cooperated solutions				
	 promote the scientific development and accept professional constructive criticism. 				
Autonomy	Y Students can independently tap knowledge of the subject area and transform it to new questions. They are capable,				
	consultation with supervisors, to assess their learning level and define further steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact.				
	targets for new application-or research-oriented duti	es in accordance with the potential socia	, economic and	cultural impact.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Specialisation Water and Traffic: E	lective Compulsory			
Following Curricula	Bioprocess Engineering: Specialisation A - General B	ioprocess Engineering: Elective Compuls	ry		
	Chemical and Bioprocess Engineering: Specialisation	General Process Engineering: Elective C	ompulsory		
	Chemical and Bioprocess Engineering: Specialisation Bioprocess Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Specialisation Chemical and Bioprocess Engineering: Elective Compulsory Environmental Engineering: Specialisation Energy and Resources: Elective Compulsory				
	5 5 7 57		anulsony		
	International Management and Engineering: Speciali Renewable Energies: Specialisation Bioenergy Syste		ipulsol y		
	Process Engineering: Specialisation Bioenergy Syste	, ,			
	Process Engineering: Specialisation Chemical Process Process Engineering: Specialisation Process Enginee	• • • • •			
	Process Engineering: Specialisation Environmental P	• • • •			
	Water and Environmental Engineering: Specialisation	• • • • •			
	Water and Environmental Engineering: Specialisation				

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

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

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

itle Iodeling of Subsurface Processes (I ubsurface Solute Transport (L2728 ubsurface Solute Transport (L2729	L2731)	Turn			
ubsurface Solute Transport (L2728	L2731)	Тур	Hrs/wk	СР	
		Recitation Section (small)	3	3	
ubsurface Solute Transport (L2729	3)	Lecture	2	2	
	9)	Recitation Section (large)	1	1	
Module Responsible	Dr. Milad Aminzadeh				
Admission Requirements	None				
Recommended Previous	Basic Mathematics, Hydrology				
Knowledge					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
Professional Competence					
Knowledge	Upon completion of this module, the st	udents will understand the mechanisms contro	lling solute transpor	rt in soil and natu	
	porous media and will be able to work wit	h the equations that govern the fate and transp	ort of solutes in porc	ous media. Analyti	
	numerical and experimental tools and tec	hniques will be used in this module.			
Skills		udents will be exposed to analytical, experimen			
	this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in the				
	future career.				
Personal Competence					
	Teamwork & problem solving				
Autonomy	The students will be involved in writing	individual reports and presentation. This wil	contribute to the	students' ability a	
	willingness to work independently and responsibly.				
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Report				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechr	ical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory				
	Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory				
	Environmental Engineering: Core Qualification: Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory			
	Water and Environmental Engineering: Sp	ecialisation Water: Compulsory			

Course L2731: Modeling of S	Course L2731: Modeling of Subsurface Processes			
Тур	Recitation Section (small)			
Hrs/wk	3			
СР	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Mohammad Aziz Zarif			
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	Dr. Milad Aminzadeh
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	Dr. Milad Aminzadeh		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M2076: Intro	duction to Climate Informed Engine	eering		
Courses				
Title		Тур	Hrs/wk	СР
Methods in Climate Informed Engineering (L3347)		Lecture	3	3
Topics in Climate Informed Enginee	ering (L3348)	Lecture	3	3
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Students are expected to have a foundational u	understanding of environmental scie	ence, basic engineering	g principles, and a
Knowledge				h engineering desig
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	This module explores next-generation climate models and high-resolution data, emphasizing their impact on environmental and engineering products and processes. It covers how various engineering disciplines can benefit from climate information. Research based learning activities, expert talks, and presentations will expose students to state-of-the-art modeling, measurement, and analysis in climate-informed engineering.			
Skills	Climate data analysis, engineering adaptation strategies, problem-solving, research-based learning, and interdisciplina collaboration.			
Personal Competence				
Social Competence	Collaboration, interdisciplinary teamwork, communication skills, problem-solving, ethical responsibility, and decision-making climate-resilient engineering.			
Autonomy	Time management, self-directed learning, critical thinking, accountability, initiative, and the ability to conduct independer research and make informed decisions in climate-informed engineering.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi			
	Civil Engineering: Specialisation Structural Engineer	5 1 5		
	Civil Engineering: Specialisation Water and Traffic:			
	Civil Engineering: Specialisation Computational En	gineering: Elective Compulsory		
	Data Science: Specialisation III. Applications: Elect	ive Compulsory		
	Environmental Engineering: Core Qualification: Ele	ective Compulsory		
	Process Engineering: Specialisation Process Engine	eering: Elective Compulsory		
	Water and Environmental Engineering: Specialisat	ion Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisat	ion Environment: Elective Compulsor	y	
	Water and Environmental Engineering: Specialisat	ion Water: Elective Compulsory		

Course L3347: Methods in Cl	imate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nima Shokri, Prof. Cathy Hohenegger, Prof. Irina Smirnova
Language	EN
Cycle	WiSe
Content	Students will learn techniques for incorporating climate data and environmental factors into engineering design. It covers climate modelling and the use of sensors and devices to measure climate-related parameters and engineering processes. Students will have the opportunity to conduct their own measurements, analyze the collected data, and write a report on their findings. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Course L3348: Topics in Clim	ate Informed Engineering
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Irina Smirnova, Prof. Cathy Hohenegger, Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	Exploring specific applications of climate data in various engineering disciplines. Invited speakers will present their research and discuss the relevance of climate-informed engineering to their work. Additionally, there will be a segment on effective communication, covering how to give impactful presentations and write research papers. Students will also give presentations on their own class projects related to climate-informed engineering, applying the concepts they've learned. This hands-on experience will be assessed and contribute to their final grade.
Literature	

Courses								
Title			Ту	/p	Hrs/wk	СР		
Seminar Advanced Foundation Engineering (L3310)			Se	eminar	2	2		
Advanced Foundation Engineering				cture	2	2		
Advanced Foundation Engineering	(L0498)		Re	ecitation Section (large)	2	2		
Module Responsible								
Admission Requirements	None							
Recommended Previous Knowledge	Soil Mechanics and F	oundation Engineering, M	lathematics I-III					
Educational Objectives	After taking part suc	cessfully, students have r	eached the following	learning results				
Professional Competence	Alter taking part such	cessiany, students have i	cachea the following i					
•	After successfully co	mpleting the module, stu	dents will be able to					
Knowiedge	Alter successfully con	inpleting the module, sta						
	 describe indiv 	idual procedures for the g	geotechnical monitorir	ng of civil engineering mea	asures,			
	 reproduce exp 	oloration and investigation	n methods of the subs	oil,				
	 select suitable 	e types of field and labora	tory tests for subsoil i	nvestigation and evaluate	their results,			
Skills	Students will be able	to						
	dimension vertical drains for soil improvement of soft soils,							
	 calculate depth compaction using various appropriate methods, 							
		apply principles of horizontal bearing capacity of piles,						
	-	 verify the internal and external stability of fluid-supported diaphragm walls, 						
		boundary conditions for	the design of a de	ep excavation and desig	in the individual	components of t		
	excavation,							
	 perform, evalu 	late and interpret tests fo	or the description and	classification of soils acco	rding to applicab	e standards,		
Personal Competence								
Social Competence	Students can work in	groups and support each	n other in finding solut	ions.				
Autonomy		-	hs and weaknesses an	id, based on this, organize	their time and le	arning manageme		
	and think in terms of	processes.						
Workload in Hours	Independent Study T	ime 96, Study Time in Le	cture 84					
Credit points	6							
Course achievement	Compulsory Bonus	Form	Description					
	Yes None	Written elaboration	ca 20 Seiten zu '	Vortrag oder eigenem The	ema			
Examination	Written exam							
Examination duration and	90 min							
scale								
Assignment for the	Civil Engineering: Sp	ecialisation Coastal Engin	eering: Compulsory					
Following Curricula	Civil Engineering: Sp	ecialisation Geotechnical	Engineering: Compuls	sory				
	Civil Engineering: Specialisation Structural Engineering: Compulsory							
	Civil Engineering: Sp	ecialisation Computationa	al Engineering: Compu	ilsory				
	Civil Engineering: Sp	ecialisation Water and Tra	affic: Elective Compuls	sorv				

Course L3310: Seminar Adva	nced Foundation Engineering				
	Seminar				
Hrs/wk					
CP	2				
Workload in Hours	ependent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Jürgen Grabe				
Language	DE				
Cycle	WiSe				
Content	Pre-examination requirement				
	 Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation 				
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag 				

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

Course L0498: Advanced Fou	ourse L0498: Advanced Foundation Engineering				
Тур	Recitation Section (large)				
Hrs/wk	2				
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Jürgen Grabe				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M2156: Wate							
Courses							
Title Water Protection (L3459)			Typ Integrated Lecture	Hrs/wk	CP 6		
Module Responsible	Prof. Simon Michae	Papalexiou	5				
Admission Requirements							
Recommended Previous							
Knowledge		lge in water management	 ,				
		lge in urban drainage;					
		lge of wastewater treatme					
	 Good knowle 	ige of pollutarits (e.g. COI	D, BOD, TS, N, P) and their properties;				
Educational Objectives	After taking part su	cessfully, students have r	eached the following learning results				
Professional Competence							
Knowledge	The students can d	scribe the basic principle	s of the regulatory framework related to the	international and Eu	ropean water secto		
	They can explain I	mnological processes, su	bstance cycles and water morphology in	detail. They are abl	e to assess comple		
			as ecosystem service and wastewater treat	tment with a specia	l focus on innovati		
	solutions, remediat	on measures as well as co	nceptual approaches.				
Skills	Students can accur	tely assess current probl	ems and situations in a country-specific or	local context. They	can suggest concre		
			norrow's urban water cycle. Furthermore,				
	administrative and	egislative solutions to solv	ve these problems.				
Personal Competence							
	The students can w	rk togothor in internation	al groups				
Social Competence	The students can w	rk together in internation	al groups.				
Autonomy			to prepare presentations and discussions.	They can acquire ap	opropriate knowledg		
	by making enquirie	independently.					
Workload in Hours	Independent Study	ime 96, Study Time in Le	cture 84				
Credit points	, ,						
Course achievement	Compulsory Bonus	Form	Description				
	Yes 20 %	Presentation	10-minütige Präsentation von Arbeitse	ergebnissen			
Examination	Written exam						
Examination duration and	150 minutes						
scale							
Assignment for the	Civil Engineering: S	ecialisation Coastal Engir	eering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
			affic: Elective Compulsory				
	-		ter Quality and Water Engineering: Elective				
		• •	pecialisation II. Civil Engineering: Elective C	ompulsory			
			lisation Cities: Elective Compulsory				
			lisation Environment: Compulsory				
	water and Environr	ental Engineering: Specia	lisation Water: Elective Compulsory				

Course L3459: Water Protect	Course L3459: Water Protection				
Тур	Integrated Lecture				
Hrs/wk	6				
СР	6				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Lecturer	. Simon Michael Papalexiou				
Language	EN				
Cycle	WiSe				
Content					
Literature					

Courses							
Title	- (1 2 4 5 9)			Typ	Hrs/wk	C 6	CP
Uncertainty Modelling for Engineer	Prof. Simon Michael Pa			Integrated Lecture	0	0)
Admission Requirements		apalexiou					
Recommended Previous	None						
Knowledge	2. Elementary pro	rity with engineering bability and statistic skills for handling c	cs, and mathematic	al skills.			
	4. Interest in solvi	ng engineering prot	olems using statisti	cal and probabilistic meth	iods.		
Educational Objectives	After taking part succe	essfully, students ha	ave reached the fol	lowing learning results			
Professional Competence							
Knowledge				probability, and risk anal			
				ng frequency-based meth			
				pility distributions, and st			
				rs linear and nonlinear re ents will gain insight into			
				ry to optimize engineerin			
Skills	-			abilistic models to quantil			
			• • •	ributions, performing ext	-		
				will also develop skills ir			
	-		Ū.	d improve risk predictions	-		
		ement stochastic m	nethods and optim	ization techniques to sup	port reliability-based	design a	ind enginee
	decision-making.						
Personal Competence							
Social Competence	Students will develop	the ability to wo	ork collaboratively	on engineering risk ass	essments, communic	ating te	echnical res
				5 5		-	
	effectively with peers	, engineers, and de		ey will engage in discuss			
	uncertainty quantifica		ecision-makers. Th		sions on risk percept	on, safe	ety factors,
			ecision-makers. Th	ey will engage in discuss	sions on risk percept	on, safe	ty factors,
Autonomy	uncertainty quantifica challenges.	ation, ensuring tha	ecision-makers. Th t engineering ana	ey will engage in discuss lyses are both rigorous	sions on risk percept and applicable to m	on, safe eal-world	ety factors,
Autonomy	uncertainty quantifica challenges. Students will learn to	ation, ensuring that independently anal	ecision-makers. Th t engineering ana yze and model en	ey will engage in discuss	sions on risk percept and applicable to n electing and applying	on, safe eal-world appropr	ety factors, d infrastruct riate probab
Autonomy	uncertainty quantifica challenges. Students will learn to distributions, regressio	independently anal	ecision-makers. Th t engineering ana yze and model en tochastic technique	ey will engage in discuss lyses are both rigorous gineering uncertainties, s	sions on risk percept and applicable to n electing and applying s. They will also gain	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
Autonomy	uncertainty quantifica challenges. Students will learn to distributions, regressio	independently anal on methods, and sinatural and human-	ecision-makers. Th t engineering ana yze and model en tochastic technique	ey will engage in discuss lyses are both rigorous gineering uncertainties, s es for various application	sions on risk percept and applicable to n electing and applying s. They will also gain	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
	uncertainty quantifica challenges. Students will learn to distributions, regressi risks associated with r assessment, and disas	ation, ensuring that independently anal on methods, and st natural and human- ster mitigation.	ecision-makers. Th t engineering ana yze and model en tochastic technique made hazards, ens	ey will engage in discuss lyses are both rigorous gineering uncertainties, s es for various application	sions on risk percept and applicable to n electing and applying s. They will also gain	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
	uncertainty quantifica challenges. Students will learn to distributions, regressi risks associated with r assessment, and disas Independent Study Tir	ation, ensuring that independently anal on methods, and st natural and human- ster mitigation.	ecision-makers. Th t engineering ana yze and model en tochastic technique made hazards, ens	ey will engage in discuss lyses are both rigorous gineering uncertainties, s es for various application	sions on risk percept and applicable to n electing and applying s. They will also gain	on, safe eal-world appropr the abil	ety factors, a d infrastruct riate probab lity to evalu
Workload in Hours	uncertainty quantifica challenges. Students will learn to distributions, regression risks associated with r assessment, and disast Independent Study Tir 6	ation, ensuring that independently anal on methods, and st natural and human- ster mitigation.	ecision-makers. Th t engineering ana yze and model en tochastic technique made hazards, ens	ey will engage in discuss lyses are both rigorous gineering uncertainties, so es for various application suring they can make info	sions on risk percept and applicable to n electing and applying s. They will also gain	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
Workload in Hours Credit points	uncertainty quantifica challenges. Students will learn to distributions, regression risks associated with r assessment, and disast Independent Study Tir 6	ation, ensuring that independently analon methods, and st natural and human- ster mitigation. me 96, Study Time i	ecision-makers. Th t engineering ana yze and model en tochastic technique made hazards, ens n Lecture 84 Descriptio	ey will engage in discuss lyses are both rigorous gineering uncertainties, so es for various application suring they can make info	sions on risk percept and applicable to re electing and applying s. They will also gain rmed engineering dee	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
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Workload in Hours Credit points Course achievement Examination Examination duration and	uncertainty quantifica challenges. Students will learn to distributions, regressiv risks associated with r assessment, and disas Independent Study Tir 6 Compulsory Bonus Yes 20 % Written exam	ation, ensuring that independently analon methods, and st natural and human- ster mitigation. me 96, Study Time i Form	ecision-makers. Th t engineering ana yze and model en tochastic technique made hazards, ens n Lecture 84 Descriptio	ey will engage in discuss lyses are both rigorous gineering uncertainties, so as for various application turing they can make info	sions on risk percept and applicable to re electing and applying s. They will also gain rmed engineering dee	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
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Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	uncertainty quantification of the second stributions, regression of the second stribution of the second st	ation, ensuring that independently anal on methods, and si natural and human- ster mitigation. me 96, Study Time i Form Presentation	ecision-makers. Th t engineering ana tyze and model en- tochastic technique made hazards, ens n Lecture 84 Descriptio 10-minüt	ey will engage in discuss lyses are both rigorous gineering uncertainties, s es for various application suring they can make info ige Präsentation von Arbe	sions on risk percept and applicable to re electing and applying s. They will also gain rmed engineering dee	on, safe eal-world appropr the abil	ety factors, d infrastruct riate probab lity to evalu
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Course L3458: Uncertainty M	lodelling for Engineers
Тур	Integrated Lecture
Hrs/wk	6
СР	6
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Lecturer	Prof. Simon Michael Papalexiou
Language	EN
Cycle	SoSe
Content	Engineering decisions are rarely made with complete certainty—uncertainty affects material properties, environmental conditions, structural performance, and risk assessments. This course provides students with theoretical foundations and practical tools to quantify uncertainty, assess risks, and enhance decision-making in civil, structural, geotechnical, and environmental engineering applications. Students will begin with fundamental probability concepts, learning how Bayes' Theorem, probability distributions, and extreme value theory help evaluate engineering uncertainties. They will explore linear and nonlinear regression methods for analyzing complex datasets, as well as joint probability distributions and stochastic optimization to improve predictive modeling and reliability assessments. The course also introduces Bayesian Decision Theory, offering a structured approach to decision-making under uncertainty. With a focus on real-world engineering problems, students will apply probabilistic models, extreme value analysis, and stochastic techniques to assess risks in infrastructure design, system reliability, and disaster resilience. Hands-on computational exercises will reinforce key concepts, preparing students to work with data-driven models and uncertainty quantification techniques used in engineering practice. This course is ideal for students interested in engineering risk assessment, reliability analysis, and data-driven modeling. By the end of the course, students will have developed critical analytical and problem-solving skills, equipping them for careers in structural safety, geotechnical engineering, environmental risk management, and beyond.
Literature	

r Thesis		
Тур	Hrs/wk	СР
Professoren der TUHH		
According to General Regulations §21 (1):		
At least 60 credit points have to be achieved in study programme. The examination	is board decides on e	ceptions.
After taking part successfully, students have reached the following learning results		
issues.The students can explain in depth the relevant approaches and terminologies describing current developments and taking up a critical position on them.	in one or more are	as of their subjec
 To select, apply and, if necessary, develop further methods that are suitable for sol To apply knowledge they have acquired and methods they have learnt in the contract of the second seco		
• To develop new scientific findings in their subject area and subject them to a critica	ıl assessment.	
way.		
 To structure a project of their own in work packages and to work them off according To work their way in depth into a largely unknown subject and to access the inform 	ation required for the	m to do so.
Independent Study Time 900, Study Time in Lecture 0		
30		
None		
Thesis		
According to General Regulations		
Civil Environment Theories Computer and		
Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Computational Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Data Science: Thesis: Compulsory Electrical Engineering and Information Technology: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Energy Systems: Thesis: Compulsory Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory International Production Management: Thesis: Compulsory International Production Management: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory		
	Professoren der TUHH According to General Regulations §21 (1): At least 60 credit points have to be achieved in study programme. The examination After taking part successfully, students have reached the following learning results The students can use specialized knowledge (facts, theories, and methods) of t issues. The students can explain in depth the relevant approaches and terminologies describing current developments and taking up a critical position on them. The students can explain in depth the relevant approaches and terminologies describing current developments and taking up a critical position on them. The students can explain in depth the relevant approaches and terminologies describing current developments and taking up a critical position on them. To select, apply and, if necessary, develop further methods that are suitable for sol To apply knowledge they have acquired and methods they have learnt in the cc incompletely defined problems in a solution-oriented way. To develop new scientific findings in their subject area and subject them to a critica Students can Both in writing and orally outline a scientific issue for an expert audience accura way. Deal with issues competently in an expert discussion and answer them in a manr while upholding their own in work packages and to work them off according To work their way in depth into a largely unknown subject and to access the inform To apply the techniques of scientific work comprehensively in research of their own Independent Study Time 900, Study Time in Lecture 0 30 None Thesis According to General Regulations Civil Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electric	Professoren der TUHH According to General Regulations §21 (1): At least 60 credit points have to be achieved in study programme. The examinations board decides on example of the students can use specialized knowledge (facts, theories, and methods) of their subject competensionses. The students can use specialized knowledge (facts, theories, and methods) of their subject competensionses. The students can use specialized knowledge (facts, theories, and methods) of their subject competensionses. The students can place a research task in their subject area in its context and describe and critically research. The students can place a research task in their subject area in its context and describe and critically research. The students are able: To select, apply and, if necessary, develop further methods that are suitable for solving the specialized p To apply knowledge they have acquired and methods they have learnt in the course of their studies incompletely defined problems in a solution-oriented way. To develop new scientific findings in their subject area and subject them to a critical assessment. Students can Bub in writing and orally outline a scientific issue for an expert audience accurately, understandably way. Dead with issues competently in an expert discussion and answer them in a manner that is appropriate while upholding their own assessments and viewpoints convincingly. Students are able: To structure a project of their own in work packages and to work them off accordingly. To apply the techniques of scientific work comprehensively in research of their own. Independent Study Time 900, Study Time in Lecture 0 30 None Thesis According to General Regulations Civil Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Electrica Engineering: Thesis: Compulsory Electrica Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory El

Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory
Logistics, Infrastructure and Mobility: Thesis: Compulsory
Aeronautics: Thesis: Compulsory
Mechanical Engineering - Product Development and Production: Thesis: Compulsory
Materials Science and Engineering: Thesis: Compulsory
Materials Science: Thesis: Compulsory
Mechanical Engineering and Management: Thesis: Compulsory
Mechatronics: Thesis: Compulsory
Biomedical Engineering: Thesis: Compulsory
Microelectronics and Microsystems: Thesis: Compulsory
Product Development, Materials and Production: Thesis: Compulsory
Renewable Energies: Thesis: Compulsory
Naval Architecture and Ocean Engineering: Thesis: Compulsory
Naval Architecture and Ocean Engineering: Thesis: Compulsory
Ship and Offshore Technology: 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