

Module Manual

Master of Science (M.Sc.)

Civil Engineering Dual study program

Cohort: Winter Term 2024

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Program description

Content

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

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

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

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

Career prospects

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

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

Learning target

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

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

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

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

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

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

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

Program structure

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

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

Module Manual M.Sc. "Civil Engineering"

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 "Nontechnical Courses for Master" and in the mandatory electives of the specialization.

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

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

Core Qualification

odule M0523: Busin	
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 management Students are able to explain basic theories, categories, and models in selected special areas of business management. Students are able to interrelate technical and management knowledge.
Skills	 Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.
Personal Competence	
Social Competence	Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems
Autonomy	Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.
Workload in Hours	Depends on choice of courses
Credit points	

Courses

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

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

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

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

Module M1756: Pract	ical module 1 (dual study program, Master's degree)
Courses	
Title	Typ Hrs/wk CP
Practical term 1 (dual study progra	m, Master's degree) (L2887) 0 10
Module Responsible	-
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of a compatible dual B.Sc. at TU Hamburg or comparable practical work experience and competence
Kilowicuge	in the area of interlinking theory and practice
	Course D from the module on interlinking theory and practice as part of the dual Master's course
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Dual students
	 combine their knowledge of facts, principles, theories and methods gained from previous study content with acquire practical knowledge - in particular their knowledge of practical professional procedures and approaches, in the current fiel of activity in engineering. have a critical understanding of the practical applications of their engineering subject.
Skills	Dual students
ZKIIS	
	 apply technical theoretical knowledge to complex, interdisciplinary problems within the company, and evaluate the associated work processes and results, taking into account different possible courses of action. implement the university's application recommendations with regard to their current tasks. develop solutions as well as procedures and approaches in their field of activity and area of responsibility.
Personal Competence	
Social Competence	Dual students
	 work responsibly in project teams within their working area and proactively deal with problems within their team. represent complex engineering viewpoints, facts, problems and solution approaches in discussions with internal and external stakeholders.
Autonomy	Dual students
	 define goals for their own learning and working processes as engineers. reflect on learning and work processes in their area of responsibility. reflect on the relevance of subject modules specialisations and specialisation for work as an engineer, and also implement the university's application recommendations and the associated challenges to positively transfer knowledge between theory and practice.
Workload in Hours	Independent Study Time 300, Study Time in Lecture 0
Credit points	10
Course achievement	None
	Written elaboration
	Documentation accompanying studies and across semesters: Module credit points are earned by completing a digital learning and development report (e-portfolio). This documents and reflects individual learning experiences and skills development relating to
scale	interlinking theory and practice, as well as professional practice. In addition, the partner company provides proof to the dual@TUHH Coordination Office that the dual student has completed the practical phase.
=	Civil Engineering: Core Qualification: Compulsory
Following Curricula	Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory
	Chemical and Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory
	Data Science: Core Qualification: Compulsory
	Electrical Engineering and Information Technology: Core Qualification: Compulsory
	Electrical Engineering: Core Qualification: Compulsory Energy Systems: Core Qualification: Compulsory
	Environmental Engineering: Core Qualification: Compulsory
	Aircraft Systems Engineering: Core Qualification: Compulsory
	Computer Science in Engineering: Core Qualification: Compulsory
	Information and Communication Systems: Core Qualification: Compulsory International Management and Engineering: Core Qualification: Compulsory
	Logistics, Infrastructure and Mobility: Core Qualification: Compulsory
	Aeronautics: Core Qualification: Compulsory
	Materials Science and Engineering: Core Qualification: Compulsory
	Materials Science: Core Qualification: Compulsory Machanical Engineering and Management: Core Qualification: Compulsory
	Mechanical Engineering and Management: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory
	Biomedical Engineering: Core Qualification: Compulsory
	Microelectronics and Microsystems: Core Qualification: Compulsory Product Development, Materials and Production: Core Qualification: Compulsory

Renewable Energies: Core Qualification: Compulsory

Naval Architecture and Ocean Engineering: Core Qualification: Compulsory

Theoretical Mechanical Engineering: Core Qualification: Compulsory

Process Engineering: Core Qualification: Compulsory

Water and Environmental Engineering: Core Qualification: Compulsory

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

Module M2004: Susta	inable Circular Economy			
Courses				
Title		Тур	Hrs/wk	СР
Circular Economy (L3264)		Seminar	2	3
Environment and Sustainability (L0	319)	Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence				
Knowledge	Students are able to describe single to	echniques and to give an overview for the fie	eld of safety and risk	assessment, Circula
J.	Economy as well as environmental and		,	
	basics in safety and reliability of t			
	risk assessment and reliability and	alysis methods		
	Circularity of material	1. (1.6)		
	Identification and evaluation of m	aterial flows		
	energy production and supply sustainable product design			
	sustainable product design			
Clálla	Students are able apply interdisciplings	a custom oriented methods for Circularity and	d right accomment as	well as sustainabilit
Skills		y system-oriented methods for Circularity and and costs for processes and select economically		
	reporting. They can evaluate the enort a	ind costs for processes and select economically	reasible treatment co	ncepts.
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the su	bject area from given sources and transform i	t to new questions. Fo	urthermore, they ca
	define targets for new application or res	earch-oriented duties in for risk management a	and sustainability conc	epts accordance wit
	the potential social, economic and cultur	ral impact.		
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points		<u>200:a.e 50</u>		
Course achievement				
Examination	Written elaboration			
	Elaboration and presentation (45 minute	es in arouns)		
scale	Liaboration and presentation (45 minute	as iii groups/		
	Civil Engineering: Coro Qualification: Cor	mpulsory		
Assignment for the	Civil Engineering: Core Qualification: Cor	C - Bioeconomic Process Engineering, Foci	is Management and	Controlling: Flective
rollowing curricula		C - Bioeconomic Frocess Engineering, Foci	as Management and	Controlling. Electiv
	Compulsory Chemical and Bioprocess Engineering: S	pecialisation General Process Engineering: Elec	tive Compulsory	
		pecialisation Bioprocess Engineering: Elective C		
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	• • •	duction: Specialisation Product Development: E	lective Compulsory	
	· ·	duction: Specialisation Production: Elective Con		
	' '	duction: Specialisation Materials: Elective Comp	. ,	
	Water and Environmental Engineering: 0	·	•	

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

Course L0319: Environment	and Sustainability
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list 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	e elements			
Courses				
Title		Тур	Hrs/wk	СР
Finite elements (L3279)		Lecture	3 2	3
Finite elements (L3280) Module Responsible	Prof. Paction Octorlo	Recitation Section (large)	2	3
Admission Requirements				
•	Mechanics I/II, Mathematics I/II, Differential Equations I, S	tructural Analysis I Structural Analy	cic II Structural Δ	nalysis III
Knowledge	Mechanics () ii, Machematics () ii, Differential Equations (, 5	Analysis I, Structural Analy	313 II, Structural A	ilary 313 III
	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After successful completion of this module, students ca element method.	n express theoretical, methodologic	cal and practical	aspects of the finite
Skills	After successfully completing this module, students are able to derive, implement and appropriately apply finite element formulations.			
Personal Competence				
Social Competence	Students can participate in subject-specific and interdisc promote the scientific development of colleagues. Furthe			
Autonomy	Students are able to gain knowledge of the subject area	-		blems. Furthermore,
	they are able to structure the solution process for probler	ms 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	its
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

Module M1757: Pract	ical module 2 (dual study pro	gram, Master's degree)		
Courses				
Fitle	ma Manharia damaa) /12000)	Тур	Hrs/wk	CP
Practical term 2 (dual study progra Module Responsible			0	10
Admission Requirements	None			
Recommended Previous	Successful completion of practical m	nodule 1 as part of the dual Master's course		
Knowledge		nking theory and practice as part of the dual	Master's course	
Educational Objectives				
Professional Competence	After taking part successfully, students have	ve reached the following learning results		
•	Dual students			
	practical knowledge - in particular the of activity in engineering.	es, principles, theories and methods gained their knowledge of practical professional proc the practical applications of their engineering	edures and approache	
Skills	Dual students			
	 associated work processes and resu implement the university's applic develop (new) solutions as well 	viedge to complex, interdisciplinary probler its, taking into account different possible cou ation recommendations with regard to their of as procedures and approaches in their fine hanging requirements (systemic skills).	rses of action. current tasks.	
Personal Competence				
Social Competence	Dual students			
		tmental and interdisciplinary project teams	and proactively deal v	vith problems with
	their team. • represent complex engineering external stakeholders and develop t	viewpoints, facts, problems and solution aphese further together.	oproaches in discussio	ns with internal a
Autonomy	Dual students			
,	define goals for their own learning	a and working processes as ongineers		
	reflect on learning and work proce reflect on the relevance of sul			
Workload in Hours	Independent Study Time 300, Study Time i	n Lecture 0		
Credit points	10			
Course achievement				
	Written elaboration	across semesters: Module credit points are	carned by completing	digital loarning an
scale	development report (e-portfolio). This doc interlinking theory and practice, as well	uments and reflects individual learning exp l as professional practice. In addition, the ual student has completed the practical phas	eriences and skills dev partner company pr	elopment relating
•	Civil Engineering: Core Qualification: Comp	,		
Following Curricula	Bioprocess Engineering: Core Qualification Chemical and Bioprocess Engineering: Core			
	Computer Science: Core Qualification: Com	• •		
	Data Science: Core Qualification: Compulso	· ·		
	Electrical Engineering and Information Tech			
	Electrical Engineering: Core Qualification: Comparing Systems: Core Qualification: Core Qual	• •		
	Environmental Engineering: Core Qualificat	*		
	Aircraft Systems Engineering: Core Qualific			
	Computer Science in Engineering: Core Qu Information and Communication Systems:			
	International Management and Engineering	• • •		
	Logistics, Infrastructure and Mobility: Core	• •		
	Aeronautics: Core Qualification: Compulsor			
	Materials Science and Engineering: Core Q Materials Science: Core Qualification: Com			
	Mechanical Engineering and Management:	•		
	Mechatronics: Core Qualification: Compulso			
	Biomedical Engineering: Core Qualification Microelectronics and Microsystems: Core Q			
	serection and merosystems. core Q			

Product Development, Materials and Production: Core Qualification: Compulsory

Renewable Energies: Core Qualification: Compulsory

Naval Architecture and Ocean Engineering: Core Qualification: Compulsory Theoretical Mechanical Engineering: Core Qualification: Compulsory

Process Engineering: Core Qualification: Compulsory

Water and Environmental Engineering: Core Qualification: Compulsory

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

Module M1758: Pract	ical module 3 (dual study program, M	aster's degree)	
Courses			
Title		Тур	Hrs/wk CP
Practical term 3 (dual study progra			0 10
Module Responsible Admission Requirements	-		
Recommended Previous	None		
Knowledge	 Successful completion of practical module 2 as p course E from the module on interlinking theory 		Master's course
Educational Objectives	After taking part successfully, students have reached the	ne following learning results	
Professional Competence			
Knowledge	Dual students		
	 combine their comprehensive and specialise strategy-oriented practical knowledge gained fro have a critical understanding of the practical implementing innovations. 	m their current field of work and	area of responsibility.
Skills	Dual students		
	 apply specialised and conceptual skills to solve evaluate the associated work processes and rest implement the university's application recomm develop new solutions as well as procedures when facing frequently changing requirements a can use academic methods to develop new these with regard to their usability. 	lts, taking into account different nendations with regard to their c and approaches to implement o nd unpredictable changes (syste	possible courses of action. current tasks. perational projects and assignments - ever mic skills).
Personal Competence			
Social Competence	Dual students		
	work responsibly in cross-departmental and their team. can promote the professional development of represent complex and interdisciplinary enging with internal and external stakeholders and deve	others in a targeted manner. neering viewpoints, facts, proble	
Autonomy	Dual students		
	 reflect on learning and work processes in their define goals for new application-oriented task company and the public. reflect on the relevance of areas of special university's application recommendations and the and practice. 	s, projects and innovation plans lisation and research for work	as an engineer, and also implement the
Workload in Hours	Independent Study Time 300, Study Time in Lecture 0		
Credit points	10		
Course achievement	None		
Examination	Written elaboration		
	Documentation accompanying studies and across semdevelopment report (e-portfolio). This documents and interlinking theory and practice, as well as profess dual@TUHH Coordination Office that the dual student h	reflects individual learning expe onal practice. In addition, the	eriences and skills development relating to partner company provides proof to the
Assignment for the	Civil Engineering: Core Qualification: Compulsory		
Following Curricula	Bioprocess Engineering: Core Qualification: Compulsory		
	Chemical and Bioprocess Engineering: Core Qualification		
	Chemical and Bioprocess Engineering: Core Qualification Computer Science: Core Qualification: Compulsory	n: Compulsory	
	Data Science: Core Qualification: Compulsory		
	Electrical Engineering and Information Technology: Cor	e Qualification: Compulsory	
	Electrical Engineering: Core Qualification: Compulsory	•	
	Energy Systems: Core Qualification: Compulsory		
	Environmental Engineering: Core Qualification: Compul		
	Aircraft Systems Engineering: Core Qualification: Comp	•	
	Computer Science in Engineering: Core Qualification: C Information and Communication Systems: Core Qualific		
	International Management and Engineering: Core Quality		
	Logistics, Infrastructure and Mobility: Core Qualification		

Aeronautics: Core Qualification: Compulsory

Mechanical Engineering - Product Development and Production: Core Qualification: Compulsory

Materials Science and Engineering: Core Qualification: Compulsory

Materials Science: Core Qualification: Compulsory

Mechanical Engineering and Management: Core Qualification: Compulsory

Mechatronics: Core Qualification: Compulsory

Biomedical Engineering: Core Qualification: Compulsory

Microelectronics and Microsystems: Core Qualification: Compulsory

Product Development, Materials and Production: Core Qualification: Compulsory

Renewable Energies: Core Qualification: Compulsory

Naval Architecture and Ocean Engineering: Core Qualification: Compulsory Naval Architecture and Ocean Engineering: Core Qualification: Compulsory Theoretical Mechanical Engineering: Core Qualification: Compulsory

Process Engineering: Core Qualification: Compulsory

Water and Environmental Engineering: Core Qualification: Compulsory

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

Specialization Coastal Engineering

Module M0699: Geote	echnics III			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Methods in Geotechnics	(L0375)	Lecture	3	3
Advanced Foundation Engineering		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 the follow	ring learning results		
Professional Competence				
Knowledge	After successfully completing the module, students will be able	to		
	describe individual precedures for the gentechnical mani-	toring of civil anginopring massu	roc	
	 describe individual procedures for the geotechnical moni reproduce exploration and investigation methods of the 		iles,	
	select suitable types of field and laboratory tests for sub-		oir recults	
	state the differences between various stress and deform	•		riants of the stress
	and distortion tensor,	acion states and the physical sig	initeditee of nive	maries or the stress
	outline the standard and special soil mechanics tests use	ed to determine the stress-strain	behavior of soil.	
	describe continuum models and the resulting boundary v			
	as well as define boundary value problems from the field		such a way that	they can be solved
	unambiguously.	3 3	,	,
Skills	Students will be able to			
	 dimension vertical drains for soil improvement of soft soil 	ls,		
	calculate depth compaction using various appropriate makes	ethods,		
	 apply principles of horizontal bearing capacity of piles, 			
	 verify the internal and external stability of fluid-supporte 	d diaphragm walls,		
	 evaluate the boundary conditions for the design of a 	deep excavation and design	the individual o	components of the
	excavation,			
	perform, evaluate and interpret tests for the description	and classification of soils accordi	ng to applicable	standards,
	computationally implement numerical algorithms to solve	e boundary value problems,		
	 select and apply the types of analyses depending on the 			
	 determine appropriate model parameters for different po 	ossibilities and limitations of mat	erial models for	the grain structure
	of soils.			
Personal Competence				
-	Students can work in groups and support each other in finding :	solutions.		
	3			
Autonomy	Students are able to assess their own strengths and weaknesse	s and, based on this, organize th	eir time and lea	rning management
	and think in terms of processes.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement	None			
	Written exam			
Examination duration and	120 min			
scale				
Assignment for the		•		
Following Curricula				
	Civil Engineering: Specialisation Coastal Engineering: Compulso	•		
	Civil Engineering: Specialisation Water and Traffic: Elective Con			
	Civil Engineering: Specialisation Computational Engineering: Co		nom.	
	International Management and Engineering: Specialisation II. Ci	vii Engineering: Elective Compul	ьигу	

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

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

Course L0498: Advanced Fou	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 M0964: Underground Constructions					
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. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules from Bachelor studies Civil	and environmental enginee	ring:		
Knowledge					
	Geotechnics I-II				
Educational Objectives	After taking part successfully, stude	nts have reached the followi	ing 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	Same with the same account as men as practical skills in structural territor analysis.				
_	Capacity for teamwork concerning project management and design of tunnels.				
,	Promotion of independent and creative work flow in the framework of a design exercise.				
,	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 5 % Excercises				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Stro	uctural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geo	otechnical Engineering: Com	pulsory		
	Civil Engineering: Specialisation Coa	astal Engineering: Compulsor	ry		
	Civil Engineering: Specialisation Wa	ter and Traffic: Elective Com	pulsory		
	Civil Engineering: Specialisation Cor	nputational Engineering: Ele	ctive Compulsory		
	International Management and Engi	neering: Specialisation II. Civ	vil Engineering: Elective Comp	oulsory	

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

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

Module M1748: Const	truction Robotics			
Courses				
Title	Тур		Hrs/wk	СР
Construction Robotics (L2867)	Project-/problem-k	based Learning	6	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basics of project-oriented programming			
Knowledge				
Educational Objectives		IS .		
Professional Competence				
Knowledge	Basics of robotics			
	Applications in civil engineering			
	Kinematics			
Skills	Use of specific hardware			
	Development of software routines			
	Python programming language			
	Image processing			
	Basics of localization (LIDAR, SLAM)			
Personal Competence				
Social Competence				
	Communication skills			
Autonomy	/ Independent work			
	Independent decisions			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and				
scale				
Assignment for the				
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	y		
	Mechatronics: Core Qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science	e: Elective Com	pulsory	

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

Courses				
itle		Тур	Hrs/wk	СР
epair of Structures (L0255)		Lecture	1	1
lineral Building Materials (L0253)		Lecture	2	2
echnology of mineral Building Ma		Project-/problem-based Learning	1	2
	erials and Damage Processes (L0254)	Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials, building	g physics and building chemistry, for exam	ple by the m	nodules Principles
Knowledge	Building Materials and Building Physics and Building	Materials and Building Chemistry.		
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Glatte	manufacture of special mineral building materials. Table to describe the manufacture, properties and fit of their material parameters. They are able to show	elds of application of special mortars and spec the principles of anchor technology and design	cial concretes gn.	and the correlation
JAIIS	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a s mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. The able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select and strengthening measures.			
Personal Competence				
Social Competence	The students are able to develop in small grous the other students. In a critical discussion they defend building material on the basis of this feedback.	•		
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to get missing components.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes 20 % Subject theoretical and			
	practical work			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engin	leering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineer	ring: Elective Compulsory		

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

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

Course L0256: Technology or	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	ourse L0254: Transport Processes in Building Materials and Damage Processes			
Тур	Lecture			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Frank Schmidt-Döhl			
Language	DE			
Cycle	SoSe			
Content	Transport Processes in Building Materials and Damage Processes			
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung			

Module M0723: Design of Prestressed Structures and Concrete Bridges					
Courses					
Title		Тур	Hrs/wk	СР	
Design of Prestressed Structures a	3	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 concret	e structures.			
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures				
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	The students know the main bridge types,	their applications and the various loads. They	can explain the ba	asic design methods	
	They can explain the design of a prestressed	l bridge.			
Skills	The students are able to design reinforced or prestressed concrete bridges.				
Personal Competence					
Social Competence	The students can design in teamwork a real concrete bridge.				
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	180 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structural E	ngineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnica	al Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Eng	ineering: Elective Compulsory			
	Civil Engineering: Specialisation Computation	nal Engineering: Elective Compulsory			
	International Management and Engineering:	Specialisation II. Civil Engineering: Elective Cor	npulsory		

Тур	Lecture
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
	 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 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

Madula M0756; Sail N	lechanics and -Dynamics			
Module M0756: Soli M	rechanics and -Dynamics			
Courses				
Title Soil Mechanics - Selected Topics (L	0374)	Typ Lecture	Hrs/wk	CP 2
Soil Dynamics (L0452) Experimental Researches in Geotec	thnics (L0706)	Lecture Practical Course	2	2
		Tractical Course	2	2
Module Responsible				
Admission Requirements				
Knowledge	Modules: Mathematics I-III, Mechanics I-II, Geotechnics I Courses: Soil laboratory course, (Applied structural dynam	nics)		
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Students will be able to, describe wave propagation in the ground under dyr to measure vibrations and to interpret the data obt justify when elastodynamic methods are sufficient at to reproduce the collapse theorems of plasticity the describe the viscous behavior of cohesive soils a	ained with regard to their effect and when plastodynamic effect eory,	t on people and struct	cures, account,
Skille	 as well as to determine the effect of partial saturation After the successful completion of the module the student		e shear strength.	
	 to derive and apply the basic equation of a simple of to understand the wave propagation in the soil understand to know the essential laboratory and field tests to do to design machine foundations to dynamic load, to design machine foundations to dynamic load, to measure shocks to perform vibration forecast, to evaluate shocks in terms of their effect on people to evaluate possibilities of isolation, to understand mechanisms that cause earthquakes to know methods to determine axial pile capacity, i to know the mechanisms that lead to a deformation mathematically, to distinguish the area of application of the method to detect the undrained shear strength as a function to capture the visous behaviour of cohesive soils a calculations, to consider the impact of the partly saturated of a second considered to the considered of the partly saturated of a second considered to the considered of the partly saturated of a second considered to the considered of the partly saturated of a second considered to the considered of the partly saturated of a second considered to the considered of the partly saturated of a second considered to the considered of the partly saturated of a second considered of the partly saturated o	er dynamic excitation and to determine soil dynamic charact e and buildings, and evaluate earthquakes in tentegrity, and the dynamic beden accumulation due to cyclic for of elastodynamics and plastodynomics and plastodynom	eristics and to evaluate terms of their magniture ding modulus, bading and to estimate dynamics,	e them, de and intensity, e these deformations
Personal Competence				
Social Competence	Students will be able to work in teams to achieve results together at the end of the semester.	on measurement and expering	mental principles and	present their results
Autonomy	Students are able to assess their own strengths and weak	nesses and organize their time	and learning manage	ment based on this.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	Compulsory Bonus Form Descrip	tion		
	Yes None Subject theoretical and			
_	practical work			
Examination	Written exam			
Examination duration and scale	135 min			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: El	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering Civil Engineering: Specialisation Coastal Engineering: Elec Civil Engineering: Specialisation Computational Engineering	tive Compulsory		
	Civil Engineering. Specialisation Computational Engineering	ig. Liective Compuisory		

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

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

	Prestigal Course
Тур	
Hrs/wk	
СР	2
Workload in Hours	
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 measurer techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as I grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and reso 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 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 result the preceding year's course group.
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubet Technische Universität Hamburg-Harburg.
	- Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Sprir 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 Groundwater Modeling using Modfl	ow (L0543)	Typ Lecture	Hrs/wk 1	CP 1
Groundwater Modeling using Modfl		Recitation Section (small)	2	2
Modeling of Water Supply Network		Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge	groundwater hydraulics and transport of subs	tances		
	Pipe Systems			
	Knowledge on urban water infrastructures, special structures Hydraulics of drinking water supply systems a Basic knowledge on water management		rban draina	ge systems includin
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence	Their taking part successiving, stauting have reache	a the following learning results		
•	The students are able to describe the modelling of g	roundwater flow and transport as well as urb	an water infi	rastructures. Thev 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.			studies. Besides the
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenario and can compare or assess different solutions for existing problems by application of selected software products. The students ar able to use different software solutions (e.g. EPANET, EPA-SWMM).			
Personal Competence				
•	Wird nicht vermittelt.			
· ·	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	.,,			
Course achievement				
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: E	Elective Compulsory		
	Civil Engineering: Specialisation Computational Engi	neering: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Water: Elective Compulsory		

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

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

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

Module M0828: Urbai	n Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/problem-based Le	arning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on orban 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 following learning results			
Professional Competence				
Knowledge	Students can describe urban development corridors as well as current and future urban	environr	mental proble	ms. They are able t
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovations and explain why thes	e contril	bute to the in	nprovement of urba
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skille	Students are able to develop specific solutions for correcting existing or future	onvironi	ment-related	problems of urba
SKIIIS	development. They can define a range of conceptual and technical solutions for environm			•
	paths. To solve specific urban environmental problems they can select technical innova-			
	context.	icionis di	na micegrate	them into the diba
Personal Competence	CONCOAC			
•	The students can work together in international groups.			
Social competence	The statents can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations a	nd cont	ributions to t	he discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	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: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory			
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualificat	ion: Cor	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective (ompuls	ory	
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Cities: Compulsory			

Course L1109: Noise Protection		
Тур	Lecture	
Hrs/wk	2	
СР	2	
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 Infrastructures	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach
Language	EN
Cycle	SoSe
Content	Problem Based Learning
	Main topics are: Central vs. Decentral Wastewater Treatment. Compaction of Cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

Module M0860: Harbo	ur Engineering and Harbour Planning			
Courses				
Title	Тур		Hrs/wk	СР
Harbour Engineering (L0809)	Lectu	ure	2	2
Harbour Engineering (L1414)	-	ect-/problem-based Learning	1	2
Port Planning and Port Construction	(L0378) Lectu	ure	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 following lea	arning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design appro	oaches for the functional de	esign of a port	and apply them to
	design tasks. They can design the fundamental elements of a port.			
Skills	The students are able to select and apply appropriate approaches for	the functional design of por	ts.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied p	problems such as the functi	onal design of	f ports. Additionaly,
	they will be able to work in team with engineers of other disciplines.			
Autonomy	The students will be able to independently extend their knowledge and	d 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 include	ides tasks with respect to t	the general ur	nderstanding of the
	lecture contents and calculations tasks.	·	J	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Comp	pulsory		
•	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co	•		
	Civil Engineering: Specialisation Coastal Engineering: Compulsory	•		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsor	ry		
	International Management and Engineering: Specialisation II. Civil Eng	•	ory	

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

Course L0378: Port Planning	and Port Construction
Тур	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
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Module M0861: Mode	lling of Hydraulic Engineering			
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 Esti	Jaries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic pro	ocesses that are related to the modelling	of flows in h	ydraulic engineering
	Besides, they can describe the basic aspects of num	nerical modelling and actual numerical mod	els for the sir	nulation of flows and
	waves.			
CL'III.		the second of th		
SKIIIS	Students are able to apply hydrodynamic-numerical i	models to practical hydraulic engineering ta	SKS.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowled	dge in simple applied problems. Additionaly	, they will be	able to work in team
·	with others.			
Autonomy	The students will be able to independently extend the	eir 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 ex	xamination includes tasks with respect to	the general i	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:			
	Civil Engineering: Specialisation Computational Engir	neering: Compulsory		

Course L0813: Hydraulic Models	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer
Literature	Strobi, Zunic. Wasserbau, Rap. 11 nyuraunsene Mouene, 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
Тур	
Hrs/wk	
СР	
Workload in Hours	
	Prof. Edgar Nehlsen, Prof. Peter Fröhle
Language	
Content	
Content	Introduction to numerical flow modelling
	Processes affecting tht flow
	Examples and applications of numerical models
	Procedure of numerical modelling Madel accords
	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 naturn
	Fließgewässern. Düsseldorf: BWK (BWK-Merkblatt).
	The Sign about 10 m (2 m m matter)
	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 Mehrdimensic numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019a): Merkblatt DWA-M 543-2 Geodaten i
	Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigur Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1).
	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensic
	numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten
	Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deuf
	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 Mehrdimensio
	numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019c): Merkblatt DWA-M 543-3 Geodaten
	Fließgewässermodellierung - Teil 3: Aspekte der Strömungsmodellierung und Fallbeispiele. Februar 2019. Hennef: Deu
	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: \
	Online verfügbar unter http://www.loc.gov/catdir/enhancements/fy0741/2007296953-b.html.
	IAND (2015). Designational Considerations for Division and Newsonical Chadies in Facility and the Indian line (2) (2)
	IAHR (2015): Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics. In: Hydrolink (3/201 90-92.
	30-32.
	Olsen, Nils Reidar B. (2012): Numerical Modelling and Hydraulics. 3. Aufl. Department of Hydraulic and Environmental Engine The Norwegian University of Science and Technology.
	Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science technology library, 83).
	van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036).
	Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband
	Wasserwirtschaft und Kulturbau. 127) Wasserwirtschaft und Kulturbau. 127)

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 (Advanced Wastewater Treatment (Lecture Recitation Section (large)	2	2 1
Module Responsible	Dr. Joachim Behrendt	Recitation Section (large)	1	1
Admission Requirements	None			
Recommended Previous		nd the key processes involved in wastewater treat	mont	
Knowledge	Knowledge of Wastewater management a	nd the key processes involved in wastewater treat	nent.	
	After telling and average till, at adopte to			
Educational Objectives Professional Competence	After taking part successfully, students ha	ave reached the following learning results		
_	Students are able to outline key areas of the full range of treatment systems in waste water management, as well as their mutual dependence for sustainable water protection. They can describe relevant economic, environmental and social factors. Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application is municipal and for some industrial treatment plants.			
Personal Competence				
•	Social skills are not targeted in this modul	le.		
Autonomy	Students are in a position to work on a subject.	subject and to organize their work flow indeper	dently. They can	also present on th
Workload in Hours	•	n Lastura 94		
	1 3 1	II Lecture 64		
Credit points Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structura			
Following Curricula	Civil Engineering: Specialisation Geotechr			
	Civil Engineering: Specialisation Coastal E			
	Civil Engineering: Specialisation Water an	d Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A -	General Bioprocess Engineering: Elective Compul	sory	
	Environmental Engineering: Specialisation	n Water Quality and Water Engineering: Elective Co	mpulsory	
	International Management and Engineering	ng: Specialisation II. Process Engineering and Biote	chnology: Elective	Compulsory
	International Management and Engineering	ng: Specialisation II. Energy and Environmental Eng	ineering: Elective	Compulsory
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Compulsor	/	
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		

ırse L0517: Biological Wa	rse 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	

 $ISBN: \quad 3540343296 \ (Gb.) \quad URL: \quad http://www.gbv.de/dms/bs/toc/516261924.pdf \quad URL: \quad http://deposit.d-nb.de/cgi-bin/dokserv?$

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

http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf

URL:

aus der Abwasserbehandlung, Kleinkläranlagen

ISBN: 3860682725 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

 $ISBN: 3527312196 \ (Gb.) \ URL: \ http://deposit.ddb.de/cgi-bin/dokserv?id=2774611\&prov=M\&dok_var=1\&dok_ext=htm-provestare for the provestar for the prove$

Weinheim: WILEY-VCH, 2007

TUB_HH_Katalog

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

Course L0357: Advanced Wa	stewater Treatment	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	ndependent 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	
	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 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	

	Planning
ourses	
i tle ty Planning (L1066)	TypHrs/wkCPProject-/problem-based Learning46
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.
	describe the main determinants of urban development. explain and compare different possibilities of how urban development can be influenced.
	discuss requirements for public streetscapes.
	explain the importance of street design.
Skills	Students are able to:
	read and analyze urban development concepts and designs for streetscapes
	appraise such concepts in the context of competing requirements.
	design, justify and reflect their own solutions for concrete examples.
Personal Competence	
Social Competence	Students are able to:
	discuss intermediate results with each other.
	constructively accept feedback on their own work.
	provide constructive feedback to others.
Autonomy	Students are able to:
	 independently complete a written report including drawings following a broadly pre-defined process.
	assess the consequences of their proposed solutions.
	independently acquire knowledge and apply this to new issues or problem areas.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	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		
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	
	Lance Comban (2000) Die Chalt und ihr Comadrie Wessenth Verlag Tübir aus	
	Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen	
	Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New	
	York.	

Module M0977: Const	ruction Logistics and Project Management			
Courses				
Title		Тур	Hrs/wk	СР
Construction Logistics (L1163)		Lecture	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2
Construction Logistics (L1164)		Recitation Section (small)	1	2
Project Development and Managen	nent (L1161)	Lecture	1	1
Project Development and Managen	nent (L1162)	Project-/problem-based Learning	1	1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	Students can			
	 give definitions of the main terms of construction logistics name advantages and disadvantages of internal or extern		nanagement	
	• explain characteristics of products, demand and production	on of construction objects and th	eir consequer	ices for construction
	specific supply chains			
	 differentiate constructions logistics from other logistics sy 	stems		
Skills	Students can			
	carry out project life cycle assessments			
	apply methods and instruments of construction logistics			
	 apply methods and instruments of project development a 	apply methods and instruments of project development and management		
	apply methods and instruments of conflict management			
	 design supply and waste removal concepts for a construct 	tion project		
Personal Competence				
Social Competence	Students can			
	hald a constation to a definition of			
	hold presentations in and for groups Apply methods of sortlist solving skills in group work and	case studies		
	apply methods of conflict solving skills in group work and	case studies		
Autonomy	Students can			
	solve problems by holistic, systemic and flow oriented thin	nkina		
	improve their creativity, negotiation skills, conflict and	-	a methods of	moderation in case
	studies		,	
	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	Civil Engineering: Specialisation Structural Facility of Structural	Compulsory		
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect Civil Engineering: Specialisation Coastal Engineering: Elective Co			
	Civil Engineering: Specialisation Coastal Engineering: Elective Com			
	International Management and Engineering: Specialisation II. Civ.		orv	
	International Management and Engineering: Specialisation II. Log		. ,	
	Logistics, Infrastructure and Mobility: Specialisation Production a		у	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure			

Course L1163: Construction	Logistics .	
	Lecture	
Hrs/wk		
CP		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
	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:	
	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	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	urse L1161: Project Development and Management		
Тур	cture		
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	ourse L1162: Project Development and Management	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0998: Statio	cs and Dynamics of Structures			
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 staticall	y determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics I/I
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence		<u> </u>		
Knowledge				
Skills	After successful completion of this module, the students will be able to predict the response of material and structures to dynamics loading using the appropriate computational approaches and methods.			
Personal Competence Social Competence				
	participate in subject-specific and interdiscipl	inary discussions,		
	 defend their own work results in front of other 	rs		
	promote the scientific development of colleage	gues		
	Furthermore, they can give and accept profes	ssional constructive criticism		
Autonomy	Students are able to gain knowledge of the subject	area from given and other sources and a	pply it to new pro	oblems. Furthermore
·	they are able to structure the solution process for p			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	, , ,			
Course achievement				
	Written exam			
Examination duration and				
scale				
		ing Compulson		
Assignment for the		3 , ,		
Following Curricula		, ,		
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic: E			
	Civil Engineering: Specialisation Computational Eng			
	International Management and Engineering: Special	isation II. Civil Engineering: Elective Com	pulsory	

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	rse 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	hanics and fatigue in steel structures Lecture		
Hrs/wk			
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
	Dr. Jürgen Priebe		
Language	DE		
Cycle	SoSe		
Content	basics of fatigue stress and fatigue resistance and determination of fatigue strength,		
	determination anduse 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 1996		
	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 Bemessungsrege 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 200:		

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

Module M0999: Steel	Construction Project			
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 have reached t	he following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the whole project and explain it to the others.			
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction to			
	changing conditions resulting from other participants o	f the project.		
Personal Competence				
Social Competence	Students can present their results to other members of	the group.		
	They have the ability to work for a broad agreement wi	th respect to intergroup depender	ncies.	
	They can distribute and process tasks independently.			
Autonomy	Students can handle their part of the project on their o	wn resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	5		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Structural Engineering	: Compulsory		
	Civil Engineering: Specialisation Computational Engineering	ering: 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.	

Module M0663: Marin	e Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III, Mathema	atics I-III		
Knowledge	Courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have r	reached the following learning results		
Professional Competence				
Knowledge	The students get a deeper knowledge of stee	I and ground engineering as well as construction	ons knowledge co	ncerning quay walls.
	Furthermore, the students get all the necessa	ary knowledge to design singular construction	elements for shee	et pile walls and they
	know how to choose the right construction ele	ements depending on the influencing conditions	5.	
Skills		sion sheet pile wall construction regarding all		
	suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile			
	walls and combined sheet pile walls) and to dimension all construction elements and connections.			
Personal Competence				
Social Competence				
Autonomy	Students are able to assess their own strengths and weaknesses and organize their time and learning management based on this.			
Workload in Hours	Independent Study Time 110, Study Time in L	actura 70		
Credit points	, , ,	Independent Study Time 110, Study Time in Lecture 70		
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory			
_	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engir			
	Civil Engineering: Specialisation Computation			
		ation Maritime Technology: Elective Compulsor	V	
			,	

Course L0548: Marine Geote	chnics	
Тур	ecture	
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 	

Course 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

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

Module M1133: Port I	Logistics	
Courses		
Title Port Logistics (L0686)	Typ Hrs/wk CP Lecture 2 3	
Port Logistics (L1473)	Recitation Section (small) 2 3	
Module Responsible		
Admission Requirements Recommended Previous		
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	Th	
	After completing the module, students can	
	 reflect on the development of seaports (in terms of the functions of the ports and the corresponding terminals, as well as the relevant operator models) and place them in their historical context; explain and evaluate different types of seaport terminals and their specific characteristics (cargo, transhipment technologies, logistic functional areas); analyze common planning tasks (e.g. berth planning, stowage planning, yard planning) at seaport terminals and develop suitable approaches (in terms of methods and tools) to solve these planning tasks; identify future developments and trends regarding the planning and control of innovative seaport terminals and discuss 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, equipment 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 types and to what extent.	
Personal Competence Social Competence	After completing the module, students can transfer the acquired knowledge to further questions of port logistics; discuss and successfully organize extensive task packages in small groups; in small groups, document work results in writing in an understandable form and present them to an appropriate extent.	
Autonomy	 After completing the module, the students are able to research and select specialist literature, including standards, guidelines and journal papers, and to develop the contents independently; submit own parts in an extensive written elaboration in small groups in due time and to present them jointly within a fixed 	
	time frame.	
	Independent Study Time 124, Study Time in Lecture 56	
Credit points		
Course achievement	No 15 % Written elaboration	
Examination	Written exam	
Examination duration and	120 minutes	
scale		
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Logistics: Elective Compulsory	
i ollowing curricula	Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory	
	Renewable Energies: Specialisation Wind Energy Systems: Elective Compulsory	
	Naval Architecture and Ocean Engineering: Core Qualification: Elective Compulsory	
	Theoretical Mechanical Engineering: Specialisation Maritime Technology: Elective Compulsory	

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

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

Courses				
litle little		Тур	Hrs/wk	СР
Maritime Transport (L0063)		Lecture	2	3
Maritime Transport (L0064)		Recitation Section (small)	2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students are able to			
	 present the actors involved in the maritime transpor 	t chain with regard to their typical	tasks:	
	name common cargo types in shipping and classify of			
	explain operating forms in maritime shipping, transp			;
	weigh the advantages and disadvantages of the vari			
	estimate the potential of digitisation in maritime ship	pping.		
Skills	The students are able to			
	determine the content of the content	611		
	determine the mode of transport, actors and function			
	identify possible cost drivers in a transport chain and			
	record, map and systematically analyse material and a systematically analyse material and a systematically analyses.	and information flows of a marit	ime logistics cha	iin, identify possii
	problems and recommend solutions;	a average abasia.		
	 perform risk assessments of human disruptions 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; 			
	 plan the deployment of a fleet based on scenarios; apply different process modelling methods in a hitherto unknown field of activity and to work out the respective advantage 			
	apply different process modelling methods in a findle	Tto unknown held of activity and to	o work out the re.	spective advantage
Personal Competence				
Social Competence	The students are able to			
	discuss and organise extensive work packages in ground in the property of	Nunc:		
	 document and present the elaborated results. 	γαρό,		
	document and present the elaborated results.			
Autonomy	The students are capable to			
	 research and select technical literature, including sta 	andards and guidelines;		
	submit own shares in an extensive written elaboration	•		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	Compulsory Bonus Form Description	on		
	No 15 % Subject theoretical and Teilnahr	ne 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: Electi	ve Compulsory		
Following Curricula	International Management and Engineering: Specialisation	II. Logistics: Elective Compulsory		
,	Logistics, Infrastructure and Mobility: Specialisation Product		Isory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastr			
	Renewable Energies: Specialisation Wind Energy Systems:	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Maritime	e Technology: Elective Compulsory	,	

Course L0063: Maritime Transport		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Carlos Jahn	
Language	DE	
Cycle	SoSe	
	The general tasks of maritime logistics include the planning, design, implementation and control of material and information flows in the logistics chain ship - port - hinterland. 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 Transfer of the Control of th	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Carlos Jahn	
Language	DE	
Cycle	SoSe	
Content	The exercise lesson bases on the haptic management game MARITIME. MARITIME focuses on providing knowledge about structures and processes in a maritime transport network. Furthermore, the management game systematically provides process management methodology and also promotes personal skills of the participants.	
Literature	 Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Koch Susanne. Methoden des Prozessmanagements. In: Einführung in das Management von Geschäftsprozessen. Springer, Berlin, Heidelberg, 2011. Liebetruth, Thomas. Prozessmanagement in Einkauf und Logistik, Springer Gabler: Wiesbaden, 2020. Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009. Stopford, Martin. Maritime Economics Routledge, 2009 	

Module M1721: Wate	r and Environment: Theory and Application			
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, Hydrolog	ıy		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	Common research tools and techniques together with the fundamental knowledge relevant to multi-scale and multi-phase challenges present in water and environmental research will be discussed in this module. Both theory and application will be considered.		•	
Skills	In addition to the fundamental knowledge, the students will be exposed to several analytical, experimental and numerical tools and techniques relevant to water and environmental research at different scales. This will provide the students with an excellent 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 Research-Based Teaching approaches will be at the core of this module.		e of this module.	
Autonomy	The students will be involved in writing individual reports and presentation. This will contribute to the students' ability and willingness to work independently and responsibly.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	Environmental Engineering: Specialisation Environment and Clim	nate: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Elec	ctive Compulsory		
	Water and Environmental Engineering: Specialisation Water: Ele	ctive Compulsory		
	Water and Environmental Engineering: Specialisation Environme	ent: Compulsory		

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 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	

Module M1724: Smar			
Courses			
Title	Typ Hrs/wk CP		
Smart Monitoring (L2762)	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 modeling, programming, and sensor technologies are helpful. Interest in model		
Knowledge	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 in scientific writing and good English skills.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge			
	decentralized smart systems to be applied for continuous (remote) monitoring of systems in the built and in the natu		
	environment. In addition, the students will learn to design and to implement intelligent sensor systems using state-of-the-art dates and the students will be s		
	analysis techniques, modern software design concepts, and embedded computing methodologies. Besides lectures, project worl		
	also part of this module, which will be conducted throughout the semester and will contribute to the grade. In small groups,		
	students will design smart monitoring systems that integrate a number of "intelligent" sensors to be implemented by the studer		
	Specific focus will be put on the application of machine learning techniques. The smart monitoring systems will be mounted		
	real-world (built or natural) systems, such as bridges or slopes, or on scaled lab structures for validation purposes. The outcome		
	every group will be documented in a paper. All students of this module will "automatically" participate with their smart monitor		
	system in the annual "Smart Monitoring" competition. The written papers and oral examinations form the final grades. The mod		
	will be taught in English. Limited enrollment.		
Skills	The students will gain insights into operating state-of-the-art smart sensor systems, used for monitoring a wide range of phys		
Skiiis	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		
	be able to document the findings of their projects in short reports.		
Personal Competence			
•			
Social Competence	The students will be able to work in groups, share parts of the work for their projects, and develop communication skills, towards as the same project goals.		
	achieving the common project goals.		
Autonomy	The students will be able to gain a solid basis on approaching and solving problems in engineering, as well as on document		
	results, through their involvement in their monitoring group projects.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points			
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: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory		
	Environmental Engineering: Specialisation Energy and Resources: Elective Compulsory		
	Environmental Engineering: Specialisation Environment and Climate: Elective Compulsory		
	Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory		
	Mechatronics: Technical Complementary Course: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: 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 L2762: Smart Monitoring		
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 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 Thin-walled structures (L1199) Thin-walled structures (L3045)		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3
Module Responsible	Prof. Bastian Oesterle	rectation section (large)		3
•				
Recommended Previous Knowledge	Structural Analysis I Structural Analysis II Finite Element Methods			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence Knowledge	After successful completion of this module, the student walled structures.	s can express the basic aspects of	the load-carryin	g behaviour of thin-
Skills	After successful completion of this module, the students will be able to predict load-carrying behaviour of thin-walled structures using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	participate in subject-specific and interdisciplinary defend their own work results in front of others promote the scientific development of colleagues Furthermore, they can give and accept professiona			
Autonomy	Students are able to gain knowledge of the subject area they are able to structure the solution process for probler			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elec Civil Engineering: Specialisation Geotechnical Engineering Civil Engineering: Specialisation Computational Engineering Civil Engineering: Specialisation Structural Engineering: E	g: Elective Compulsory ng: Compulsory		
	Theoretical Mechanical Engineering: Specialisation Simula	tion Technology: Elective Compulso	ry	

Course L1199: Thin-walled st	tructures
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bastian Oesterle
Language	DE
Cycle	SoSe
Content	Plates loaded in-plane
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Airy stress function Plane stress / plane strain Structural behaviour of plates loaded in-plane 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	 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 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 Title Offshore Geotechnical Engineering (LC Hydro Power Use (L0013)	able energy from wind and water			
Title Offshore Geotechnical Engineering (LC				
Offshore Geotechnical Engineering (LC				
		Тур	Hrs/wk	СР
Hydro Power Use (LUU13)	0067)	Lecture	1	1
Wind Turbine Plants (L0011)		Lecture Lecture	1 2	1 3
Wind Energy Use - Focus Offshore (L0)	012)	Lecture	1	1
Module Responsible D	r. Marvin Scherzinger			
Admission Requirements N	one			
Recommended Previous M	odule: Technical Thermodynamics I,			
Knowledge M	odule: Technical Thermodynamics II,			
М	odule: Fundamentals of Fluid Mechanics			
Educational Objectives Af	fter taking part successfully, students have reached	the following learning results		
Professional Competence				
of to in	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use ir offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countries outside Europe.			
	Through active discussions of various topics within the seminar of the module, students improve their understanding and the application of the theoretical background and are thus able to transfer what they have learned in practice.			
as	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.			
Personal Competence				
•				
	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.			
Workload in Hours In	dependent Study Time 110, Study Time in Lecture	70		
Credit points 6				
Course achievement N	one			
Examination W	ritten exam			
Examination duration and 18 scale	180 min			
	ivil Engineering: Specialisation Structural Engineerin	a: Flective Compulsory		
-	ivil Engineering: Specialisation Structural Engineerin			
•	ivil Engineering: Specialisation Coastal Engineering:			
In	sternational Management and Engineering: Specialis	ation II. Energy and Environmenta	al Engineering: Elective	Compulsory
In	ternational Management and Engineering: Specialis	ation II. Renewable Energy: Electi	ve Compulsory	
Pr	roduct Development, Materials and Production: Spec	cialisation Product Development: E	Elective Compulsory	
Pr	roduct Development, Materials and Production: Spec	cialisation Production: Elective Cor	mpulsory	
	roduct Development, Materials and Production: Spec	cialisation Materials: Elective Com	pulsory	
	enewable Energies: Core Qualification: Compulsory			
	heoretical Mechanical Engineering: Specialisation En			
	rocess Engineering: Specialisation Environmental Pro		ulsory	
	/ater and Environmental Engineering: Specialisation /ater and Environmental Engineering: Specialisation		v	
	rater and Environmental Engineering: Specialisation	·	у	
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Course L0067: Offshore Geotechnical Engineering			
Тур	Lecture		
Hrs/wk			
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Jan Dührkop		
Language	DE		
Cycle	SoSe		
Content	 Overview and Introduction Offshore Geotechnics Introduction to Soil Mechanics Offshore soil investigation Focus on cyclical effects Geotechnical design of offshore foundations Monopiles Jackets Heavyweight foundations Geotechnical preliminary exploration for the use of lift boats and platforms 		
Literature	 Randolph, M. and Gourvenec, S (2011): Offshore Geotechnical Engineering. Spon Press. Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London BSH-Standard Baugrunderkundung für Offshore-Windenergieparks Lesny K. (2010): Foundations for Offshore Wind Turbines. VGE Verlag, Essen. EA-Pfähle (2012): Empfehlungen des Arbeitskreises Pfähle der DGGT. Ernst & Sohn, Berlin. 		

Course L0013: Hydro Power	Use		
Тур	Lecture		
Hrs/wk			
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 Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 16, Study Time in Lecture 14
	Prof. Martin Skiba
Language	
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.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M1895: Digita	al Twinning in Civil Engine	ering		
Courses				
Title		Тур	Hrs/wk	СР
Digital Twinning in Civil Engineering	g (L3136)	Lecture	2	2
Digital Twinning in Civil Engineering	g (L3137)	Seminar	2	4
Module Responsible	Alexander Chmelnizkij			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, student	ts have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study T	Fime in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	20 min presentation and 5 pages hand	dout		
scale				
Assignment for the	Civil Engineering: Specialisation Comp	putational Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coast	tal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Geote	echnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Struc	ctural Engineering: Elective Compulsory		

Course L3136: Digital Twinni	ourse 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 Twinni	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	al Hydraulic Engineering I				
Courses					
Title		1	Гур	Hrs/wk	СР
Basics of Coastal Engineering (L080	07)	L	ecture	3	4
Basics of Coastal Engineering (L142	.3)	F	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	g 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 constructions.				
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.			engineering.	
Personal Competence					
Social Competence	The students are able to deploy their gain	ined knowledge in applie	ed problems such as the design	n of coastal p	rotection structures.
	Additionaly, they will be able to work in te	eam with engineers of oth	ner disciplines, for instance des	igning of coas	stal breakwaters.
Autonomy	The students will be able to independently	y extend their knowledge	e and applyit to new problems.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 2 ho	ours. The examination in	cludes tasks with respect to	the general u	nderstanding of the
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Coastal E	Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Compu	lsory		
	Civil Engineering: Specialisation Structura	al Engineering: Elective C	ompulsory		
	Environmental Engineering: Specialisation	n Environment and Clima	te: Elective Compulsory		
	Environmental Engineering: Specialisation	n Water Quality and Wate	er Engineering: Elective Compu	lsory	
	International Management and Engineering	ng: Specialisation II. Civil	Engineering: Elective Compulse	ory	
	Water and Environmental Engineering: Sp				
	Water and Environmental Engineering: Sp	pecialisation Water: Elect	ive Compulsory		

Course L0807: Basics of Coas	stal Engineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Peter Fröhle
Language	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
Literature	Coastal Engineering Manual, CEM
	Vorlesungsumdruck

ourse 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 M0595: Exam	ination of Materials, Structural Cond	ition and Damages		
Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura		Lecture	3	4
Examination of Materials, Structura	l Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials or mater	rial science, for example by the mo	dule Building Ma	terials and Buildin
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tradin methods for the testing of building material properties testing methods.	•		
Skills	The students are able to responsibly discover the rules. They are able to chose suitable methods for the testir the examination of the structural conditions of building are able to describe an examination in form of a test in	ng and inspection of construction produ gs. They are able to conclude from syn	icts, the examina	-
Personal Competence Social Competence	The students can describe the different roles of manuframework of material testing. They can describe the o	• .	•	on bodies within th
Autonomy	The students are able to make the timing and the open	ration steps to learn the specialist knov	vledge of a very e	xtensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Structural Engineering	g: Elective Compulsory		
	International Management and Engineering: Specialisa	ation II. Civil Engineering: Elective Comp	oulsory	
	Materials Science: Specialisation Engineering Materials	s: 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	ourse L0261: Examination of Materials, Structural Condition and Damages	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0713: Conci	rete Structure:	5			
Courses					
Title			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L0577)			Lecture	2	3
Structural Concrete Members (L05)	78)		Recitation Section (la	rge) 2	2
Module Responsible	Dr. Adrian Faron				
Admission Requirements	None				
Recommended Previous	Basics of structural analysis, conception and dimensioning of structural concrete				
Knowledge	Modules Reinforced				
	Modules. Reillioreed	concrete structures in	-II, Structural Analysis I+II, Mechanics I+II		
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence		•			
Knowledge					
	the knowledge for the conception and design of concrete buildings and structural members that are often used.				
			, and the second		
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 desigr	n and construction sketches and draw up to	echnical descriptions.	
Personal Competence					
Social 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 Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	No None	Presentation	Es werden 2 Referate ausgegeber	1	
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compulsory				
Following Curricula					
-	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory				
			: Specialisation II. Civil Engineering: Electi	ve Compulsorv	

Course L0579: Concrete Structures				
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
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	 skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members
Literature	 Vorlesungsunterlagen können im STUDiP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser: Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997

Course L0578: Structural 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

	rated Transportation Planning
Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	g (L1068) 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 Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	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 measures.
	relate current issues in the area of integrated transport planning and formulate an opinion on them.
Skills	Students are able to:
	 quantify important parameters, which influence travel demand or are influenced by it. comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document to the comprehensively examine.
	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
	 assess potential consequences of their future professional activities independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
Examination	
Examination duration and	
scale	
Assignment for the	
Following Curricula	
3	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 Transportation Planning		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß	
Language	DE	
Cycle	WiSe	
Content	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.: • interactions between transport and the environment and consequent limitations • characteristics of integrated planning • complex planning processes • interdependencies of location choice and mobility behaviour • transport and land-use policies • project on current issues in transportation studies	
Literature	Kutter, Eckhard (2019) Stadtstruktur und Erreichbarkeit in der postfossilen Zukunft. Erich Schmidt Verlag. Berlin. Gies, Huber u. a. (Hrsg.) (93. Ergänzung 2022) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)	

Module M0963: Steel	and Composite Structures			
	•			
Courses				
Title		Тур	Hrs/wk	CP
Steel and Composite Structures (L1		Lecture	2	2
Steel and Composite Structures (LI Steel Bridges (L1097)	1205)	Recitation Section (large) Lecture	2	2
Module Responsible	Prof. Marcus Butner	Lecture	2	2
Admission Requirements	None			
Recommended Previous		I RURC)		
Knowledge	basics of steel construction (i.e. steel structures) and i	1, 5050)		
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence	Their taking part successionly, stadents have rederied to	Te following rearring results		
•	After successful completition, students can			
J	·			
	describe the phenomenon of local buckling			
	explain warping torsion			
	illustrate the behaviour of composite structures			
	 specify the principles in design of composite sttr 			
	 sketch the contructions of steel and composite b 	ridges		
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structures	5		
	 recognize and verify warping tosion in strucures 			
	design composite structures			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
	Civil Engineering: Specialisation Computational Engineer			
	International Management and Engineering: Specialisat		ulsory	

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

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

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

ourses	
itle	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 ar 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 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	
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	The number of pages depends on the task.
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Compulsory
Following Curricula	

Title				
Design of Commonly Building (1200)		Тур	Hrs/wk	СР
Design of Composite Bridges (L3092	2)	Integrated Lecture	2	3
Analysis of Offshore Structures (L18)		Lecture	1	1
Solid Matter Process Technology for	Biomass (L0052)	Lecture	2	3
Innovative Timber Construction (L26	666)	Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Sustainable landfill design and opera		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 I			2	2
Special topics of civil engineering 3 l Structural Design (L2789)	LP (LZ38U)	Seminar	3	3
	Duff Food Calculat Bill	Seriillai	2	2
	Prof. Frank Schmidt-Döhl			
	None			
	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned 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 structure of the second of		civii and structura	itural engineering.	
	Students are able to interrelate scientific ar	nd technical knowledge.		
Skills	Students are able to apply basic methods in	selected areas of civil and structural engin	neering	
	Students are upic to apply basic methods in	r selected dreas or civil and structural engil	icering.	
Personal Competence				
Social Competence				
Autonomy				
	 Students can chose independently, in which 	h fields they want to deepen their knowle	dge and skills thr	rough the election o
	courses.			
Workload in Hours	Depends on choice of courses			
	6			
	Civil Engineering: Specialisation Structural Engine	ering: Flective Compulsory		
-	Civil Engineering: Specialisation Structural Engine Civil Engineering: Specialisation Geotechnical Eng			
	Civil Engineering: Specialisation Geotechnical Eng Civil Engineering: Specialisation Coastal Engineeri			
1.				
	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	

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

Course L0052: Solid Matter I	Process Technology for Biomass
	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 Structur	res		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent 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 landfill design and operation			
Тур	Integrated Lecture		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Examination Form	Klausur		
Examination duration and	60 min		
scale			
Lecturer	Dr. Marco Ritzkowski		
Language	EN		
Cycle	SoSe		
Content	The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context.		
Literature	 Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB 		

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

Course L2378: Special topics 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	

Module M0801: Wate	r Resources and -Supply			
Courses				
Title	_	Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatment (L0311)		Lecture	2	1
Chemistry of Drinking Water Treatr	nent (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04		Lecture	2	2
Water Resource Management (L04	03)	Recitation Section (small)	1	1
Module Responsible				
Admission Requirements				
Kecommended Previous Knowledge	Knowledge of water management and the k	key processes involved in water treatment.		
	After taking part cusperfully, students have	re reached the following learning recults		
Educational Objectives	After taking part successfully, students hav	re reactied the following learning results		
Professional Competence	City of the second seco			6
	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainabl water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain an outline the organisational structures of water companies. They will be able to explain the available water treatment processes an the scope of their application.			
Skills	Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students will be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and standards to these processes.			
Personal Competence				
Social Competence	Working in a diverse group of 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 user interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others.			
Autonomy	Students will be in a position to work on a s	Students will be in a position to work on a subject independently and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
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 Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Chemical and Bioprocess Engineering: Tech	nnical Complementary Course: Elective Compuls	sory	
	Chemical and Bioprocess Engineering: Tech	nnical Complementary Course: Elective Compuls	sory	
	International Management and Engineering	: Specialisation II. Energy and Environmental Er	ngineering: Elective	Compulsory
	Process Engineering: Specialisation Environ	nmental Process Engineering: Elective Compulso	ry	
	Process Engineering: Specialisation Process	s Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spe-	cialisation Water: Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe-	cialisation Cities: Elective Compulsory		

Course L0311: Chemistry of	Drinking Water Treatment
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
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	urse L0312: Chemistry of Drinking Water Treatment		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	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	

Module MISOS: Adap	tation to Climate Change in Hyd	radic Engineering (ARWA3)		
Courses				
Γitle		Тур	Hrs/wk	СР
Adaptation to climate change in hy	draulic engineering (L2291)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous				
Knowledge	Hydrology, Hydraulic Engineering			
	Hydromechanic, Hydraulics Fundamentals of Coastal Engineering Coastal Enginee	and I and Flood Protection		
	Fundamentals of Coastal Engineering, C Hydrological Systems	oastal- and Flood Protection		
	Hydrological Systems			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Climate protection and climate adaptati	on		
	 Climate protection and climate adaptati Insights into climate change and its regi 	on onal characteristics - fundamentals, climate model	lling / climate	models
		onents of the regional hydrological cycle	illing / cilinate	models
	Fundamentals of analysis of climate dat			
	Consequences of the impact of the climater			
	Measures for climate adaptation			
	Assessment, prioritization and communi	cation of adaptation measures		
	Fundamentals of the analysis of hydrom	eteorological and hydrological data		
Skills	Critical thinking: analysis of processes a	nd relations, assessment of needs for action		
	Creative thinking: development of adapt			
	 Practical thinking: inclusion of restriction 	ons, application of calculation approaches, meth	nods, numerio	al models, planr
	methods			
	 Consideration of complex tasks 			
B 16				
Personal Competence				
Social Competence	Working in heterogenous groups			
	Working with different scientific / non-scientific /	cientific disciplines		
	Self reflection			
4				
Autonomy	Application oriented use of knowledge a	nd skills		
	 Autonomous work on complex tasks 			
Workload in Hours	Independent Study Time 124. Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Preparation of a written report and a presental	ion of a complex task.		
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical I	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Cities: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Environment: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Water: Elective Compulsory		

Course 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	-		Hrs/wk	СР
Title Scientific Working in Computationa		Typ Project-/problem-based Learning	6	6
	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String interest in topics relate	ed to computing in civil engines	ering.	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Kilowieuge	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 scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A project will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance in this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be written based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.			
Skills	The students will be capable (i) of solving a scientific problem following a scientific methodology, (ii) of documenting their work effectively in the form of a paper, and (iii) of sharing their work in a presentation.			
Personal Competence				
Social Competence	The students will be able to work in a multidisciplinary team and de	evelop communication skills ne	cessary for pr	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 projec
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 Comput	Isory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Com	pulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective Co	ompulsory		
	Civil Engineering: Specialisation Computational Engineering: Elective	ve Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Election	ive Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory			
	Mechatronics: Technical Complementary Course: Elective Compulso	orv		

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
	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 Hydraulic Engineering			
	Hydromechanics, Hydraulics Fundamentals of Coastal Engineering, Coastal or	d Flood Protection		
	 Fundamentals of Coastal Engineering, Coastal- ar 	a Flood Protection		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	a Climate and Climate Change			
	Climate and Climate Change General Impacts of Climate Change on Wind Regi	me and Water Cycle		
	Consequences of Climate Change for Coastal Proc			
	Coastal Protection in Taiwan and Germany			
	Fundamentals of Climate Adaptation			
	 Nature-based Solutions (NBS) for Coastal Protecti 	on		
Skills				
SKIIIS	Critical thinking: analysis of processes and relation	ns, assessment of needs for action		
	 Creative thinking: development of adaptation strain 	tegies and adaptation measures		
	 Practical thinking: inclusion of restrictions, appl 	cation of calculation approaches, meth	ods, numerica	l models, plannin
	methods			
	Consideration of complex tasks			
Personal Competence				
Social Competence	Mod See Selection			
	Working in heterogenous groups Working in international groups			
	Working in international groups Working with different scientific / non-scientific di	sciplines		
	Self reflection	ocipinies		
Autonomy	Application oriented use of knowledge and skills			
	Autonomous work on complex tasks			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
	Written elaboration			
	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	n the complex tas
scale		ativa Camandaan		
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Ele Civil Engineering: Specialisation Geotechnical Engineering			
i onowing curricula	Civil Engineering: Specialisation Structural Engineering:			
	Civil Engineering: Specialisation Water and Traffic: Elect			
	Environmental Engineering: Specialisation Environment			
	Water and Environmental Engineering: Specialisation Ci			
	Water and Environmental Engineering: Specialisation Er	vironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation W	story Floating Commulatory		

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

Module M1844: Mode	rn discretization methods in st	ructural mechanics		
Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in s	tructural mechanics (L3043)	Lecture	2	3
Modern discretization methods in structural mechanics (L3044) Recitation Section (small) 2 3			3	
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Finite Element Methods			
Knowledge	Flächentragwerke			
	Trachendragwerke			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, s	tudents can express the basic aspects of mode	ern discretization r	methods in structura
	mechanics.			
Skills	After successful completion of this module, th	ne students will be able to use and further imp	ovo modorn dicer	atization mothods for
SKIIIS	problems in structural mechanics.	ie students will be able to use and further impl	ove modern discre	etization methods to
	problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and intermediate 	rdisciplinary discussions		
	defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend their own work results in front of the defend the d			
	promote the scientific development of			
	Furthermore, they can give and accept	· ·		
	3			
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 proces	s for problems in the area of modern discretiza	tion methods.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnica	l Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Er	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Computation	al Engineering: Elective Compulsory		
	Computational Engineering: Core Qualificatio	n: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialis	sation Simulation Technology: Elective Compuls	sory	

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	

Module M1956: Buildi	ing and Excavation Law			
Courses				
Title		Тур	Hrs/wk	СР
Construction law BGB and VOB - law	w in (excavation) practice (L3182)	Lecture	2	3
Construction disputes from constru	ection (excavation) practice (L3181)	Lecture	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
	Complete modules: Geotechnics I-III			
Knowledge				
-	After taking part successfully, students have	reached the following learning results		
Professional Competence Knowledge	Students will gain knowledge of			
	a the history of sivil angineering law			
	the history of civil engineering law,basics of foundation and civil engineer	ing law		
	legal aspects of technical regulations i			
	the civil engineering contract,			
	the liability of the designer and contra	ctor in civil engineering,		
	 the subsoil risk and the system risk, 			
	 the total debt in (civil) engineering law 	<i>I</i> ,		
	·	idance models and the construction process	,	
	the systematics of construction contra	ct law,		
	the BGB construction contract law,			
	· ·	responsibilities on the construction site,		
		remuneration and contract management, liability for defeats.		
	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 plan	ning and construction in a legally balanced	way Students learn h	now to use legal and
SKIIIS	construction management aspects in practic			
	to manage the construction project optimally			
Personal Competence				
Social Competence	Students can work in groups and support each	ch other in finding solutions.		
Autonomy	Students are able to assess their own strengt	ths and weaknesses and organize their time	and learning manage	ment based on this.
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory		
Following Curricula				
	Civil Engineering: Specialisation Structural Er			
	Civil Engineering: Specialisation Water and T			
	Civil Engineering: Specialisation Computation	nai Engineering: Elective Compulsory		

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

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

Module M0859: Coast	al Hydraulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Coastal- and Flood Protection (L080	08)	Lecture	2	3
Coastal- and Flood Protection (L14)		Project-/problem-based Learning	1	1
Maintenance and Defence of Flood		Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements				
Recommended Previous	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students have the capability to define and exp	lain in detail the important aspects of erosion	on protection	and flood protection
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension importan			dimension important
	coastal protection measures from the functional and	I from the constructional point of view.		
Skille	The students are able to select design approaches	for the functional and constructional design	in of erosion	and flood protection
Skiiis	measures and apply these approaches to practical d		jii oi ciosioii	and nood protection
	incasares and appropriate approaches to practical a	ico.g., tables		
Personal Competence				
Social Competence	The students are able to deploy their gained know	ledge in applied problems such as the fund	ctional and co	onstructive design of
	coastal and flood protection structures. Additionaly,	they will be able to work in team with engine	eers of other o	lisciplines.
Autonomy	The students will be able to independently extend the	neir knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	: 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The	examination includes tasks with respect to	the general ι	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	g: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory		
	Environmental Engineering: Specialisation Environm	ent and Climate: Elective Compulsory		
	Environmental Engineering: Specialisation Water Qu		lsory	
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	n Water: Elective Compulsory		

Course L0808: Coastal- and I	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
	Callingah burganah
	Sediment transportMorphology
	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	Course 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

	gical Waste Treatment			
Courses				
Title		Тур	Hrs/wk	СР
Waste and Environmental Chemist	y (L0328)	Practical Course	2	2
Biological Waste Treatment (L0318)	Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous	chemical and biological basics			
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	The module aims possess knowledge concerning			
	design and layout of anaerobic and aerobic waste	treatment plants in detail, describe different to	echniques for	waste gas treatm
	plants for biological waste treatment plants and e	xplain different methods for waste analytics.		
Skills	The students are able to discuss the compilation		-	
	control measurements. The students can recher		I to the tasks	given in der mod
	and plan additional tests. They are capable of ref	ecting and evaluating findings in the group.		
Personal Competence				
Social Competence	Students can participate in subject-specific and			
	work results in front of others and promote the	scientific development in front of colleagues	. Furthermore	, they can give a
	accept professional constructive criticism.			
Autonomy	Students can independently tap knowledge from			
	are capable, in consultation with supervisors as w			
	steps on this basis. Furthermore, they can define potential social, economic and cultural impact.	e targets for new application-or research-orien	ted duties in	accordance with
	potential social, economic and cultural impact.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes None Subject theoretical ar	nd		
	practical work			
Examination	Presentation			
Examination duration and	Elaboration and Presentation (15-25 minutes in g	roups)		
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic	:: Elective Compulsory		
	Bioprocess Engineering: Specialisation A - Genera	l Bioprocess Engineering: Elective Compulsory		
	Chemical and Bioprocess Engineering: Specialisat			
	Chemical and Bioprocess Engineering: Specialisat	• •		
	Chemical and Bioprocess Engineering: Specialisat			ry
	Chemical and Bioprocess Engineering: Specialisat		-	
	Chemical and Bioprocess Engineering: Specialisat		ive Compulso	ry
	Environmental Engineering: Core Qualification: Co			
	International Management and Engineering: Spec	•	Isory	
	Process Engineering: Specialisation Environmenta			
	Water and Environmental Engineering: Specialisa	· · ·		
	Water and Environmental Engineering: Specialisa			

Course L0328: Waste and En	vironmental Chemistry
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	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	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			

Module M2025: Finite	e element modeling of structures			
Courses				
Title		Тур	Hrs/wk	СР
Finite element modeling of structur	res (L3046)	Lecture	2	3
Finite element modeling of structur	res (L3047)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	- Finite Flamout Matheda			
Knowledge	Finite Element Methods Thin-walled structures			
	• Triiri-wailed structures			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stude	nts can express the basic aspects of mode	elling of structures	with finite elements.
Skills	After successful completion of this module, the	students will be able to model structur	es with finite elem	ents and to analys
55	structures using appropriate computational metho			circo aria co arialyo
	and all the second seco			
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdisc	iplinary discussions.		
	defend their own work results in front of ot	•		
	promote the scientific development of colle	eagues		
	Furthermore, they can give and accept pro	fessional constructive criticism		
Autonomy	Students are able to gain knowledge of the subje	ct area from given and other sources and	apply it to new pro	oblems Furthermore
,	they are able to structure the solution process for	•		
	,	<u> </u>		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	written elaboration of a project work (10-15 pages	5)		
scale				
Assignment for the	Civil Engineering: Specialisation Computational En	ngineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
	Computational Engineering: Core Qualification: El	ective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	n Simulation Technology: Elective Compu	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	ourse L3047: Finite element modeling of structures		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Bastian Oesterle		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M2033: Subsu	ırface Processes				
Courses					
Title		Typ		Hrs/wk	СР
Modeling of Subsurface Processes (L2731)	Recitation	n Section (small)	3	3
Subsurface Solute Transport (L272)	3)	Lecture		2	2
Subsurface Solute Transport (L272	9)	Recitation	n 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 re	ached the following learni	ng results		
Professional Competence					
Knowledge	Upon completion of this module, the student	s will understand the me	chanisms controlling	solute transport	in soil and natural
	porous media and will be able to work with the	equations that govern the	fate and transport o	f solutes in poro	us media. Analytical,
	numerical and experimental tools and techniqu	es will be used in this mod	lule.		
Skills	In addition to the physical insights, the student		·		
	this module. This provides them with an excell	ent opportunity to improve	their skills on multip	ole fronts which w	vill be useful in their
	future career.				
Personal Competence					
,	Teamwork & problem solving				
Autonomy	The students will be involved in writing individual reports and presentation. This will contribute to the students' ability and				
	willingness to work independently and responsibly.				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Report				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compuls	ory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	Engineering: Elective Comp	oulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsor	у		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory			
	Civil Engineering: Specialisation Computational	Engineering: Elective Con	npulsory		
	Chemical and Bioprocess Engineering: Technical	al Complementary Course:	Elective Compulsory		
	Chemical and Bioprocess Engineering: Technical	al Complementary Course:	Elective Compulsory		
	Environmental Engineering: Core Qualification:	Compulsory			
	Process Engineering: Specialisation Environment	ntal Process Engineering: I	Elective Compulsory		
	Process Engineering: Specialisation Process En	gineering: Elective Compu	sory		
	Water and Environmental Engineering: Special	sation Water: Compulsory			
	Water and Environmental Engineering: Special	sation Environment: Elect	ve 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	ourse L2728: Subsurface Solute Transport			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	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: Introd	duction to Climate Informed Eng	ineering		
Courses				
Title		Тур	Hrs/wk	СР
Methods in Climate Informed Engin	_	Lecture	3	3
Topics in Climate Informed Enginee		Lecture	3	3
Module Responsible				
Admission Requirements				
	Students are expected to have a foundation	-	•	
Knowledge	,	•		th engineering design
	processes. Analytical and critical thinking and o	creative problem-solving skills are also b	eneticiai	
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	This module explores next-generation climate	models and high-resolution data, emp	hasizing their impact o	n environmental ar
	engineering products and processes. It covers	how various engineering disciplines can	benefit from climate in	formation. Researc
	based learning activities, expert talks, and p	resentations will expose students to st	ate-of-the-art modeling	, measurement, ar
	analysis in climate-informed engineering.			
Skills	Climate data analysis, engineering adaptat	ion strategies, problem-solving, rese	arch-based learning.	and interdisciplina
	collaboration.	5,	3 ,	
Personal Competence				
Social Competence				
	climate-resilient engineering.			
Autonomy	Time management, self-directed learning, cr	itical thinking, accountability, initiative	e, 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 Lecture 84			
Credit points	, , ,			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
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 Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
	Civil Engineering: Specialisation Computational	Engineering: Elective Compulsory		
	Data Science: Specialisation III. Applications: El	ective Compulsory		
	Environmental Engineering: Core Qualification:	Elective Compulsory		
	Process Engineering: Specialisation Process En			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali	•	У	
	Water and Environmental Engineering: Special	sation Water: Elective Compulsory		

Course L3347: Methods in Cl	ourse L3347: Methods in Climate 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	

Module M2156: Wate	r Protection				
•					
Courses					
Title		Тур	Hrs/wk	СР	
Nater Protection (L3459)		Integrated Lecture	6	6	
Module Responsible	Prof. Simon Michael Papalexiou				
Admission Requirements	None				
Recommended Previous	Basic knowledge in water manager	ment;			
Knowledge	Good knowledge in urban drainage);			
	Good knowledge of wastewater tre	atment techniques;			
	 Good knowledge of pollutants (e.g. 	COD, BOD, TS, N, P) and their properties;			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
Professional Competence	The taking part successiony, students in	ave redefied the following feditining results			
	The students can describe the basic princ	ciples of the regulatory framework related to the i	nternational and Fu	ronean water secto	
Momeage		s, substance cycles and water morphology in d			
		ich as ecosystem service and wastewater treatr			
	solutions, remediation measures as well a		·		
Ckilla	Students can accurately accord surrent a	problems and situations in a country-specific or lo	ocal context. They	an suggest concret	
SKIIIS	·	f tomorrow's urban water cycle. Furthermore, tl	-		
	administrative and legislative solutions to		ney can suggest ap	opropriate tecinica	
Personal Competence					
Social Competence	The students can work together in international groups.				
Autonomy	Students are able to organize their work flow to prepare presentations and discussions. They can acquire appropriate knowledg by making enquiries independently.				
Workload in Hours	Independent Study Time OF Study Time i	in Lactura 94			
Credit points		in Lecture 04			
Course achievement	Compulsory Bonus Form	Description			
Common delinered literature	Yes 20 % Presentation	10-minütige Präsentation von Arbeitser	gebnissen		
Examination	Written exam				
Examination duration and	150 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechr				
	Civil Engineering: Specialisation Structura				
	Civil Engineering: Specialisation Water an				
		n Water Quality and Water Engineering: Elective C			
		ng: Specialisation II. Civil Engineering: Elective Co	mpulsory		
	Water and Environmental Engineering: Sp				
	Water and Environmental Engineering: Sp				
	Water and Environmental Engineering: Sp	pecialisation 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						
Title			Тур		Hrs/wk	СР
Uncertainty Modelling for Engineer	rs (L3458)			ted Lecture	6	6
Module Responsible	Prof. Simon Michael Papalexio	ı				
Admission Requirements	None					
Recommended Previous						
Knowledge		-	•			
	 Elementary probability Basic computer skills for 		u mathematical skiils.			
	Interest in solving engi		using statistical and pro	pabilistic methods	i.	
			g p		-	
	After taking part successfully	students have re	eached the following learr	ing results		
Professional Competence						
Knowledge	Students will develop a stroi					
	introduces probability as a n					
	probability distributions, extruncertainty in engineering properties.				•	
	decision-making and predicti			-		
	and disutility and learn how to					
C1.''I	B. the control of the control of		1	data ta caracte		
SKIIIS	By the end of the course, stud					
	problems. They will gain exp inference to real-world engil					
	enabling them to analyze cor					
	they will learn to implement					
	decision-making.			4	,	3
Personal Competence			. H. L P L			
Social Competence	· ·					
	effectively with peers, engin uncertainty quantification, e					
	challenges.	saring that the	Jineening unaryses are i	John Tigorous uni	a applicable to real	world initiastract
	_					
Autonomy						
	distributions, regression met risks associated with natural		•			-
	assessment, and disaster mit		e nazarus, ensuring they	can make miorme	ed engineering decisi	ons in design, sa
	assessment, and disaster mit	41011.				
Workload in Hours	Independent Study Time 96, 9	udy Time in Lec	ture 84			
Credit points						
Course achievement	Yes 20 % Preser	ation	Description 10-minütige Präsent	ation von Arheitse	orgehnissen	
Fyamination	Written exam	acion	10-minutige Frasent	acion von Arbeitse	i gebrii 33eri	
Examination duration and						
scale						
Assignment for the	Civil Engineering: Specialisati	n Coastal Engine	eering: Elective Compulso	ry		
Following Curricula	Civil Engineering: Specialisati	n Geotechnical F	Engineering: Elective Com	pulsory		
	Civil Engineering: Specialisati	n Structural Eng	ineering: Elective Compu	lsory		
	Civil Engineering: Specialisati	n Computational	l Engineering: Elective Co	mpulsory		
	Civil Engineering: Specialisati	n Water and Tra	ffic: Elective Compulsory			
	Civil Engineering: Specialisati					
	Civil Engineering: Specialisati		3 3	. ,		
	Civil Engineering: Specialisati					
	Civil Engineering: Specialisati			mpulsory		
	Civil Engineering: Specialisati Environmental Engineering: C					
	Environmental Engineering: C					
	Water and Environmental Eng			mpulsorv		
	water and Environmental End		isation Environment: Elec	tive Compulsorv		
	Water and Environmental Eng					
		neering: Special	isation Water: Elective Co	mpulsory		
	Water and Environmental Eng	neering: Speciali neering: Speciali	isation Water: Elective Co isation Cities: Elective Co	mpulsory mpulsory		

Course L3458: Uncertainty Modelling 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. Handson 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: Geoto	echnics III			
Courses				
Title		Time	Hwa hude	СР
Numerical Methods in Geotechnics	(10375)	Typ Lecture	Hrs/wk 3	3
Advanced Foundation Engineering		Lecture	2	2
Advanced Foundation Engineering		Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
•	Geotechnics I and II, Mathematics I-III			
Knowledge	· ·			
Educational Objectives		ving learning results		
Professional Competence	31 7.			
	After successfully completing the module, students will be able	to		
	describe individual procedures for the geotechnical moni	itoring of civil engineering measu	ıres,	
	reproduce exploration and investigation methods of the	subsoil,		
	 select suitable types of field and laboratory tests for sub 	soil investigation and evaluate th	eir results,	
	state the differences between various stress and deform	nation states and the physical sig	nificance of inv	ariants of the stress
	and distortion tensor,			
	outline the standard and special soil mechanics tests use	ed to determine the stress-strain	behavior of soil	l,
	describe continuum models and the resulting boundary v	value problems,		
	as well as define boundary value problems from the field	d of geotechnical engineering in s	such a way that	t they can be solved
	unambiguously.			
Skills	Students will be able to			
	dimension vertical drains for soil improvement of soft soils,			
	calculate depth compaction using various appropriate m	ethods,		
	 apply principles of horizontal bearing capacity of piles, 			
	 verify the internal and external stability of fluid-supported 	ed diaphragm walls,		
	evaluate the boundary conditions for the design of a	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				
Social Competence	Students can work in groups and support each other in finding	solutions.		
Autonomy	_	es and, based on this, organize th	eir time and lea	arning management
	and think in terms of processes.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	lsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Con	npulsory		
	Civil Engineering: Specialisation Coastal Engineering: Compulso	ory		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		
	Civil Engineering: Specialisation Computational Engineering: Co			
	International Management and Engineering: Specialisation II. C	ivil Engineering: Elective Compul	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		

Module M0964: Underground Constructions						
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. Jürgen Grabe					
Admission Requirements	None					
Recommended Previous	Modules from Bachelo	r studies Civil and	environmental enginee	ring:		
Knowledge						
	Geotechnics I-II					
Educational Objectives	After taking part succe	essfully, students h	ave reached the follow	ing 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 %	Excercises				
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Spe-	cialisation Structur	al Engineering: Elective	· Compulsory		
Following Curricula	Civil Engineering: Spe	cialisation Geotech	nical Engineering: Com	pulsory		
	Civil Engineering: Spe	cialisation Coastal	Engineering: Compulso	ry		
	Civil Engineering: Spe	cialisation Water a	nd Traffic: Elective Com	pulsory		
	Civil Engineering: Spe	cialisation Comput	ational Engineering: Ele	ective Compulsory		
	International Manager	nent and Engineer	ng: Specialisation II. Ci	vil Engineering: Elective Comp	oulsory	

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

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

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

Module M1748: Const	truction Robotics		
Courses			
Title	Тур	Hrs/w	k CP
Construction Robotics (L2867)	Project-/problem-based Le		6
Module Responsible	Prof. Kay Smarsly		
Admission Requirements	None		
Recommended Previous	Basics of project-oriented programming		
Knowledge			
Educational Objectives			
Professional Competence			
Knowieage	Basics of robotics		
	Applications in civil engineering		
	Kinematics		
Skills	S 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			
Assignment for the			
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: Election	ve Compulsory	

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

Courses						
Title			Тур		rs/wk	СР
Repair of Structures (L0255)			Lecture	1		1
Mineral Building Materials (L0253)	toriale (L0256)		Lecture	-based Learning 1		2
Technology of mineral Building Ma Transport Processes in Building Ma		esses (I 0254)	Project-/problem- Lecture	-based Learning 1		1
	Prof. Frank Schmidt-D					-
Admission Requirements		70111				
Recommended Previous		out building materials h	uilding physics and building chem	nistry for example	hy the m	andules Principles
Knowledge		-	illding Materials and Building Chem		by the n	lodules Filliciples (
Kilowieuge	building Materials and	a ballaling Frigsics and bi	maning Materials and Building Chem	iisti y.		
Educational Objectives	After taking part succ	essfully, students have r	eached the following learning resul	ts		
Professional Competence						
Skills	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. The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair and strengthening measures.					
Personal Competence Social Competence	The students are able other students. In a		us the mixture of a special mortar. defend and adjust their results. Th 			
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	Compulsory Bonus Form Description Yes 20 % Subject theoretical and practical work					
Examination	Written exam					
Examination duration and scale	120 min					
Assignment for the	Civil Engineering: Spe	ecialisation Geotechnical	Engineering: Compulsory			
Following Curricula	Civil Engineering: Spe	ecialisation Coastal Engir	eering: Elective Compulsory			
	Civil Engineering: Spe	ecialisation Structural En	gineering: Elective Compulsory			
	Civil Engineering: Spe	ecialisation Water and Tr	affic: Elective Compulsory			

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

Course L0253: Mineral Buildi	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	ourse L0254: Transport Processes in Building Materials and Damage Processes	
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Transport Processes in Building Materials and Damage Processes	
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung	

Module M0723: Design of Prestressed Structures and Concrete Bridges				
Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	3	Lecture	3	4
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of concrete	e structures.		
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students know the main bridge types, their applications and the various loads. They can explain the basic design metho			asic design methods
	They can explain the design of a prestressed	bridge.		
Skills	The students are able to design reinforced or prestressed concrete bridges.			
Personal Competence				
Social Competence	The students can design in teamwork a real concrete bridge.			
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Er	ngineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnica	ll Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Computation	nal Engineering: Elective Compulsory		
	International Management and Engineering:	Specialisation II. Civil Engineering: Elective Com	pulsory	

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
	 history of bridges design of 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 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	Mechanics and -Dynamics			
Courses				
litle		Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L0374)		Lecture	2	2
Soil Dynamics (L0452)		Lecture	2	2
experimental Researches in Geote	chnics (L0706)	Practical Course	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules: Mathematics I-III, Mechanics I-II, Geotechnics	I		
Knowledge	Courses: Soil laboratory course, (Applied structural dyn	amics)		
Educational Objectives	After taking part successfully, students have reached t	ne following learning results		
Professional Competence				
Knowledge	Students will be able to,			
	describe wave propagation in the ground under	dynamic excitation and define the	e relevant parameters,	,
	to measure vibrations and to interpret the data of			
	 justify when elastodynamic methods are sufficie 	nt and when plastodynamic effect	ts must be taken into	account,
	to reproduce the collapse theorems of plasticity	theory,		
	 describe the viscous behavior of cohesive soils 	and computationally account for	or creep deformation	and rate-depender
	shear strengthsas well as to determine the effect of partial satu	ration on the seenage flow and th	a shear strength	
Skilla	After the successful completion of the module the stud		e shear strength.	
SKIIIS	,			
	to derive and apply the basic equation of a simp			
	to understand the wave propagation in the soil understand the wave propagation in the soil understand the language of the			
	to know the essential laboratory and field tests to the design machine foundations to dunamic lead.	o determine soil dynamic charact	eristics and to evaluat	e tnem,
	 to design machine foundations to dynamic load, to measure shocks to perform vibration forecast 			
	to evaluate shocks in terms of their effect on per			
	to evaluate shocks in terms of their effect on per to evaluate possibilities of isolation,	opic and bandings,		
	to understand mechanisms that cause earthqua	kes and evaluate earthquakes in t	terms of their magnitu	de and intensity,
	to know methods to determine axial pile capacit			,
	 to know the mechanisms that lead to a deforma 	tion accumulation due to cyclic lo	pading and to estimate	e these deformation
	mathematically,			
	 to distinguish the area of application of the meth 	nod of elastodynamics and plasto	dynamics,	
	 to detect the undrained shear strength as a fund 	tion of a number of state variable	es,	
	 to capture the visous behaviour of cohesive soil 	s and to consider the effects of co	reep and rate-depend	ent shear strength
	calculations,			
	 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 res	ults on measurement and experir	mental principles and	present their resul
	together at the end of the semester.			
Autonomy	Students are able to assess their own strengths and we	saknesses and organize their time	and learning manage	ment hased on this
Autonomy	students are able to assess their own strengths and we	aknesses and organize their time	and learning manage	inche basca on this
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement		ription		
	Yes None Subject theoretical 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 Geotechnical Engineer			
,	Civil Engineering: Specialisation Coastal Engineering: E			
	Civil Engineering: Specialisation Computational Engine	ering: Elective Compulsory		

The second secon	- Selected Topics
Typ Le	ecture
Hrs/wk 2	
CP 2	
Workload in Hours In	ndependent Study Time 32, Study Time in Lecture 28
Lecturer Dr	Dr. Hans Mathäus Stanford
Language Di	DE CONTRACTOR CONTRACT
Cycle So	ioSe
Content se	elected 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	
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	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	 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	CP
Groundwater Modeling using Modflow (L0543)		Lecture	1	1
Groundwater Modeling using Modfl		Recitation Section (small)	2	2
Modeling of Water Supply Network	(L0875)	Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge	groundwater hydraulics and transport of substances			
	• groundwater right and transport of substances			
	Pipe Systems			
	Knowledge on urban water infrastructures, in particular	r drinking water systemsand u	ırban drainag	e systems including
	special structures			
	Hydraulics of drinking water supply systems and sewer systems.	stems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence	g p	<u>.g .eeg .eee</u>		
Knowledge	The students are able to describe the modelling of groundwater in	flow and transport as well as urb	an water infra	astructures. They ca
	carry out systems analyses and can detect technical and concep	•		•
	are able to analyse interdependencies of hydraulic and toxic phe			
Skills	The students are able to construct and apply scientific groundy	vater models indipendently. The	y can work o	n different scenarios
and can compare or assess different solutions for existing problems by application of selected software products		cts. The students are		
	able to use different software solutions (e.g. EPANET, EPA-SWMM $$	1).		
Personal Competence				
•	Wird nicht vermittelt.			
bocial competence				
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Election	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	mpulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	Civil Engineering: Specialisation Computational Engineering: Elec	ctive Compulsory		
	Water and Environmental Engineering: Specialisation Environme	nt: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Elec	• •		
	Water and Environmental Engineering: Specialisation Water: Elec	ctive Compulsory		

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

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

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

Module M0828: Urbai	n Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/problem-ba	ased Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
	General knowledge of Scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students can describe urban development corridors as well as current and future u	urban environn	nental proble	ms. They are able t
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovations and explain wh	y these contrib	oute to the in	nprovement of urba
	life. They can, for example, derive and discuss measures for effective noise abaten	nent.		
Skills	Students are able to develop specific solutions for correcting existing or for	uturo onvironr	mont rolated	problems of urba
SKIIIS	development. They can define a range of conceptual and technical solutions for en			•
	paths. To solve specific urban environmental problems they can select technical			
	context.	iiiiovations ai	id integrate	them into the triba
Personal Competence	CONTEXE			
•	The students can work together in international groups.			
Social Competence	The stadents can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presenta	tions and cont	ributions to t	he discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	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: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory			
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qu	alification: Cor	npulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Ele	ctive Compuls	ory	
	Water and Environmental Engineering: Specialisation Environment: Elective Compu	ulsory		
	Water and Environmental Engineering: Specialisation Cities: Compulsory			

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

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

Module M0860: Harbo	ur Engineering and Harbour Planning			
Courses				
Title	Тур		Hrs/wk	СР
Harbour Engineering (L0809)	Lectu	ure	2	2
Harbour Engineering (L1414)	-	ect-/problem-based Learning	1	2
Port Planning and Port Construction	(L0378) Lectu	ure	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 following lea	arning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design appro	oaches for the functional de	esign of a port	and apply them to
	design tasks. They can design the fundamental elements of a port.			
Skills	The students are able to select and apply appropriate approaches for	the functional design of por	ts.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied p	problems such as the functi	onal design of	f ports. Additionaly,
	they will be able to work in team with engineers of other disciplines.			
Autonomy	The students will be able to independently extend their knowledge and	d 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 include	ides tasks with respect to t	the general ur	nderstanding of the
	lecture contents and calculations tasks.	·	J	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Comp	pulsory		
•	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co	•		
	Civil Engineering: Specialisation Coastal Engineering: Compulsory	•		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsor	ry		
	International Management and Engineering: Specialisation II. Civil Eng	•	ory	

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

Course L0378: Port Planning	and Port Construction
Тур	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
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Module M0861: Mode	lling of Hydraulic Engineering				
Courses					
Title	itle Typ Hrs/wk CP				
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1	
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1	
Modelling of Flow in Rivers and Esti		Lecture	3	4	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous	Coastal Hydraulic Engineering I				
Knowledge					
E ducational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	Students are able to define in detail the basic prod	cesses that are related to the modelling	of flows in hy	draulic engineering.	
	Besides, they can describe the basic aspects of num	erical modelling and actual numerical mod	els for the sin	nulation of flows and	
	waves.				
Chille	Students are able to apply bydrodynamic numerical ne	and als to practical budraulis anaipagring to	alea		
SKIIIS	Students are able to apply hydrodynamic-numerical n	loders to practical hydraulic engineering ta	5K5.		
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to work in team				
	with others.				
Autonomy	The students will be able to independently extend the	ir knowledge and apply it to new problems.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement					
Examination	Written exam				
Examination duration and	The duration of the examination is 3 hours. The examination includes tasks with respect to the general understanding of the				
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
_	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Coastal Engineering:				
	Civil Engineering: Specialisation Computational Engineering	eering: Compulsory			

Course L0813: Hydraulic Mod	ourse 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 Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer	

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

Course L0810: Modelling of F	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
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 Calution allowithms
	Solution algorithms Convergence
	- Convergence
Literature	Vorlesungsskript
	Literaturemefehlungen
	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).
	Destrolo Versiniana 6" Mesonaitrolofi Alemana and Alefill a V. (DMA). DMA Arbeitana and Alefill a V.
	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).
	Doutecho Verginiques für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA), DWA Arbeitsgruppe WW 3.2 Mehrdimensionale
	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
Biological Wastewater Treatment (Lecture	2	2
Biological Wastewater Treatment (Recitation Section (large)	1	1
Advanced Wastewater Treatment (Advanced Wastewater Treatment (Lecture Recitation Section (large)	2	2 1
Module Responsible	Dr. Joachim Behrendt	Recitation Section (large)	1	1
Admission Requirements	None			
Recommended Previous		nd the key processes involved in wastewater treat	mont	
Knowledge	Knowledge of Wastewater management a	nd the key processes involved in wastewater treat	nent.	
	After telling and average till, at adopte to			
Educational Objectives Professional Competence	After taking part successfully, students ha	ave reached the following learning results		
_	Students are able to outline key areas of the full range of treatment systems in waste water management, as well as their mutua dependence for sustainable water protection. They can describe relevant economic, environmental and social factors. Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application in municipal and for some industrial treatment plants.			
Personal Competence				
•	Social skills are not targeted in this module.			
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on thi			
Workload in Hours	subject.	n Lastura 94		
	1 3 1	Independent Study Time 96, Study Time in Lecture 84		
Credit points Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structura			
Following Curricula	Civil Engineering: Specialisation Geotechr			
	Civil Engineering: Specialisation Coastal E			
	Civil Engineering: Specialisation Water an	d Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A -	General Bioprocess Engineering: Elective Compul	sory	
	Environmental Engineering: Specialisation	n Water Quality and Water Engineering: Elective Co	mpulsory	
	International Management and Engineering	ng: Specialisation II. Process Engineering and Biote	chnology: Elective	Compulsory
	International Management and Engineering	ng: Specialisation II. Energy and Environmental Eng	ineering: Elective	Compulsory
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Compulsor	/	
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		

ourse 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

 $ISBN: \quad 3540343296 \ (Gb.) \quad URL: \quad http://www.gbv.de/dms/bs/toc/516261924.pdf \quad URL: \quad http://deposit.d-nb.de/cgi-bin/dokserv?$

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

 $ISBN: 3527312196 \ (Gb.) \ URL: \ http://deposit.ddb.de/cgi-bin/dokserv?id=2774611\&prov=M\&dok_var=1\&dok_ext=htm-provestill \ (Gb.) \ URL: \ http://deposit.ddb.de/cgi-bin/dokserv.ddb.de/cgi-bin/$

Weinheim: WILEY-VCH, 2007

TUB HH Katalog

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

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

Module M0922: City F	lanning
ourses	
itle	Typ Hrs/wk CP
ity Planning (L1066)	Project-/problem-based Learning 4 6
Module Responsible	
Admission Requirements	
	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.
	 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.
	Cxplain the importance of street design.
Skills	Students are able to:
Skiiis	Stadens 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:
•	
	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	
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 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				
Γitle	Т	' ур	Hrs/wk	СР
Construction Logistics (L1163)	Le	ecture	1	2
Construction Logistics (L1164)		ecitation Section (small)	1	2
Project Development and Managen		ecture	1	1
Project Development and Managen		roject-/problem-based Learning	1	1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	Students can			
	 give definitions of the main terms of construction logistics are name advantages and disadvantages of internal or external explain characteristics of products, demand and production specific supply chains differentiate constructions logistics from other logistics system 	construction logistics of construction objects and th		nces for construction
Skills	Students can			
	 carry out project life cycle assessments apply methods and instruments of construction logistics apply methods and instruments of project development and apply methods and instruments of conflict management design supply and waste removal concepts for a construction 			
Personal Competence				
Social Competence	Students can			
	hold presentations in and for groups	. "		
	 apply methods of conflict solving skills in group work and ca 	se studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow oriented thinking improve their creativity, negotiation skills, conflict and crises solution skills by applying methods of moderation in case 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 Co	ompulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Com	pulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compu			
	International Management and Engineering: Specialisation II. Civil I	Engineering: Elective Compuls	ory	
	International Management and Engineering: Specialisation II. Logis			
	Logistics, Infrastructure and Mobility: Specialisation Production and			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure a	and Mobility: Elective Compuls	ory	

Course L1163: Construction	Logistics
	Lecture
Hrs/wk	
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:
	The following departs and condition
	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.
Likewskows	Flännin Haller, Davidskingelaniskilt in Challer also and the Foundation of Challering Makiller (Hara) Foundational anish Dd
Literature	Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000.
	13.2. 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 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	ourse L1162: Project Development and Management	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0998: Static	s and Dynamics of Structures			
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 s	steel structures (L0564)	Lecture	1	1
Fracture mechanics and fatigue in s	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis of statically	determinate and indeterminate structu	ures; Mechanics	I/II, Mathematics I/I
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence		<u> </u>		
Knowledge	After successful completion of this module, the stude respective methods.	ent can explain the basic aspects of d	ynamic effects o	n structures and the
Skills Personal Competence	After successful completion of this module, the students will be able to predict the response of material and structures to dynamics loading using the appropriate computational approaches and methods.			
Social Competence	Students can			
Autonomy	 participate in subject-specific and interdisciplina defend their own work results in front of others promote the scientific development of colleague Furthermore, they can give and accept profession Students are able to gain knowledge of the subject are they are able to structure the solution process for profession 	es onal constructive criticism ea from given and other sources and a		oblems. Furthermore
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
•	Civil Engineering: Specialisation Coastal Engineering: I	, ,		
	Civil Engineering: Specialisation Water and Traffic: Ele			
	Civil Engineering: Specialisation Computational Engine			
	International Management and Engineering: Specialisa		oulsory	

Course L1202: Structural Dynamics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. 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	

Course L0564: Fracture mech	hanics and fatigue in steel structures
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 anduse 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 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

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 M0999: Steel	Construction Project			
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 have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the whole project	ct and explain it to the others.		
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction to		work in reaction to	
	changing conditions resulting from other participants	of the project.		
Personal Competence				
Social Competence	Students can present their results to other members o	f the group.		
	They have the ability to work for a broad agreement w	vith respect to intergroup depende	ncies.	
	They can distribute and process tasks independently.			
Autonomy	Students can handle their part of the project on their o	own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering	g: Compulsory		
	Civil Engineering: Specialisation Computational Engine	eering: 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.

Module M0663: Marir	ne Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III, Mathematics I-III			
Knowledge	Courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	The students get a deeper knowledge of steel and grou	nd engineering as well as constructio	ns knowledge co	ncerning quay walls.
	Furthermore, the students get all the necessary knowled	dge to design singular construction e	lements for shee	t pile walls and they
	know how to choose the right construction elements dep			
Skills	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 influ	•		alls (wave sheet pile
	walls and combined sheet pile walls) and to dimension all construction elements and connections.			
Personal Competence				
Social Competence				
Autonomy	Students are able to assess their own strengths and wea	knesses and organize their time and	learning manage	ment based on this.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Co	mpulsory		
	Civil Engineering: Specialisation Computational Engineer	ring: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Marit	ime Technology: 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 Cliff 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

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

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

Module M1724: Smar				
Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762)		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 modeling, p	rogramming, and sensor technol	ogies are helpful	l. Interest in mo
Knowledge	research and teaching areas, such as Internet of Things, I	ndustry 4.0 and cyber-physical sy	stems, as well a	s the will to dee
	skills of scientific working, are required. Basic knowledge in	scientific writing and good English	n skills.	
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
Professional Competence	The taking part succession, stadents have reached the re-	g .cag .ccac		
•	The students will become familiar with the principles and	nractices of smart monitoring	The students wi	ll he able to de
Knowieuge	decentralized smart systems to be applied for continuous			
	environment. In addition, the students will learn to design a			
	analysis techniques, modern software design concepts, and			
	also part of this module, which will be conducted througho			
	students will design smart monitoring systems that integrat	e a number of "intelligent" sensor	s to be implemer	nted by the stude
	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 slop	es, or on scaled lab structures fo	r validation purpo	ses. The outcom
	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 written papers and oral examinations form the final grades. The modu			
	will be taught in English. Limited enrollment.			
Skille	The students will gain insights into operating state of the a	rt smart sensor systems used fo	r monitoring a wi	de range of phys
Skiiis	s The students will gain insights into operating state-of-the-art smart sensor systems, used for monitoring a wide range of physi 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 of the strategies in smart wireless sensor nodes, using embedded computing and programming.			
	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 d	avalan sammuni	cation chille tow
Social Competence	The students will be able to work in groups, share parts of	the work for their projects, and d	evelop communic	cation skills, tow
	achieving the common project goals.			
Autonomy	The students will be able to gain a solid basis on approac	hing and solving problems in eng	gineering, as well	l as on documer
	results, through their involvement in their monitoring group	projects.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination	Written elaboration			
	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: I	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elec	tive Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering	g: Elective Compulsory		
	Environmental Engineering: Specialisation Energy and Reso	urces: Elective Compulsory		
	Environmental Engineering: Specialisation Environment and Climate: Elective Compulsory			
	Environmental Engineering: Specialisation Water Quality and	d Water Engineering: Elective Con	npulsory	
	Mechatronics: Technical Complementary Course: Elective Co	ompulsory		
	Mechatronics: Core Qualification: Elective Compulsory			
	Theoretical Mechanical Engineering: Specialisation Robotics	and Computer Science: Elective (Compulsory	
	Water and Environmental Engineering: Specialisation Cities:	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro			
	Water and Environmental Engineering: Specialisation Water	: Elective Compulsory		

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	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 1 2762: Smart Manita			
Course L2763: Smart Monito			
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		
Content	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 w		
	participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction		
	Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be		
	taught in the group exercises as well as through external sources, such as video tutorials and literature.		
Literature	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 Thin-walled structures (L1199)		Typ Lecture	Hrs/wk	CP 3
Thin-walled structures (L3045)	1	Recitation Section (large)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Structural Analysis I Structural Analysis II Finite Element Methods			
Educational Objectives	After taking part successfully, students have reached the	ne 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 thin-walled structures.			
Skills	After successful completion of this module, the students will be able to predict load-carrying behaviour of thin-walled structures using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdisciplina defend their own work results in front of others promote the scientific development of colleague Furthermore, they can give and accept profession 	5		
Autonomy	Students are able to gain knowledge of the subject are they are able to structure the solution process for prob			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engineer	ering: Compulsory		
	Civil Engineering: Specialisation Structural Engineering			
	Theoretical Mechanical Engineering: Specialisation Sim	ulation Technology: Elective Compulso	ry	

Course L1199: Thin-walled st	tructures
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bastian Oesterle
Language	DE
Cycle	SoSe
Content	Plates loaded in-plane
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Airy stress function Plane stress / plane strain Structural behaviour of plates loaded in-plane 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	 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 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					
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: Technical Memodynamics II,				
	Module: Fundamentals of Fluid Mechanics				
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence	Arter taking part successibility, students have reache	d the following learning results			
•	By ending this module students can explain in de	tail knowledge of wind turbines w	with a particular focus o	f wind onoray uso	
Knowieuge	offshore conditions and can critical comment these				
	to describe fundamentally the use of water power to				
	in the implementation of renewable energy projects	•	is reproduce and explain	Title busic proced	
	Through active discussions of various topics withi			derstanding and t	
	application of the theoretical background and are th	ius able to transfer what they have	e learned in practice.		
Skills	Students are able to apply the acquired theoretics	al foundations on exemplary wate	er or wind power syster	ns and evaluate a	
	assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can i				
	compare critically the special procedure for the imp	lementation of renewable energy	projects in countries ou	tside Europe with	
	in principle applied approach in Europe and can app	ly this procedure on exemplary th	eoretical projects.		
Danis and Comments and					
Personal Competence Social Competence	Students can discuss scientific tasks subjet-specific	ly and multidisciplinary within a s	aminar		
Jucial Competence	Students can discuss scientific tasks subject-specific	iy ana maidascipiinary widiin a si	enninar.		
Autonomy	Students can independently exploit sources in the	context of the emphasis of the $% \left\{ 1,2,,n\right\}$	lecture material to clea	r the contents of t	
	lecture and to acquire the particular knowledge about the subject area.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	2 70			
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	180 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory			
Following Curricula					
_	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory				
	International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Materials: Elective Compulsory				
	Renewable Energies: Core Qualification: Compulsory				
	Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisation	n Cities: Elective Compulsory			
	Water and Environmental Engineering: Specialisation	n Environment: Elective Compulso	ory		
	Water and Environmental Engineering: Specialisatio	n Water: Flective Compulsory			

Course 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	lica
•	Lecture
Hrs/wk	
CP	
	Independent Study Time 16, Study Time in Lecture 14
	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

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.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M1895: Digita	al Twinning in Civil Enginee	ering			
Courses					
Title	Typ Hrs/wk CP				
Digital Twinning in Civil Engineering	g (L3136)	Lecture	2	2	
Digital Twinning in Civil Engineering	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 Tir	me in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Presentation				
Examination duration and	20 min presentation and 5 pages hand	out			
scale					
Assignment for the	Civil Engineering: Specialisation Compu	utational Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Coasta	al Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Geotec	chnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structu	ural Engineering: Elective Compulsory			

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

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

Module M0858: Coast	al Hydraulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L080	7)	Lecture	3	4
Basics of Coastal Engineering (L143	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of hydraulic engineering, hydrology and hydromec	hanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to define and explain the basic con	cepts of coastal engineering and port e	ngineering. Tl	ney are able to apply
	the concepts to selected practical problems of coastal en	ngineering. Students can define and de	termine the b	asics for design and
	dimensioning of coastal engineering constructions.			
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.			
Personal Competence				
·	The students are able to deploy their gained knowledge	in applied problems such as the design	n of coastal r	rotection structures
Social Competence	Additionaly, they will be able to work in team with engine	• • • •		
	Additionary, they will be able to work in team with engine	ers of other disciplines, for instance des	ngilling of cod.	star breakwaters.
Autonomy	The students will be able to independently extend their k	nowledge and applyit to new problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The exami	nation includes tasks with respect to	the general ι	inderstanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Cor	npulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	g: Compulsory		
	Civil Engineering: Specialisation Structural Engineering: E	lective Compulsory		
	Environmental Engineering: Specialisation Environment a	nd Climate: Elective Compulsory		
	Environmental Engineering: Specialisation Water Quality	and Water Engineering: Elective Compu	Isory	
	International Management and Engineering: Specialisatio	n II. Civil Engineering: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Env	rironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	ter: Elective Compulsory		

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

Course L1413: Basics of Coas	ourse 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 M0595: Exam	ination of Materials, Structural Cond	ition and Damages		
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 mate	rial science, for example by the mo	dule Building Ma	terials and Buildin
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tradir methods for the testing of building material propertie 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 and the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. They are able to describe an examination in form of a test report or expert opinion.			
Personal Competence Social Competence	The students can describe the different roles of man framework of material testing. They can describe the	- '	-	on bodies within th
Autonomy	The students are able to make the timing and the ope	eration steps to learn the specialist know	ledge of a very e	xtensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	66		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Enginee	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Comp	oulsory	
	Materials Science: Specialisation Engineering Material	s: Elective Compulsory		

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

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

Module M0713: Concr	ete Structures				
Courses					
Title			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L057	77)		Lecture	2	3
Structural Concrete Members (L057	78)		Recitation Section (large	2	2
Module Responsible	Dr. Adrian Faron				
Admission Requirements	None				
Recommended Previous	Basics of structural a	nalysis, conception and	dimensioning of structural concrete		
Knowledge	Madulas Dainfarsad	Congreto Structures III	I Structural Analysis IIII Machaniss IIII		
	Modules: Reinforced	Concrete Structures I+I	I, Structural Analysis I+II, Mechanics I+II		
Educational Objectives	After taking part succ	essfully, students have	reached the following learning results		
Professional Competence	3 1	, ,			
•	The students broader	their skills in structura	al engineering, especially in the field of build	linas (houses, roofs, h	alls). They dispose of
	The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose of the knowledge for the conception and design of concrete buildings and structural members that are often used.				
	3	,	3		
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering.				
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing and				
	execution. Moreover, they can make design and construction sketches and draw up technical descriptions.				
Personal Competence					
•	The students are able	to obtain results of his	gh quality in teamwork.		
30Clai Competence	The students are able	to obtain results of mig	gir quality in teamwork.		
Autonomy	The students are able	The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors.			
Workload in Hours		me 110, Study Time in	Lecture 70		
Credit points	6 Compulsory Bonus	Form	Description		
Course achievement	No None	Presentation	Es werden 2 Referate ausgegeben		
Examination	Written exam	cocincation	25 Werden 2 Hererate adagegeben		
Examination duration and	120 minutes				
scale	120 minutes				
	Civil Familian Car		aniana dia na Camanalana		
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compulsory				
Following Curricula			al Engineering: Elective Compulsory		
		-	ineering: Elective Compulsory		
			Fraffic: Elective Compulsory		
		·	nal Engineering: Elective Compulsory	0	
	international Manage	ment and Engineering:	Specialisation II. Civil Engineering: Elective	Lompulsory	

Course L0579: Concrete Stru	Course L0579: Concrete Structures		
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.		

e L0577: Structural Co	
Тур	
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	
	 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalende 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin,1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997

Course L0578: Structural Concrete Members		
Тур	Recitation Section (large)	
Hrs/wk	2	
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 M0801: Wate	r Resources and -Supply			
Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treati	ment (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 key proce	esses involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.			
Skills	Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students will be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and standards to these processes.			
Personal Competence				
Social Competence	Working in a diverse group of 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 user interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others.			
Autonomy	Students will be in a position to work on a subject in	dependently and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: (Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
	Chemical and Bioprocess Engineering: Technical Co	mplementary Course: Elective Compulsory	/	
	Chemical and Bioprocess Engineering: Technical Co	mplementary Course: Elective Compulsory	/	
	International Management and Engineering: Special	isation II. Energy and Environmental Engir	neering: Elective	Compulsory
	Process Engineering: Specialisation Environmental F	Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineer	ering: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Water: Compulsory		
	Water and Environmental Engineering: Specialisatio	n Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Cities: Elective Compulsory		

Course L0311: Chemistry of Drinking Water Treatment		
Тур	Lecture	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen	
Language	DE	
Cycle	WiSe	
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	urse L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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	
	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	

	rated Transportation Planning
Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	(L1068) 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 Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	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 measures.
	relate current issues in the area of integrated transport planning and formulate an opinion on them.
Skills	Students are able to:
	quantify important parameters, which influence travel demand or are influenced by it.
	comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document to
	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, acquire the necessary knowledge and use appropriate means for the project topic, acquire the necessary knowledge and use appropriate means for the project topic, acquire the necessary knowledge and use appropriate means for the project topic, acquire the necessary knowledge and use appropriate means for the project topic, acquire the necessary knowledge and use appropriate means for the project topic.
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation 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
Content	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.: • interactions between transport and the environment and consequent limitations • characteristics of integrated planning • complex planning processes • interdependencies of location choice and mobility behaviour • transport and land-use policies • project on current issues in transportation studies
Literature	Kutter, Eckhard (2019) Stadtstruktur und Erreichbarkeit in der postfossilen Zukunft. Erich Schmidt Verlag. Berlin. Gies, Huber u. a. (Hrsg.) (93. Ergänzung 2022) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0963: Steel	and Composite Structures			
	•			
Courses				
Title		Тур	Hrs/wk	CP
Steel and Composite Structures (L1		Lecture	2	2
Steel and Composite Structures (LI Steel Bridges (L1097)	1205)	Recitation Section (large) Lecture	2	2
Module Responsible	Prof. Marcus Butner	Lecture	2	2
Admission Requirements	None			
Recommended Previous		I BUBC)		
Knowledge	basics of steel construction (i.e. steel structures) and i	i, bobe)		
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence	Their taking part successionly, stauchts have reached to	ic following featining results		
•	After successful completition, students can			
_				
	describe the phenomenon of local buckling			
	explain warping torsion			
	illustrate the behaviour of composite structures			
	 specify the principles in design of composite sttr 			
	 sketch the contructions of steel and composite b 	ridges		
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structures	5		
	 recognize and verify warping tosion in strucures 			
	design composite structures			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
	Civil Engineering: Specialisation Computational Engineer			
	International Management and Engineering: Specialisat		ulsory	

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

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

Module M0966: Study	Work Foundation Engineering
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Dozenten des SD B
Admission Requirements	None
Recommended Previous	Subjects of the Foundation Engineering specialisation.
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of geotechnical and foundation engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.
	The students can develop solving strategies and approaches for fundamental and practical problems in geotechnical and foundation engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society.
Skills	Scientific work techniques that are used can be described and critically reviewed. The students are able to independently select methods for the project work and to justify this choice. They can explain how these methods relate to the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.
Personal Competence	
Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
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 Geotechnical Engineering: Compulsory
Following Curricula	

Courses				
Title		Тур	Hrs/wk	СР
Design of Composite Bridges (L309	2)	Integrated Lecture	2	3
Analysis of Offshore Structures (L1867)		Lecture	1	1
Solid Matter Process Technology for Biomass (L0052)		Lecture	2	3
Innovative Timber Construction (L2666)		Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Sustainable landfill design and ope	ration (L3270)	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)		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	·	civil and structura	al engineering.
	Students are able to interrelate scientific as	nd technical knowledge.		
Skills	5			
	Students are able to apply basic methods in	n selected areas of civil and structural engir	neering.	
Personal Competence				
Social Competence				
Autonomy				
Autonomy	 Students can chose independently, in which 	ch fields they want to deepen their knowle	dge and skills thi	rough the election o
	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		
	Civil Engineering: Specialisation Coastal Engineer	ng: Elective Compulsory		
	I .			
	Civil Engineering: Specialisation Water and Traffic	: 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	

Course L1867: Analysis of Of	
Тур	
Hrs/wk	
CP Workland in House	1 Independent Study Time 16 Study Time in Lecture 14
Examination Form	Independent 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 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

rocess Technology for Biomass
Lecture
2
3
Independent Study Time 62, Study Time in Lecture 28
Klausur
60 min
bu min
Prof. Werner Sitzmann
DE .
SoSe
The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass
processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important
unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC -
products. Aspects of explosion protection and plant design complete the lecture.
Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4
Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe,
Followed a North and the Publishers of the Artist Annual Control of the Ar
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"
	- Huckreigt 1.: "Hausfaule- und Baunoizpilze"

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

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

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

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

Course L2378: Special topics 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	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				
litle		Тур	Hrs/wk	СР
Adaptation to climate change in hy	draulic engineering (L2291)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous				
Knowledge	Hydrology, Hydraulic Engineering			
_	Hydromechanic, Hydraulics			
	Fundamentals of Coastal Engineering, Coastal- and	Flood Protection		
	Hydrological Systems			
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge				
	Climate protection and climate adaptation	toristics fundamentals slimate mode	lling / climata	madala
	 Insights into climate change and its regional charac Impacts of climate change on the components of th 		iling / cilmate	models
	 Impacts of climate change on the components of th Fundamentals of analysis of climate data 	e regional flydrological cycle		
	Consequences of the impact of the climate change			
	Measures for climate adaptation			
	Assessment, prioritization and communication of ad	aptation measures		
	Fundamentals of the analysis of hydrometeorological			
		, ,		
Skills	Critical thinking: analysis of processes and relations	assessment of needs for action		
	Creative thinking: development of adaptation strate			
	Practical thinking: inclusion of restrictions, applications		nods. numeric	al models, plann
	methods	1,000		
	Consideration of complex tasks			
Personal Competence				
Social Competence	Working in heterogenous groups			
	Working with different scientific / non-scientific disc	plines		
	Self reflection			
Autonomy	Application oriented use of knowledge and skills			
	Autonomous work on complex tasks			
Morkland in House	Independent Study Time 124 Study Time in Lecture E6			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Preparation of a written report and a presentation of a con	pplex task.		
scale	, , , , , , , , , , , , , , , , , , , ,	•		
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elect	ive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	• •		
•	Civil Engineering: Specialisation Structural Engineering: El	• •		
	Civil Engineering: Specialisation Water and Traffic: Elective	, ,		
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Envi	ronment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	er: Elective Compulsory		

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

Courses			
Title	Тур	Hrs/wk	СР
Scientific Working in Computationa	**	6	6
Module Responsible	Prof. Kay Smarsly		
Admission Requirements	None		
Recommended Previous	Basic knowledge in scientific writing. String interest in topics related to computing in civil engine	ering.	
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowleage	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 scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A project will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance in this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writter based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.		
Skills	The students will be capable (i) of solving a scientific problem following a scientific methodology, (ii) of documenting their work effectively in the form of a paper, and (iii) of sharing their work in a presentation.		
Personal Competence			
Social Competence	The students will be able to work in a multidisciplinary team 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 indep	endently in a projec
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: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory		
	Mechatronics: Technical Complementary Course: 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
	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements				
Recommended Previous				
Knowledge	Hydraulic Engineering			
	Hydromechanics, Hydraulics Fundamentals of Constal Engineering Constal on	d Flood Bushostics		
	Fundamentals of Coastal Engineering, Coastal- an	a Flood Protection		
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
	Climate and Climate Change General Impacts of Climate Change on Wind Regin	me and Water Cycle		
	Consequences of Climate Change for Coastal Proc			
	Coastal Protection in Taiwan and Germany			
	Fundamentals of Climate Adaptation			
	Nature-based Solutions (NBS) for Coastal Protection	on		
Skills				
55	Critical thinking: analysis of processes and relatio	ns, assessment of needs for action		
	Creative thinking: development of adaptation stra			
	Practical thinking: inclusion of restrictions, appli	cation of calculation approaches, meth	nods, numerica	ıl models, plannir
	methods			
	Consideration of complex tasks			
Personal Competence				
Social Competence	Working in heterogenous groups			
	Working in international groups			
	Working with different scientific / non-scientific dis-	sciplines		
	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				
Course achievement				
	Written elaboration			
	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	n the complex tas
scale		. ,		, , ,
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineerin	g: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Election	ve Compulsory		
	Environmental Engineering: Specialisation Environment	and Climate: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cit			
	Water and Environmental Engineering: Specialisation En			
	Water and Environmental Engineering: Specialisation Wa	ater: Elective Compulsory		

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

Module M1844: Mode	rn discretization methods in stru	ctural 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	Eleft Element Matheda			
Knowledge	Finite Element Methods			
	Flächentragwerke			
Educational Objectives	After taking part successfully, students have rea	iched the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stud	lents can express the basic aspects of mode	rn discretization r	methods in structura
	mechanics.			
Skills	After successful completion of this module, the	students will be able to use and further impro	ove modern discre	etization methods fo
	problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdis	•		
	defend their own work results in front of or the second seco			
	promote the scientific development of column in the scientific development of the scientific development in the	•		
	Furthermore, they can give and accept pr	ofessional constructive criticism		
Autonomy	Students are able to gain knowledge of the subj	ect area from given and other sources and a	pply it to new pro	blems. Furthermore
	they are able to structure the solution process for			
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				
Following Curricula	Civil Engineering: Specialisation Geotechnical Er			
	Civil Engineering: Specialisation Structural Engir			
	Civil Engineering: Specialisation Computational			
	Computational Engineering: Core Qualification: I			
ĺ	Theoretical Mechanical Engineering: Specialisati	on Simulation Technology: Elective Compulse	ory	

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

Module M1956: Buildi	ing and Excavation Law			
Courses				
Title		Тур	Hrs/wk	СР
Construction law BGB and VOB - law		Lecture	2	3
Construction disputes from constru		Lecture	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III			
Knowledge	After taking part suggestivily, students have reache	d the following learning regults		
Educational Objectives Professional Competence	After taking part successfully, students have reache	a the following learning results		
•	Students will gain knowledge of			
	the history of civil engineering law,			
1	 basics of foundation and civil engineering law 	Ι,		
	 legal aspects of technical regulations in civil of 	engineering (with case studies),		
	the civil engineering contract,			
	the liability of the designer and contractor 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 proce	200	
	 the (construction) conflict, dispute avoidance the systematics of construction contract law, 	models and the construction proce	255,	
	 the BGB construction contract law, 			
	responsibilities on the construction site,			
	remuneration and contract management,			
	liability for defects,			
	public procurement law			
	Disturbed construction processes: How much	money am I entitled to?		
	Correct calculation of supplements.			
Skills	Students learn to apply legal aspects in planning a	nd construction in a legally balance	ed way. Students learn h	now to use legal and
	construction management aspects in practice (plan	ning and construction) on the con-	struction site in a target	ted manner and how
	to manage the construction project optimally.			
Personal Competence				
Social Competence	Students can work in groups and support each othe	r in finding solutions.		
Autonomy	Students are able to assess their own strengths and	weaknesses and organize their tim	ne and learning manage	ment based on this.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin			
	Civil Engineering: Specialisation Structural Engineer	, ,		
	Civil Engineering: Specialisation Water and Traffic: E			
	Civil Engineering: Specialisation Computational Engi	neering: 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	

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

Module M0859: Coastal Hydraulic Engineering II						
Courses						
Title		Тур	Hrs/wk	СР		
Coastal- and Flood Protection (L0808)		Lecture	2	3		
Coastal- and Flood Protection (L1415)		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 erosion protection and flood protect					
	and are able to apply the aspects to practic	al coastal protection problems. They are able to	design and	dimension importan		
	coastal protection measures from the functional and from the constructional point of view.					
CI-III-	The students are able to color design account					
SKIIIS	Its The students are able to select design approaches for the functional and constructional design of erosion and flood measures and apply these approaches to practical design tasks.					
	Theasures and apply these approaches to prac	ilical 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 will be able to work in team with engineers of other disciplines.					
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems.					
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	ination duration and The duration of the examination is 130 min. The examination includes tasks with respect to the general u					
scale	lecture contents and calculations tasks.					
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Compulsory					
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	Environmental Engineering: Specialisation Env	vironment and Climate: Elective Compulsory				
	Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory					
	Water and Environmental Engineering: Specia	lisation Environment: Elective Compulsory				
	Water and Environmental Engineering: Specia	lisation Water: Elective Compulsory				

Course L0808: Coastal- and I	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
L	

Course 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	

	gical Waste Treatment			
Courses				
Title		Тур	Hrs/wk	СР
Waste and Environmental Chemist		Practical Course	2	2
Biological Waste Treatment (L0318		Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous Knowledge	chemical and biological basics			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	The calling pare succession, state have reached	and continuity realistics		
•	The module aims possess knowledge concerning the possess design and layout of anaerobic and aerobic waste treatment plants and expla	atment plants in detail, describe different to		
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and qualit control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.			
Personal Competence				
Social Competence	Students can participate in subject-specific and interest	disciplinary discussions, develop cooperate	ed solutions a	nd defend their o
	work results in front of others and promote the science accept professional constructive criticism.	entific development in front of colleagues	. Furthermore	, they can give a
Autonomy	Students can independently tap knowledge from liter are capable, in consultation with supervisors as well a steps on this basis. Furthermore, they can define tar potential social, economic and cultural impact.	s in the interim presentation, to assess the	eir learning lev	el and define furtl
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Course achievement		scription		
	Yes None Subject theoretical and			
	practical work			
Examination	Presentation			
Examination duration and	Elaboration and Presentation (15-25 minutes in groups	5)		
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ctive Compulsory		
	Bioprocess Engineering: Specialisation A - General Bio	process Engineering: Elective Compulsory		
	Chemical and Bioprocess Engineering: Specialisation C	General Process Engineering: Elective Com	pulsory	
	Chemical and Bioprocess Engineering: Specialisation C	Chemical Process Engineering: Elective Cor	npulsory	
	Chemical and Bioprocess Engineering: Specialisation C	Chemical and Bioprocess Engineering: Elect	tive Compulso	ry
	Chemical and Bioprocess Engineering: Specialisation E	Bioprocess Engineering: Elective Compulso	ry	
	Chemical and Bioprocess Engineering: Specialisation (tive Compulso	ry
	Environmental Engineering: Core Qualification: Compu		ulcon.	
	International Management and Engineering: Specialisation Environmental Process Engineering: Specialisation Environmental Process Engineering: Specialisation Environmental Process Engineering: Specialisation Environmental		11501 y	
	Process Engineering: Specialisation Environmental Pro Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	·		

Course L0328: Waste and Environmental Chemistry		
Тур	Practical Course	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Kerstin Kuchta	
Language	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.	
	5	
	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		

Module M2025: Finite	e element modeling of structures			
Courses				
Title		Тур	Hrs/wk	СР
Finite element modeling of structur	res (L3046)	Lecture	2	3
Finite element modeling of structure	res (L3047)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Figure Flores of Markets			
Knowledge	Finite Element Methods This will be to be a second or a seco			
	Thin-walled structures			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, studer	its can express the basic aspects of modelli	ing of structures	with finite elements.
Skills	After successful completion of this module, the	students will be able to model structures	with finite elem	ents and to analyse
55	structures using appropriate computational metho			cites and to analyse
	structures using appropriate computational metric			
Personal Competence				
Social Competence	Students can			
	a participate in subject specific and interdisci	plipary discussions		
	participate in subject-specific and interdisci defend their own work results in front of other.	•		
	promote the scientific development of colle			
	Furthermore, they can give and accept prof	-		
	Turthermore, they can give and accept prof	essional constructive enticism		
Autonomy	Students are able to gain knowledge of the subject	ct area from given and other sources and a	pply it to new pro	blems. Furthermore,
	they are able to structure the solution process for	problems in the area of finite element mod	elling of structure	es.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 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 En	gineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineeri	ng: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
	Computational Engineering: Core Qualification: Ele	ective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Simulation Technology: Elective Compulso	ory	

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

Module M2033: Subsu	ırface Processes				
Courses					
Title		Typ		Hrs/wk	СР
Modeling of Subsurface Processes (L2731)	Recitation	n Section (small)	3	3
Subsurface Solute Transport (L272)	3)	Lecture		2	2
Subsurface Solute Transport (L272	9)	Recitation	n 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 re	ached the following learni	ng results		
Professional Competence					
Knowledge	Upon completion of this module, the student	s will understand the me	chanisms controlling	solute transport	in soil and natural
	porous media and will be able to work with the	equations that govern the	fate and transport o	f solutes in poro	us media. Analytical,
	numerical and experimental tools and techniqu	es will be used in this mod	lule.		
Skills	In addition to the physical insights, the student		·		
	this module. This provides them with an excell	ent opportunity to improve	their skills on multip	ole fronts which w	vill be useful in their
	future career.				
Personal Competence					
,	Teamwork & problem solving				
Autonomy	The students will be involved in writing individual reports and presentation. This will contribute to the students' ability and				
	willingness to work independently and responsibly.				
Workload in Hours	Independent Study Time 96, Study Time in Lec	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 Structural Eng	ineering: Elective Compuls	ory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	Engineering: Elective Comp	oulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsor	у		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory			
	Civil Engineering: Specialisation Computational	Engineering: Elective Con	npulsory		
	Chemical and Bioprocess Engineering: Technical	al Complementary Course:	Elective Compulsory		
	Chemical and Bioprocess Engineering: Technical	al Complementary Course:	Elective Compulsory		
	Environmental Engineering: Core Qualification:	Compulsory			
	Process Engineering: Specialisation Environment	ntal Process Engineering: I	Elective Compulsory		
	Process Engineering: Specialisation Process En	gineering: Elective Compu	sory		
	Water and Environmental Engineering: Special	sation Water: Compulsory			
	Water and Environmental Engineering: Special	sation Environment: Elect	ve 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	ourse L2729: Subsurface Solute Transport		
Тур	Recitation Section (large)		
Hrs/wk			
СР	1		
Workload in Hours	dependent Study Time 16, Study Time in Lecture 14		
Lecturer	Milad Aminzadeh		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses					
Title		Тур	Hrs/wk	СР	
Methods in Climate Informed Engine	-	Lecture Lecture	3 3	3	
Topics in Climate Informed Engine	1	Lecture	3	3	
Module Responsible					
Admission Requirements		-tildt diafitl			
Kecommended Previous Knowledge	Students are expected to have a foundational understanding of environmental science, basic engineering principles, and a				
Knowieuge	interest in sustainability. Recommended knowledge includes climate science, data analysis, and familiarity with engineering processes. Analytical and critical thinking and creative problem-solving skills are also beneficial				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results			
Professional Competence	,				
Knowledge	engineering products and processes. It co	mate models and high-resolution data, em vers how various engineering disciplines ca nd presentations will expose students to s	n benefit from climate in	formation. Researc	
Skills	Climate data analysis, engineering adaptation strategies, problem-solving, research-based learning, and interdisciplinar collaboration.				
Personal Competence					
Social Competence	Collaboration, interdisciplinary teamwork climate-resilient engineering.	, communication skills, problem-solving, e	ethical responsibility, and	d decision-making	
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 i	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and scale					
Assignment for the	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory			
Following Curricula	,				
	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water an	d Traffic: Elective Compulsory			
	Civil Engineering: Specialisation Computa				
	Data Science: Specialisation III. Applicatio	· ·			
	Environmental Engineering: Core Qualifica				
	Process Engineering: Specialisation Process				
	Water and Environmental Engineering: Sp		ony		
	Water and Environmental Engineering: Sp Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulso	от у		

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	

urses					
le			Тур	Hrs/wk	СР
ter Protection (L3459)	I		Integrated Lecture	6	6
Module Responsible	Prof. Simon Michael	Papalexiou			
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowled	dge in water managemen	t;		
Kilowieuge	Good knowled	dge in urban drainage;			
	Good knowledge of wastewater treatment techniques;				
	Good knowled	dge of pollutants (e.g. CO	D, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part suc	cessfully, students have	reached the following learning results		
Professional Competence					
Knowledge	The students can de	scribe the basic principle	s of the regulatory framework related to	the international and Eu	ropean water sec
	They can explain lir	mnological processes, su	ubstance cycles and water morphology	in detail. They are able	e to assess comp
	problems related to	water protection, such	as ecosystem service and wastewater to	reatment with a special	focus on innova
	solutions, remediation	on measures as well as co	onceptual approaches.		
Skills	Students can accura	ately assess current prob	lems and situations in a country-specific	or local context. They o	can suggest concr
	Students can accurately assess current problems and situations in a country-specific or local context. They can suggest concre- actions to contribute to the planning of tomorrow's urban water cycle. Furthermore, they can suggest appropriate technical				
	administrative and le	egislative solutions to sol	ve these problems.		
Personal Competence					
•	The students can wo	ork together in internation	nal groups.		
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			3		
Autonomy	Students are able to	organiza thair work flow	y to propage procentations and discussion	ns. Thoy can acquire an	propriato knowlo
Autonomy	by making enquiries		v to prepare presentations and discussion	ns. They can acquire ap	ipropriate knowle
	by making enquires	acpendentiy.			
Workload in Hours	Independent Study T	Γime 96, Study Time in Le	ecture 84		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
Post and the section of the section	Yes 20 %	Presentation	10-minütige Präsentation von Arbe	itsergebnissen	
Examination Examination duration and	Written exam				
examination duration and scale	150 minutes				
Assignment for the	Civil Engineering: Sp	pecialisation Coastal Engi	neering: Elective Compulsory		
Following Curricula		-	Engineering: Elective Compulsory		
. cc.ing carricula			gineering: Elective Compulsory		
			raffic: Elective Compulsory		
			ater Quality and Water Engineering: Elect	ive Compulsory	
	_		Specialisation II. Civil Engineering: Electiv		
	Water and Environm	ental Engineering: Specia	alisation Cities: Elective Compulsory		
	Water and Environm	ental Engineering: Specia	alisation Environment: Compulsory		
	Water and Environm	ental Engineering: Speci	alisation Water: Elective Compulsory		

Course L3459: Water Protect	ourse L3459: Water Protection		
Тур	egrated 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			

Module M2155: Unce	rtainty Modellir	ng for Engine	ers			
Courses						
Title	(4.2.450)			Тур	Hrs/wk	СР
Jncertainty Modelling for Engineer		I I .		Integrated Lecture	6	6
Module Responsible		'apalexiou				
Admission Requirements Recommended Previous						
Knowledge	 General familia 	arity with engineerin	ng concepts.			
Knowieuge		obability and statisti	tics, and mathematical s	kills.		
		r skills for handling				
	4. Interest in solv	ing engineering pro	oblems using statistical	and probabilistic methods	i.	
Educational Objectives	After taking part succ	essfully, students h	nave reached the followi	ng learning results		
Professional Competence						
Knowledge	Students will develop	o a strong foundati	ion in uncertainty, prob	ability, and risk analysis	in engineering appl	ications. The cour
				requency-based methods		-
	,		, , ,	distributions, and stoch		•
	,	• .		near and nonlinear regre s will gain insight into ris		
	_		•	o optimize engineering so		·
Skills	By the end of the cou	rse, students will be	e able to apply probabil	istic models to quantify u	ncertainty and assess	s risks in engineerir
	problems. They will g	gain expertise in fit	tting probability distribu	itions, performing extrem	ne value analysis, an	d applying Bayesia
				also develop skills in lir		
	-		•	prove risk predictions. Th	-	•
	decision-making.	nement stochastic i	methods and optimizati	on techniques to support	reliability-based des	sign and engineerii
	decision-making.					
Personal Competence						
Social Competence				engineering risk assess		
		•	•	will engage in discussion		-
	challenges.	ation, ensuring tha	at engineering analyse	es are both rigorous and	d applicable to real	-world intrastructui
	chancinges.					
Autonomy				ering uncertainties, selec		
	_			or various applications. T		
		risks associated with natural and human-made hazards, ensuring they can make informed engineering decisions in design, safet assessment, and disaster mitigation.				
Workload in Hours		me 96, Study Time	in Lecture 84			
Credit points Course achievement	t	Form	Description			
course acmevement	Yes 20 %	Presentation	10-minütige	Präsentation von Arbeitse	ergebnissen	
Examination	Written exam					
Examination duration and	150 min					
scale	Civil Engineering, Spa	scialization Coastal I	Engineering, Floative Co	amanula anu		
Following Curricula			Engineering: Elective Co nnical Engineering: Elect			
ronowing curricula	3 ,		ral Engineering: Elective			
			ational Engineering: Ele			
		•	nd Traffic: Elective Com	, ,		
	Civil Engineering: Spe	ecialisation Coastal I	Engineering: Elective Co	ompulsory		
	Civil Engineering: Spe	ecialisation Geotech	nnical Engineering: Elect	ive Compulsory		
			ral Engineering: Elective			
		•	ational Engineering: Ele	, ,		
			nd Traffic: Elective Com			
	_		cation: Elective Compuls cation: Elective Compuls			
	_		Specialisation Cities: Elec	•		
				ent: Elective Compulsory		
			Specialisation Water: Ele			
	Water and Environme	ental Engineering: S	Specialisation Cities: Elec	ctive Compulsory		
	Water and Environme	ental Engineering: S	Specialisation Environme	nt: Elective Compulsory		
	Water and Environme	ental Engineering: S	Specialisation Water: Ele	ctive 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. Handson 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

Module M0699: Geote	echnics III			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Methods in Geotechnics	(L0375)	Lecture	3	3
Advanced Foundation Engineering	(L0497)	Lecture	2	2
Advanced Foundation Engineering	(L0498)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Geotechnics I and II, Mathematics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	After successfully completing the module, students will be able	to		
	describe individual procedures for the geotechnical moni		ires,	
	reproduce exploration and investigation methods of the s			
	select suitable types of field and laboratory tests for substantial types.			
	state the differences between various stress and deform	ation states and the physical sig	nificance of inva	ariants of the stress
	and distortion tensor,			
	outline the standard and special soil mechanics tests use		behavior of soil,	
	describe continuum models and the resulting boundary v			U
	as well as define boundary value problems from the field	of geotechnical engineering in	such a way that	they can be solved
	unambiguously.			
Skills	Students will be able to			
	dimension vertical drains for soil improvement of soft soil			
	calculate depth compaction using various appropriate me	ethods,		
	apply principles of horizontal bearing capacity of piles,			
	verify the internal and external stability of fluid-supporter		ne e e ar ea e e	
	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, 			
	 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 			
	 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.	ossibilities and limitations of mat	eriai modeis ior	the grain structure
	OI SOIIS.			
Personal Competence				
Social Competence	Students can work in groups and support each other in finding s	solutions.		
Autonomy	Students are able to assess their own strengths and weaknesse	s and, based on this, organize tr	ieir time and lea	rning management
	and think in terms of processes.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Comput	sory		
Following Curricula		•		
	Civil Engineering: Specialisation Coastal Engineering: Compulso			
	Civil Engineering: Specialisation Water and Traffic: Elective Com			
	Civil Engineering: Specialisation Computational Engineering: Co			
	International Management and Engineering: Specialisation II. Ci		sorv	
	International Management and Engineering: Specialisation II. Cl	vii Engineering. Elective Comput	301 y	

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			
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 M0713: Conci	rete Structure	S			
Courses					
Title			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L05			Lecture	2	3
Structural Concrete Members (L05	78)		Recitation Section (Ia	irge) 2	2
Module Responsible	NN				
Admission Requirements	None				
Recommended Previous	Basics of structural	analysis, conception an	d dimensioning of structural concrete		
Knowledge	Modules: Reinforced	Concrete Structures I+	·II, Structural Analysis I+II, Mechanics I+II		
	Produces. Remoree	r concrete structures i i	ii, structurur riiarysis 11 ii, inceriariies 11 ii		
Educational Objectives	After taking part suc	ccessfully, students hav	e reached the following learning results		
Professional Competence					
Knowledge	The students broade	en their skills in structu	ral engineering, especially in the field of b	ouildings (houses, roofs, l	nalls). They dispose o
	the knowledge for the conception and design of concrete buildings and structural members that are often used.			ed.	
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 desigr	and construction sketches and draw up t	echnical descriptions.	
Personal Competence					
Social Competence	The students are ab	le to obtain results of h	igh quality in teamwork.		
	The second secon				
Autonomy	The students are ab	le to carry out complex	conception and dimensioning tasks of str	uctures under the guida	nce of tutors.
Workload in Hours	Independent Study	Time 110, Study Time in	1 Lecture 70		
Credit points					
Course achievement	Compulsory Bonus	Form	Description		
	No None	Presentation	Es werden 2 Referate ausgegebe	n	
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: S	pecialisation Structural	Engineering: Compulsory		
Following Curricula			cal Engineering: Elective Compulsory		
-			gineering: Elective Compulsory		
			Traffic: Elective Compulsory		
	Civil Engineering: S	pecialisation Computation	onal Engineering: Elective Compulsory		
			: Specialisation II. Civil Engineering: Elect	ive Compulsory	

Course L0579: Concrete Stru	Course L0579: Concrete Structures		
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	
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	CP
Steel and Composite Structures (L1		Lecture	2	2
Steel and Composite Structures (L1	1205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I and II	, BUBC)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e 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 sttru 	uctures		
	 sketch the contructions of steel and composite br 			
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structures 			
	recognize and verify warping tosion in strucures			
	design composite structures			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineeri	ng: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: El	ective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elect	tive Compulsory		
	Civil Engineering: Specialisation Computational Enginee			
	International Management and Engineering: Specialisati	ion II. Civil Engineering: Elective Comp	oulsory	

Course L1204: Steel and Con	nposite Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	WiSe
Content	 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 Composite Structures		
Тур	ecitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Module M1748: Const	ruction Robotics
Courses	
Title	Typ Hrs/wk CP
Construction Robotics (L2867)	Project-/problem-based Learning 6 6
Module Responsible	Prof. Kay Smarsly
Admission Requirements	None
Recommended Previous	Basics of project-oriented programming
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Basics of robotics
	Applications in civil engineering
	Kinematics
Skills	Use of specific hardware
	Development of software routines
	Python programming language
	Image processing
	Basics of localization (LIDAR, SLAM)
Personal Competence	
Social Competence	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 Water and Traffic: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical 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
	and the second s

Course L2867: Construction	ourse L2867: Construction Robotics		
Тур	Project-/problem-based Learning		
Hrs/wk	5		
СР	6		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Lecturer	Prof. Kay Smarsly, Jan Stührenberg		
Language	EN		
Cycle	WiSe		
Content	 Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization 		
Literature	Bock/Linner: Construction Robotics		
	Verl et al.: Soft Robotics		
	Pasquale: New Laws of robotics		

Module M0723: Desig	n of Prestressed Structures ar	nd Concrete Bridges			
Courses					
Title		Тур	Hrs/wk	СР	
Design of Prestressed Structures a	3	Lecture	3	4	
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2	
Module Responsible	NN				
Admission Requirements	None	None			
Recommended Previous	Detailed knowledge on the design of concret	e structures.			
Knowledge	Modules: Reinforced Concrete Structures I+I	I, Structural Analysis I+II, Mechanics I+II, Concr	ete Structures		
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	The students know the main bridge types,	their applications and the various loads. They	can explain the ba	asic design methods	
	They can explain the design of a prestressed bridge.				
Skills	The students are able to design reinforced or prestressed concrete bridges.				
Personal Competence					
Social Competence	The students can design in teamwork a real concrete bridge.				
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	180 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structural E	ngineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnica	al Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Eng	ineering: Elective Compulsory			
	Civil Engineering: Specialisation Computation	nal Engineering: Elective Compulsory			
	International Management and Engineering:	Specialisation II. Civil Engineering: Elective Cor	npulsory		

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

Courses				
Title		Тур	Hrs/wk	CP
Soil Mechanics - Selected Topics (L0374)		Lecture	2	2
Soil Dynamics (L0452) Experimental Researches in Geote	chnics (10706)	Lecture Practical Course	2	2
		Fractical Course	2	2
Module Responsible	, ,			
Admission Requirements	None			
Recommended Previous	Modules: Mathematics I-III, Mechanics I-II, Geotechnics	5 I		
Knowledge	Courses: Soil laboratory course, (Applied structural dy	namics)		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students will be able to,			
	describe wave propagation in the ground under	dynamic excitation and define the	relevant parameters	,
	 to measure vibrations and to interpret the data 	obtained with regard to their effect	t on people and struc	tures,
	 justify when elastodynamic methods are suffici 	ent and when plastodynamic effect	s must be taken into	account,
	 to reproduce the collapse theorems of plasticity 	theory,		
	describe the viscous behavior of cohesive so	ls and computationally account for	r creep deformation	and rate-depender
	shear strengths			
	as well as to determine the effect of partial sati	uration on the seepage flow and the	e shear strength.	
Skills	After the successful completion of the module the stu	dents should be able to:		
	 to derive and apply the basic equation of a sim 	ple mass oscillator,		
	to understand the wave propagation in the soil	under dynamic excitation and to de	etect the relevant par	ameters,
	 to know the essential laboratory and field tests 	to determine soil dynamic characte	eristics and to evaluat	te them,
	to design machine foundations to dynamic load	,		
	 to measure shocks to perform vibration forecas 			
	to evaluate shocks in terms of their effect on positions are also as a second control of their effect on positions.	eople and buildings,		
	to evaluate possibilities of isolation,			1 12.1
	 to understand mechanisms that cause earthquistone to know methods to determine axial pile capaci 			ide and intensity,
	to know the mechanisms that lead to a deform			e these deformation
	mathematically,	ation accumulation due to cyclic lo	ading and to estimate	e these deformation
	to distinguish the area of application of the me	hod of elastodynamics and plastod	vnamics.	
	to detect the undrained shear strength as a fur			
	 to capture the visous behaviour of cohesive so 			ent shear strength
	calculations,			
	to consider the impact of the partly saturated or	f a seepage and shear strength.		
D				
Personal Competence Social Competence	Students will be able to work in teams to achieve re	sults on massurament and experin	contal principles and	procent their recul
Social Competence	together at the end of the semester.	suits on measurement and experin	ientai principies and	present their resul
	together at the end of the semester.			
Autonomy	Students are able to assess their own strengths and w	reaknesses and organize their time	and learning manage	ement based on this
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	Compulsory Bonus Form De	scription		·
	Yes None Subject theoretical and			
	practical work			
Examination	Written exam			
Examination duration and scale	135 min			
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	a: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering			
,	Civil Engineering: Specialisation Coastal Engineering:			
	Civil Engineering: Specialisation Computational Engine			

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	
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	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	 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	CP
Groundwater Modeling using Modfl	ow (L0543)	Lecture	1	1
Groundwater Modeling using Modfl		Recitation Section (small)	2	2
Modeling of Water Supply Network	(L0875)	Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge	groundwater hydraulics and transport of substances			
	Dia a Contagna			
	Pipe Systems			
	Knowledge on urban water infrastructures, in particular	r drinking water systemsand u	rban drainag	e systems including
	special structures			
	Hydraulics of drinking water supply systems and sewer systems	stems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling of groundwater f	flow and transport as well as urb	an water infra	astructures. They ca
	carry out systems analyses and can detect technical and concep	tual weak points within the sys	tems in case s	studies. Besides the
	are able to analyse interdependencies of hydraulic and toxic phe	nomena in soil and water.		
Skills	The students are able to construct and apply scientific groundw	rater models indipendently. The	y can work o	n different scenarios
	and can compare or assess different solutions for existing problems by application of selected software products. The students			cts. The students are
	able to use different software solutions (e.g. EPANET, EPA-SWMM).		
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	•		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	•		
	Civil Engineering: Specialisation Computational Engineering: Elec			
	Water and Environmental Engineering: Specialisation Environmen			
	Water and Environmental Engineering: Specialisation Cities: Elec			
	Water and Environmental Engineering: Specialisation Water: Elec	ctive 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 wo	
	with the model PMWIN for practical case studies.	
Literature	MODFLOW-Handbuch	
	Chiang, Wen Hsien: PMWIN	

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

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

Module M0828: Urbai	n Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/problem-based Lo	earning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on orban 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 following learning results			
Professional Competence				
Knowledge	Students can describe urban development corridors as well as current and future urban	environr	mental proble	ms. They are able t
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovations and explain why thes	e contri	bute to the in	nprovement of urba
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skille	Students are able to develop specific solutions for correcting existing or future	onviron	ment-related	problems of urba
SKIIIS	development. They can define a range of conceptual and technical solutions for environr			•
	paths. To solve specific urban environmental problems they can select technical innov			
	context.	acions a	na micegrate	them into the diba
Personal Competence	Concord			
•	The students can work together in international groups.			
Social competence	The statents can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations a	and cont	ributions to t	he discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	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: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory			
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualifica	tion: Cor	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective	Compuls	ory	
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Cities: Compulsory			

Course L1109: Noise Protection		
Тур	Lecture	
Hrs/wk	2	
СР	2	
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 Infrastructures	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach
Language	EN
Cycle	SoSe
Content	Problem Based Learning
	Main topics are: Central vs. Decentral Wastewater Treatment. Compaction of Cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

Module M0860: Harbo	our Engineering and Harbour Planning			
Courses				
Title	Туј	p	Hrs/wk	СР
Harbour Engineering (L0809)	Lec	cture	2	2
Harbour Engineering (L1414)		pject-/problem-based Learning	1	2
Port Planning and Port Construction	(L0378) Lec	cture	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 following le	earning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design app	proaches for the functional de	esign of a port	t and apply them to
	design tasks. They can design the fundamental elements of a port.			
Skills	The students are able to select and apply appropriate approaches for	or the functional design of por	ts.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied	problems such as the functi	ional design o	f ports. Additionaly,
	they will be able to work in team with engineers of other disciplines.			
Autonomy	The students will be able to independently extend their knowledge a	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 incl	ludes tasks with respect to t	the general u	nderstanding of the
	lecture contents and calculations tasks.	·	3	3
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Com	npulsory		
-	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	•		
-	Civil Engineering: Specialisation Coastal Engineering: Compulsory	•		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso	sory		
	International Management and Engineering: Specialisation II. Civil En	•	ory	

C	•.
Course L0809: Harbour Engin	
	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 Engir	Course L1414: Harbour Engineering	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0378: Port Planning	and Port Construction
Тур	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
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Module M0861: Mode	lling of Hydraulic Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Est	uaries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering.			
	Besides, they can describe the basic aspects of	numerical modelling and actual numerical mod	els for the sir	mulation of flows and
	waves.			
Skills	Students are able to apply hydrodynamic-numeri	cal models to practical hydraulic engineering ta	SKS.	
Personal Competence				
Social Competence	The students are able to deploy their gained kno	wledge in simple applied problems. Additionaly	, they will be	able to work in team
,	with others.		•	
Autonomy	The students will be able to independently extend	d their knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 3 hours. Th	e examination includes tasks with respect to	the general i	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Computational E	ngineering: Compulsory		

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

Course L0812: Modelling of Waves		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	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
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
	busic equations of flydrodynamics
	Saint-Venant equations
	Euler Equations
	Navier-Stokes equations
	Reynolds-averaged Navier-Stokes equations Challey weeks a synthesis.
	Shallow water equations
	Solving schemes
	Numerical discretization
	Solution algorithms
	Convergence
Literature	Vorlesungsskript
	Literaturempfehlungen
	Literaturempremungen
	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 de
	Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigung für
	Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1).
	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale
	numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten in de
	Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deutsche
	Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-2).
	Doutrobe Versingung für Maccornittechaft Abwaccar und Abfall a.V. (DWA), DWA Arbeitegruppe WW 2.2 Mahrdimancianala
	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).
	Telesingung tal Masser Misseriati, 7 anasser and 7 anath (2007) Negeriativ, 2012-27,
	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.
	The Norwegian oniversity of Science and Technology.
	Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science and
	technology library, 83).
	van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-RIZA
	SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036).
	Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband fü Wasserwirtschaft und Kulturbau. Bonn: Wirtschafts- und VerlGes. Gas und Wasser (Schriftenreihe des Deutschen Verbandes für

Wasserwirtschaft und Kulturbau, 127).

Courses				
Title		Тур	Hrs/wk	СР
Biological Wastewater Treatment (Lecture	2	2
Biological Wastewater Treatment (Recitation Section (large)	1 2	1 2
Advanced Wastewater Treatment (Advanced Wastewater Treatment (Lecture Recitation Section (large)	1	1
Module Responsible	<u> </u>	Hechanon Section (id. ge)	-	_
Admission Requirements				
Recommended Previous		nd the key processes involved in wastewater treat	ment.	
Knowledge		, , , , , , , , , , , , , , , , , , ,		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
_	Students are able to outline key areas of the full range of treatment systems in waste water management, as well as their mutua dependence for sustainable water protection. They can describe relevant economic, environmental and social factors. Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application in			
	municipal and for some industrial treatme	ent plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this modu	le.		
Autonomy	Students are in a position to work on a subject.	subject and to organize their work flow independent	ndently. They can	also present on th
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	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	Il Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr			
	Civil Engineering: Specialisation Coastal E	ingineering: Elective Compulsory		
	Civil Engineering: Specialisation Water an	d Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A -	General Bioprocess Engineering: Elective Compul	sory	
	Environmental Engineering: Specialisation	n Water Quality and Water Engineering: Elective Co	ompulsory	
	International Management and Engineerin	ng: Specialisation II. Process Engineering and Biote	chnology: Elective	Compulsory
	International Management and Engineerin	ng: Specialisation II. Energy and Environmental En	gineering: Elective	Compulsory
		onmental Process Engineering: Elective Compulsor		
	Process Engineering: Specialisation Proces	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Water: Compulsory		
		pecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Sp			

ourse 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	

 $ISBN: \quad 3540343296 \ (Gb.) \quad URL: \quad http://www.gbv.de/dms/bs/toc/516261924.pdf \quad URL: \quad http://deposit.d-nb.de/cgi-bin/dokserv?$

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

http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf

URL:

aus der Abwasserbehandlung, Kleinkläranlagen

ISBN: 3860682725 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

 $ISBN: 3527312196 \ (Gb.) \ URL: \ http://deposit.ddb.de/cgi-bin/dokserv?id=2774611\&prov=M\&dok_var=1\&dok_ext=htm-provestare for the provestar for the prove$

Weinheim: WILEY-VCH, 2007

TUB HH Katalog

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

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

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

ourses	
itle ty Planning (L1066)	Typ Hrs/wk CP Project-/problem-based Learning 4 6
Module Responsible	
Admission Requirements	
	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.
	 describe the main determinants of urban development. explain and compare different possibilities of how urban development can be influenced.
	 explain and compare different possibilities of now dipart development can be influenced. discuss requirements for public streetscapes.
	explain the importance of street design.
Skills	Students are able to:
	read and analyze urban development concepts and designs for streetscapes
	appraise such concepts in the context of competing requirements.
	design, justify and reflect their own solutions for concrete examples.
Personal Competence Social Competence	Students are able to: • discuss intermediate results with each other. • constructively accept feedback on their own work. • provide constructive feedback to others.
Autonomy	Students are able to: • independently complete a written report including drawings following a broadly pre-defined process. • assess the consequences of their proposed solutions. • independently acquire knowledge and apply this to new issues or problem areas.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	written assignment, designwork during the semester
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				
Title		Тур	Hrs/wk	СР
Construction Logistics (L1163)		Lecture	1	2
Construction Logistics (L1164)		Recitation Section (small)	1	2
Project Development and Managen Project Development and Managen		Lecture Project-/problem-based Learning	1	1
Module Responsible		Troject /problem basea Leanning	_	-
Admission Requirements	None			
Recommended Previous				
Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence	,,	9		
•	Students can			
Skills	 give definitions of the main terms of construction logistics and project development and management name advantages and disadvantages of internal or external construction logistics explain characteristics of products, demand and production of construction objects and their consequences for construction 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 			
Personal Competence Social Competence				
	 hold presentations in and for groups apply methods of conflict solving skills in group work and conflict ship skil	ase studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow oriented think improve their creativity, negotiation skills, conflict and creativity 		g 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			
Examination duration and scale	Two written papers with presentations			
	Civil Engineering, Specialisation Structural Engineering, Elective C	`ompulcon/		
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective C Civil Engineering: Specialisation Geotechnical Engineering: Electiv			
i onowing curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Con	, ,		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu			
	International Management and Engineering: Specialisation II. Civil	•	ory	
	International Management and Engineering: Specialisation II. Logis		•	
	Logistics, Infrastructure and Mobility: Specialisation Production an	, ,	У	
	, , , , , , , , , , , , , , , ,	3	-	

Course L1163: Construction	Indistics	
	Lecture	
Hrs/wk		
CP		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
	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:	
	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		
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 Development and Management		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	Within the lecture, the main aspects of project development and management are tought:	
	 Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises.	
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.	

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

Module M0998: Statio	cs and Dynamics of Structures			
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 staticall	y determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics I/I
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence	7.	3 3		
Knowledge	After successful completion of this module, the sturespective methods.	ident can explain the basic aspects of d	ynamic effects o	n structures and th
Skills	After successful completion of this module, the students will be able to predict the response of material and structures to dynamics loading using the appropriate computational approaches and methods.			
Personal Competence Social Competence	Students can			
	 participate in subject-specific and interdiscipl 	inary discussions,		
	defend their own work results in front of othe	rs		
	promote the scientific development of colleage	gues		
	Furthermore, they can give and accept profes	ssional constructive criticism		
Autonomy	Students are able to gain knowledge of the subject	area from given and other sources and a	pply it to new pro	oblems. Furthermore
	they are able to structure the solution process for pr	roblems in the area of Structural Analysis		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
Credit points				
Course achievement				
	Written exam			
Examination duration and			-	
scale	230 11111			
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Compulsory		
•		, ,		
Following Curricula		, ,		
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic: E	• •		
	Civil Engineering: Specialisation Computational Engi			
	International Management and Engineering: Special	isation ii. Civii Engineering: Elective Com	Juis0i y	

Course L1202: Structural Dynamics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. 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 	
	 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		

Course L0564: Fracture mecl	hanics and fatigue in steel structures
Тур	Lecture
Hrs/wk	1
СР	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	
Content	basics of fatigue stress and fatigue resistance and determination of fatigue strength,
	determination anduse 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 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

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				
litle little		Тур	Hrs/wk	СР
Repair of Structures (L0255)		Lecture	1	1
Mineral Building Materials (L0253)		Lecture	2	2
echnology of mineral Building Ma		Project-/problem-based Learning		2
•	erials and Damage Processes (L0254)	Lecture	1	1
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building mate	ls, building physics and building chemistry, for exa	mple by the n	nodules Principles
Knowledge	Building Materials and Building Physics	d Building Materials and Building Chemistry.		
Educational Objectives	After taking part successfully, students	ve reached the following learning results		
Professional Competence				
Shille	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 correlation of their material parameters. They are able to show the principles of anchor technology and design.			
Skins	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a spec mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They a able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select reparand 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 Time 110, Study Tir	in Lecture 70		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes 20 % Subject theore	cal and		
	practical work			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotec	ical Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coasta	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	l Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water	d Traffic: Flactive Compulsory		

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

Course L0253: Mineral 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 or	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	ourse L0254: Transport Processes in Building Materials and Damage Processes	
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Transport Processes in Building Materials and Damage Processes	
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung	

Module M0999: Steel	Construction Project			
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 have reached th	e 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 th	eir part of the project. They are	e able to adjust their	work in reaction to
	changing conditions resulting from other participants of	the project.		
Personal Competence				
Social Competence	Students can present their results to other members of the group.			
	They have the ability to work for a broad agreement wit	h respect to intergroup depende	ncies.	
	They can distribute and process tasks independently.			
Autonomy	Students can handle their part of the project on their ow	n 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 Geotechnical Engineerin	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Structural Engineering:	Compulsory		
	Civil Engineering: Specialisation Computational Enginee	ring: 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.

Module M0663: Marin	e Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III, Mathematics I-III			
Knowledge	Courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	The students get a deeper knowledge of steel and grou	und engineering as well as constructio	ns knowledge co	ncerning quay walls.
	Furthermore, the students get all the necessary knowle	edge to design singular construction e	lements for shee	et pile walls and they
	know how to choose the right construction elements de	pending on the influencing conditions.		
Skills	Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to choose the			
	suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile			
	walls and combined sheet pile walls) and to dimension all construction elements and connections.			
Personal Competence				
Social Competence				
Autonomy	Students are able to assess their own strengths and we	aknesses and organize their time and	learning manage	ement based on this.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Compulsory			
	Civil Engineering: Specialisation Computational Enginee	ering: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Mari	time Technology: 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 	

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

Module M1724: Smar			
Courses			
Title	Typ Hrs/wk CP		
Smart Monitoring (L2762)	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 modeling, programming, and sensor technologies are helpful. Interest in mode		
Knowledge	research and teaching areas, such as Internet of Things, Industry 4.0 and cyber-physical systems, as well as the will to deeper		
	skills of scientific working, are required. Basic knowledge in scientific writing and good English skills.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
•	The students will become familiar with the principles and practices of smart monitoring. The students will be able to des		
Knowieuge	decentralized smart systems to be applied for continuous (remote) monitoring of systems in the built and in the natu		
	environment. In addition, the students will learn to design and to implement intelligent sensor systems using state-of-the-art day		
	analysis techniques, modern software design concepts, and embedded computing methodologies. Besides lectures, project world		
	also part of this module, which will be conducted throughout the semester and will contribute to the grade. In small groups,		
	students will design smart monitoring systems that integrate a number of "intelligent" sensors to be implemented by the studer		
	Specific focus will be put on the application of machine learning techniques. The smart monitoring systems will be mounted		
	real-world (built or natural) systems, such as bridges or slopes, or on scaled lab structures for validation purposes. The outcome		
	every group will be documented in a paper. All students of this module will "automatically" participate with their smart monitor		
	system in the annual "Smart Monitoring" competition. The written papers and oral examinations form the final grades. The mod		
	will be taught in English. Limited enrollment.		
Skills	The students will gain insights into operating state-of-the-art smart sensor systems, used for monitoring a wide 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		
	be able to document the findings of their projects in short reports.		
Personal Competence			
Social Competence	The students will be able to work in groups, share parts of the work for their projects, and develop communication skills, towa		
	achieving the common project goals.		
Autonomy			
	results, through their involvement in their monitoring group projects.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
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: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory		
	Environmental Engineering: Specialisation Energy and Resources: Elective Compulsory		
	Environmental Engineering: Specialisation Environment and Climate: Elective Compulsory		
	Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory		
	Mechatronics: Technical Complementary Course: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: 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 L2762: Smart Monitoring		
Тур	ntegrated 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 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 M1878: Susta	inable energy from wind and water			
Courses				
Title		Тур	Hrs/wk	СР
Offshore Geotechnical Engineering	(L0067)	Lecture	1	1
Hydro Power Use (L0013) Wind Turbine Plants (L0011)		Lecture Lecture	1 2	1
Wind Energy Use - Focus Offshore (L0012)	Lecture	1	1
Module Responsible	Dr. Marvin Scherzinger			
Admission Requirements	None			
Recommended Previous	Module: Technical Thermodynamics I,			
Knowledge	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanics			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy projects in countries outside Europe.			
	Through active discussions of various topics within application of the theoretical background and are the			derstanding and the
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with the in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects.			
Personal Competence				
Social Competence				
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale	Civil Familian Caracialisation Characterist Familians	- Flasting Committee		
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineeri Civil Engineering: Specialisation Geotechnical Engine			
rollowing curricula	Civil Engineering: Specialisation Coastal Engineering			
	International Management and Engineering: Specialis	, ,	l Engineering: Elective	Compulsory
	International Management and Engineering: Specialis			
	Product Development, Materials and Production: Spe	3,	, ,	
	Product Development, Materials and Production: Spe	cialisation Production: Elective Cor	npulsory	
	Product Development, Materials and Production: Spe	cialisation Materials: Elective Com	pulsory	
	Renewable Energies: Core Qualification: Compulsory			
	Theoretical Mechanical Engineering: Specialisation E			
	Process Engineering: Specialisation Environmental Pr		ulsory	
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	·	у	
	Water and Environmental Engineering: Specialisation	i water. Elective Compulsory		

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

Course L0013: Hydro Power			
Тур	Lecture		
Hrs/wk			
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			
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Martin Skiba		
Language	DE		
Cycle	SoSe		
Content	 Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion 		
Literature	 Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage 		

Module M1895: Digita	al Twinning in Civil Engine	eering		
Courses				
Title		Тур	Hrs/wk	СР
Digital Twinning in Civil Engineering	-	Lecture	2	2
Digital Twinning in Civil Engineering	g (L3137)	Seminar	2	4
Module Responsible	Alexander Chmelnizkij			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, studen	nts have reached the following learning re	sults	
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	20 min presentation and 5 pages har	ndout		
scale				
Assignment for the	Civil Engineering: Specialisation Computational Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Geot	technical Engineering: Elective Compulso	ry	
	Civil Engineering: Specialisation Struc	ictural Engineering: Elective Compulsory		

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

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

Module M0858: Coastal Hydraulic Engineering I				
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L080	7)	Lecture	3	4
Basics of Coastal Engineering (L143	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of hydraulic engineering, hydrology and hydromec	hanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to define and explain the basic con	cepts of coastal engineering and port e	ngineering. Tl	ney are able to apply
	the concepts to selected practical problems of coastal en	ngineering. Students can define and de	termine the b	asics for design and
	dimensioning of coastal engineering constructions.			
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.			
Personal Competence				
·	The students are able to deploy their gained knowledge	in applied problems such as the design	n of coastal r	rotection structures
Social Competence	Additionaly, they will be able to work in team with engine	• • • • • • • • • • • • • • • • • • • •		
	Additionary, they will be able to work in team with engine	ers of other disciplines, for instance des	ngilling of cod.	star breakwaters.
Autonomy	The students will be able to independently extend their k	nowledge and applyit to new problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The exami	nation includes tasks with respect to	the general ι	inderstanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Cor	npulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	g: Compulsory		
	Civil Engineering: Specialisation Structural Engineering: E	lective Compulsory		
	Environmental Engineering: Specialisation Environment a	nd Climate: Elective Compulsory		
	Environmental Engineering: Specialisation Water Quality	and Water Engineering: Elective Compu	Isory	
	International Management and Engineering: Specialisatio	n II. Civil Engineering: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Env	rironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	ter: Elective Compulsory		

Course L0807: Basics of Coas	stal Engineering
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Peter Fröhle
Language	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
Literature	Coastal Engineering Manual, CEM
	Vorlesungsumdruck

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

Courses				
Title		Тур	Hrs/wk	CP
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)	_	Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Structural Analysis I			
Knowledge	Structural Analysis I Structural Analysis II			
	Finite Element Methods			
	Finite Element Methods			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the stu	idents can express the basic aspects of	the load-carryin	g behaviour of thi
	walled structures.			
Skille	After successful completion of this module, the stu	dents will be able to predict load-carryin	a hehaviour of th	hin-walled structur
Skills	using appropriate analytical and coputational metho	·	g bellaviour of ti	illi-walled Structur
	using appropriate unarytical and coputational metho			
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdiscipli	nary discussions.		
	defend their own work results in front of other	•		
	promote the scientific development of colleage	ues		
	Furthermore, they can give and accept profes			
Autonomy	Students are able to gain knowledge of the subject			
	they are able to structure the solution process for pr	oblems in the area of modelling and anal	ysis of thin-walle	d structures.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engi	neering: Compulsory		
	Civil Engineering: Specialisation Structural Engineeri	ng: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation S	imulation Technology: Elective Compulso	ry	

Tire	Lecture
	Lecture
Hrs/wk	
СР	
	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
	- 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 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				
Title	_,	Тур	Hrs/wk	СР
Nonlinear Structural Analysis (L027 Nonlinear Structural Analysis (L027		Lecture Recitation Section (small)	3 1	4 2
Module Responsible	Prof. Alexander Düster	recitation section (small)	1	
•				
Admission Requirements	None	acommonded.		
Knowledge	Knowledge of partial differential equations is r	ecommended.		
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence	After taking part successiony, students have i	eached the following learning results		
	Students are able to			
Knowieuge	+ give an overview of the different nonlinear	phonomona in structural mochanics		
	+ explain the mechanical background of nonli			
		analysis, to identify them in a given situation a	nd to explain the	ir mathematical a
	mechanical background.	anarysis, to identify them in a given situation a	na to explain the	macricinatical c
Skills	Students are able to			
	+ model nonlinear structural problems.			
	+ select for a given nonlinear structural proble			
	+ apply finite element procedures for nonline			
	+ critically verify and judge results of nonlinear			
	+ to transfer their knowledge of nonlinear sol	ition procedures to new problems.		
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups.			
	+ present and discuss their results in front of	others.		
	+ give and accept professional constructive of	riticism.		
Autonomy	Students are able to			
Autonomy	+ assess their knowledge by means of exercise	es and F-I earning		
	+ acquaint themselves with the necessary kn			
	+ to transform the acquired knowledge to sim			
	·			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	, ,		
Following Curricula	Civil Engineering: Specialisation Computation			
	Computational Engineering: Core Qualification	· · ·	ulcon.	
		pecialisation II. Civil Engineering: Elective Comp nt and Production: Core Qualification: Elective C	•	
	Materials Science and Engineering: Specialisa		ompuisory	
	Materials Science: Specialisation Modeling: Ele			
	Mechatronics: Technical Complementary Cour	· · ·		
	Mechatronics: Core Qualification: Elective Con	, ,		
	Product Development, Materials and Production	•		
	Naval Architecture and Ocean Engineering: Co			
	Naval Architecture and Ocean Engineering: Co			
	Ship and Offshore Technology: Core Qualificat			
	3,	. ,		

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

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

Module M0801: Wate	r Resources and -Supply			
Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatment (L0311)		Lecture	2	1
Chemistry of Drinking Water Treatr	nent (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04	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 key proc	esses involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowleage	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainab water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain an outline the organisational structures of water companies. They will be able to explain the available water treatment processes an the scope of their application.			
Skills	Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students we be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules an standards to these processes.			
Personal Competence				
Social Competence Autonomy	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the managemen and treatment of drinking water. They will be able to take an appropriate professional position, for example representing use interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others. Students will be in a position to work on a subject independently and present on this subject.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale	22 (circuitati), . presentation			
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Flective Compulsory		
Following Curricula	Civil Engineering: Specialisation Scructural Engineer			
i ollowing culticula	Civil Engineering: Specialisation Geotechnical Engin	. ,		
	Civil Engineering: Specialisation Coastal Engineerin			
	Chemical and Bioprocess Engineering: Technical Co		,	
	•			
	Chemical and Bioprocess Engineering: Technical Co International Management and Engineering: Specia			Compulsory
	Process Engineering: Specialisation Environmental	• • • • • • • • • • • • • • • • • • • •	icernig. Elective	Corripuisory
	Process Engineering: Specialisation Process Engine			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	·		
	Water and Environmental Engineering: Specialisation	on Cities: Elective Compulsory		

Course L0311: Chemistry of	Drinking Water Treatment
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
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	ourse L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	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	Course 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		

	rated Transportation Planning
Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	(L1068) Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
	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 transportation/mobility behaviour
	explain and evaluate the social, ecological and economic effects of transport and land-use policy measures.
	 relate current issues in the area of integrated transport planning and formulate an opinion on them.
Skills	Students are able to:
	quantify important parameters, which influence travel demand or are influenced by it.
	comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document the
	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, acquire the necessary knowledge and use appropriate means f
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	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			
СР			
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 M0964: Underground Constructions					
Courses					
Title		Ту	'p	Hrs/wk	СР
Applied Tunnel Constructions (L240	7)	Le	cture	2	3
Introduction to tunnel construction	(L0707)	Le	cture	1	2
Introduction to tunnel construction	(L1811)	Re	citation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules from Bachelor studies Civil and e	environmental engineering			
Knowledge	Geotechnics I-II				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction.				
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis.				
Personal Competence					
Social Competence	Capacity for teamwork concerning project	t 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	16				
Course achievement	Compulsory Bonus Form	Description			
	No 5 % Excercises				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Cor	mpulsory		
Following Curricula	Civil Engineering: Specialisation Geotechn	nical Engineering: Compuls	ory		
	Civil Engineering: Specialisation Coastal E	Engineering: Compulsory			
	Civil Engineering: Specialisation Water an	nd Traffic: Elective Compuls	sory		
	Civil Engineering: Specialisation Computa	ational Engineering: Elective	e Compulsory		
	International Management and Engineering	ng: Specialisation II. Civil E	ngineering: Elective Com	oulsory	

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

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

Educational Objectives After Professional Competence Knowledge The sexual exemptions of the sexual exemption of the sexual exe	
Module Responsible Doze Admission Requirements None Recommended Previous Knowledge Educational Objectives After Professional Competence Knowledge The sexual exemptions of the sexual exemptions	tenten des SD B de opects of the Structural Engineering specialisation. En taking part successfully, students have reached the following learning results estudents are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. Estudents can develop solving strategies and approaches for fundamental and practical problems in structural and construction inneering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
Admission Requirements None Recommended Previous Subjeting Knowledge Educational Objectives After Professional Competence Knowledge The sexual Subjeting Sub	piects of the Structural Engineering specialisation. The taking part successfully, students have reached the following learning results Students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. The students can develop solving strategies and approaches for fundamental and practical problems in structural and construction lineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
Recommended Previous Knowledge Educational Objectives Professional Competence Knowledge The sexual competence	er taking part successfully, students have reached the following learning results estudents are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. estudents can develop solving strategies and approaches for fundamental and practical problems in structural and construction lineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
Knowledge Educational Objectives After Professional Competence Knowledge The second	er taking part successfully, students have reached the following learning results e students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. e students can develop solving strategies and approaches for fundamental and practical problems in structural and construction lineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
Professional Competence Knowledge exem	e students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. Estudents can develop solving strategies and approaches for fundamental and practical problems in structural and construction lineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
Professional Competence Knowledge exem	e students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. Estudents can develop solving strategies and approaches for fundamental and practical problems in structural and construction lineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
Knowledge The s	emplify the state of technology and application and discuss critically in the context of actual problems and general conditions of ence and society. Students can develop solving strategies and approaches for fundamental and practical problems in structural and construction incering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
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	ence and society. estudents can develop solving strategies and approaches for fundamental and practical problems in structural and construction incering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
	ineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points
engir	
Scien	entific work techniques that are used can be described and critically reviewed.
meth	estudents are able to independently select methods for the project work and to justify this choice. They can explain how these thods relate to the field of work and how the context of application has to be adjusted. General findings and further relopments may essentially be outlined.
Personal Competence	
Social Competence The s	e students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their eagues.
dead	students are capable of independently planning and documenting the work steps and procedures while considering the given idlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback in 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 Indep	ependent Study Time 180, Study Time in Lecture 0
Credit points 6	
Course achievement None	ne
Examination Study	dy work
Examination duration and see F	FSPO
scale	
Assignment for the Civil Following Curricula	il Engineering: Specialisation Structural Engineering: Compulsory

Courses					
Title		Тур	Hrs/wk	CP	
Design of Composite Bridges (L309		Integrated Lecture	2	3	
Analysis of Offshore Structures (L1		Lecture	1	1	
Solid Matter Process Technology fo		Lecture	2	3	
Innovative Timber Construction (L2	2666)	Lecture	2	4	
Glass Structures (L1152)		Lecture	2	2	
Glass Structures (L1447)	(12070)	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	
Special topics of civil engineering 2			2 3	2 3	
Special topics of civil engineering 3 Structural Design (L2789)	3 LP (L2380)	Seminar	2	2	
-	Prof. Frank Schmidt-Döhl	Seminar	2	2	
Module Responsible					
Admission Requirements					
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have read	ched the following learning results			
Professional Competence					
Knowledge					
	Students are able to find their way through				
	•	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 i	in selected areas of civil and structural engir	neering.		
Personal Competence					
•					
Social Competence					
Autonomy	Students can chose independently, in whi	ch fields they want to deepen their knowle	dge and skills th	rough the election o	
	courses.		. 3		
Workload in Hours	Depends on choice of courses				
Credit points	6				
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	gineering: Elective Compulsory			
	I				
	Civil Engineering: Specialisation Coastal Engineer	ring: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineer Civil Engineering: Specialisation Water and Traffic				

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

Course L1867: Analysis of Of		
Тур		
Hrs/wk		
CP Workland in House	1 Independent Study Time 16 Study Time in Lecture 14	
Examination Form	Independent 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 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	
	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					
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	ViSe				
Content					
Literature	- Blass, J.: "Ingenieurholzbau"				
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"				
	- Informationsdienst Holz: div. Merkblätter und Broschüren				
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2				
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"				
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"				
	- Kempe K.: "Dokumentation Holzschädlinge"				
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"				

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

Course L1447: Glass 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 landfill design and operation				
Тур	Integrated Lecture			
Hrs/wk	3			
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	ntegrated Lecture			
Hrs/wk				
СР	3			
Workload in Hours	ndependent Study Time 62, Study Time in Lecture 28			
Examination Form	Klausur			
Examination duration and	0 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	NiSe/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	NiSe/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				
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28			
Examination Form	Mündliche Prüfung			
Examination duration and	20 min			
scale				
Lecturer	Dr. Jan Mittelstädt			
Language	DE/EN			
Cycle	SoSe			
Content				
Literature	[1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761			
	Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and			
	Sons; 1st edition (Sept 2009), ISBN-10: 047017465X			
	[2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237			
	[3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10:			
	9783038601104			
	[4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL,			
	(June 2018), ISBN-10: 3955533948			
	[5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition			
	edition (Mar 2003), ISBN-10: 0300097867			
	[6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of			
Modern Art (Jul 2019), ISBN-10: 1633450562				
	[7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015),			
	ISBN-10: 3038600253			

Module M1505: Adap	tation to Climate Change in Hydraulic Engineering (AKWAS)
Courses	
Title Adaptation to climate change in hy	Typ Hrs/wk CP draulic engineering (L2291) Project-/problem-based Learning 4 6
Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous	
Knowledge	 Hydrology, Hydraulic Engineering 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, plannin methods Consideration of complex tasks
Personal Competence Social Competence Autonomy	 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	the second secon
Course achievement	None
Examination	Written elaboration
Examination duration and	Preparation of a written report and a presentation of a complex task.
scale	The second secon
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
•	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory

Course L2291: Adaptation to	climate change in hydraulic engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	4		
СР	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	 Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / clim 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. 		

Module M1345: Metal	lic and Hybrid Light-weight N	Materials				
Courses						
Title		Тур	Hrs/wk	СР		
Joining of Polymer-Metal Lightweight Structures (L0500)		Lecture	2	2		
Joining of Polymer-Metal Lightweigh	nt Structures (L0501)	Practical Course	1	1		
Metallic Light-weight Materials (L16	560)	Lecture	2	3		
Module Responsible	Prof. Marcus Rutner	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 Time in Lecture 70					
Credit points	6					
Course achievement	None					
Examination	Oral exam					
Examination duration and	45 min					
scale						
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
Following Curricula	Materials Science and Engineering: Specialisation Engineering Materials: Elective Compulsory					
	Materials Science: Specialisation Engineer	ing Materials: Elective Compulsory				
	Theoretical Mechanical Engineering: Speci	ialisation Materials Science: Elective Compulsor	/			

Course L0500: Joining of Polymer-Metal Lightweight 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	EN			
Cycle	WiSe			
Content	Contents:			
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures.			
	Theoretical Lectures:			
	 Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics Mechanical Fastening of Polymer-Metal Hybrid Structures Adhesive Bonding of Polymer-Metal Hybrid Structures Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures Laboratory Exercises: Joining Processes: Introduction to state-of-the-art joining technologies Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints Course Outcomes: After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields. 			
Literature	 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 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	

Language	EN					
Cycle	WiSe					
	See interlocking course					
Literature	See interlocking course					
Course L1660: Metallic Light-weight Materials						
Тур						
Hrs/wk						
СР	3					
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28					
Lecturer	Dr. Domonkos Tolnai					
Language						
Cycle	Lightweight construction					
Content						
	- Structural lightweight construction					
	- Material lightweight construction					
	- Choice criteria for metallic lightweight construction materials Steel as lightweight construction materials					
	- Introduction to the fundamentals of steels					
	- Modern steels for the lightweight construction					
	- Fine grain steels					
	- High-strength low-alloyed steels					
	- Multi-phase steels (dual phase, TRIP)					
	- Weldability					
	- Applications					
	Alternative alleges					
	Aluminium alloys:					
	Introduction to the fundamentals of aluminium materials					
	Alloy systems					
	Non age-hardenable Al alloys: Processing and microstructure, mechanical qualities and applications					
	Age-hardenable Al alloys: Processing and microstructure, mechanical qualities and applications					
	Magnesium alloys					
	Introduction to the fundamental of magnesium materials					
	Alloy systems					
	Magnesium casting alloys, processing, microstructure and qualities					
	Magnesium wrought alloys, processing, microstructure and qualities					
	Examples of applications					
	Titanium alloys					
	Introduction to the fundamental of the titanium materials					
	Alloy systems					
	Processing, microstructure and properties					
i						

Examples of applications

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

Courses			
Title	Тур	Hrs/wk	СР
Scientific Working in Computationa	**	6	6
Module Responsible	Prof. Kay Smarsly		
Admission Requirements	None		
Recommended Previous	Basic knowledge in scientific writing. String interest in topics related to computing in civil engine	ering.	
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowleage	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 scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A project will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance in this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be written based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.		
Skills	The students will be capable (i) of solving a scientific problem following a scientific methodolo effectively in the form of a paper, and (iii) of sharing their work in a presentation.	gy, (ii) of doc	umenting their wor
Personal Competence			
Social Competence	The students will be able to work in a multidisciplinary team 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 indep	endently in a projec
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: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory		
	Mechatronics: Technical Complementary Course: Elective Compulsory		

Course L2764: Scientific Wor	king 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				
Courses				
Title	Protection in a Changing Climate (SeaPiaC) (L2926)	Typ Project-/problem-based Learning	Hrs/wk 4	CP 6
		Project-/problem-based Learning	4	0
Module Responsible				
Admission Requirements Recommended Previous	None			
Kecommended Previous Knowledge	Hydraulic Engineering			
imomougo	Hydromechanics, Hydraulics			
	Fundamentals of Coastal Engineering, Coastal- ar	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 Proc			
	Consequences of Climate Change for Coastal Protection in Taiwan and Germany	esses		
	Fundamentals of Climate Adaptation			
	Nature-based Solutions (NBS) for Coastal Protecti	on		
Skills				
SKIIIS	Critical thinking: analysis of processes and relation	ns, assessment of needs for action		
	Creative thinking: development of adaptation stra	tegies and adaptation measures		
	 Practical thinking: inclusion of restrictions, appl 	cation of calculation approaches, meth	nods, numerica	al models, plannin
	methods			
	Consideration of complex tasks			
Personal Competence				
Social Competence				
	Working in international groups Working in international groups			
	Working in international groups Working with different scientific / non-scientific di	scinlines		
	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 Course achievement				
	Written elaboration			
	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	on the complex tas
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory		
Following Curricula				
	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elect	ve Compulsory		
	Environmental Engineering: Specialisation Environment	and Climate: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cit			
	Water and Environmental Engineering: Specialisation En			
	Water and Environmental Engineering: Specialisation Wa	ater: Elective Compulsory		

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

Module M1844: Modern discretization methods in structural mechanics				
Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in s	structural mechanics (L3043)	Lecture	2	3
Modern discretization methods in s	structural mechanics (L3044)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous	Elife Element Matterla			
Knowledge	Finite Element Methods			
	Flächentragwerke			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stude	nts can express the basic aspects of moder	n discretization r	nethods in structura
	mechanics.			
Skills	After successful completion of this module, the st	udents will be able to use and further impro	ve modern discre	etization methods fo
	problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
·				
	participate in subject-specific and interdisc	• •		
	defend their own work results in front of ot			
	promote the scientific development of colle	•		
	Furthermore, they can give and accept pro	fessional constructive criticism		
Autonomy	Students are able to gain knowledge of the subje	ct area from given and other sources and a	oply it to new pro	blems. Furthermore
	they are able to structure the solution process for			
	,	•		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Computational Er	ngineering: Elective Compulsory		
	Computational Engineering: Core Qualification: El	ective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	n 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	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		

Module M1956: Buildi	ing and Excavation Law			
Courses				
Title		Тур	Hrs/wk	СР
Construction law BGB and VOB - la	w in (excavation) practice (L3182)	Lecture	2	3
	ection (excavation) practice (L3181)	Lecture	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III			
Knowledge				
	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students will gain knowledge of			
	 the history of civil engineering law, 			
	 basics of foundation and civil engineering 	law,		
	 legal aspects of technical regulations in c 	ivil engineering (with case studies),		
	the civil engineering contract,			
	the liability of the designer and contracto	r in civil engineering,		
	the subsoil risk and the system risk,			
	the total debt in (civil) engineering law, the (construction) conflict dispute equide		_	
	the (construction) conflict, dispute avoida	·	5,	
	the systematics of construction contract I the BCB construction contract law	aw,		
	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 m	uch money am I entitled to?		
	Correct calculation of supplements.	deli money ani i endided to.		
	Sometic cancalation of Supplemental			
Skills	Students learn to apply legal aspects in plannin	a and construction in a legally halanced	way Students learn h	now to use legal and
Skiiis	construction management aspects in practice (
	to manage the construction project optimally.	starming and construction, on the constr	detion site in a target	ica manner and now
	to manage the construction project optimally.			
Personal Competence				
•	Students can work in groups and support each o	ther in finding solutions.		
Autonomy	Students are able to assess their own strengths	and weaknesses and organize their time	and learning manage	ment based on this.
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points		ture 50		
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Enginee	ering: Elective Compulsory		
Following Curricula		• • •		
	Civil Engineering: Specialisation Structural Engir			
	Civil Engineering: Specialisation Water and Traff			
	Civil Engineering: Specialisation Computational			

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	

Module M0859: Coast	al Hydraulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Coastal- and Flood Protection (L0808)		Lecture	2	3
Coastal- and Flood Protection (L1415)		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 rea	ached 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 practica	coastal protection problems. They are able to	design and	dimension important
	coastal protection measures from the functional	and from the constructional point of view.		
g/ ///				
Skills	The students are able to select design approa		gn 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 I	knowledge in applied problems such as the fun	ctional and co	onstructive design o
	coastal and flood protection structures. Addition	aly, they will be able to work in team with engin	eers of other o	disciplines.
Autonomy	The students will be able to independently exte	nd their knowledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Led	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. 7	The examination includes tasks with respect to	the general (understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineer	ering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
	Environmental Engineering: Specialisation Envir	onment and Climate: Elective Compulsory		
	Environmental Engineering: Specialisation Wate	r Quality and Water Engineering: Elective Compu	ulsory	
	Water and Environmental Engineering: Specialis	ation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialis	ation Water: Elective Compulsory		

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
,	

Course L1415: Coastal- and I	Course 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

ourses				
itle		Тур	Hrs/wk	CP
aste and Environmental Chemist ological Waste Treatment (L0318		Practical Course Project-/problem-based Learning	2	2
•		Project-/problem-based Learning	3	4
Module Responsible				
Admission Requirements	None			
Recommended Previous	chemical and biological basics			
Knowledge	A6	The fill of the land of the land		
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence		and a state of the last and a second and a second		
Knowledge	The module aims possess knowledge concerning the design and layout of anaerobic and aerobic waste to			•
	plants for biological waste treatment plants and exp	plain different methods for waste analytics.		
Skills	The students are able to discuss the compilation of		-	
	control measurements. The students can recherche		I to the tasks	given in der mod
	and plan additional tests. They are capable of reflec	iting and evaluating findings in the group.		
Personal Competence				
•	Students can participate in subject specific and int	erdisciplinary discussions, develop cooperate	ad colutions a	nd defend their (
30ciai Competence	Students can participate in subject-specific and int work results in front of others and promote the s			
	accept professional constructive criticism.	cientific development in front of concagues.	. raitiiciiiioic	, they can give i
	accept professional consciuence charesinn			
Autonomy	Students can independently tan knowledge from li			
	Students can independently tap knowledge from in	erature, business or test reports and transfo	rm it to the c	ourse projects. T
	are capable, in consultation with supervisors as wel	erature, business or test reports and transfo I as in the interim presentation, to assess the		
		as in the interim presentation, to assess the	ir learning lev	el and define furt
	are capable, in consultation with supervisors as wel	as in the interim presentation, to assess the	ir learning lev	el and define furt
	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define t	as in the interim presentation, to assess the	ir learning lev	el and define furt
	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define t potential social, economic and cultural impact.	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Workload in Hours	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define t potential social, economic and cultural impact.	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Credit points	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define to potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define to potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Credit points	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define to potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Credit points Course achievement	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Credit points Course achievement Examination	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Credit points Course achievement	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work	l as in the interim presentation, to assess the argets for new application-or research-orient	ir learning lev	el and define furt
Credit points Course achievement Examination Examination and scale	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in grounds)	l as in the interim presentation, to assess the argets for new application-or research-orient 2 70 Description	ir learning lev	el and define furt
Credit points Course achievement Examination Examination and	are capable, in consultation with supervisors as well steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient 2 70 Description ups) g: Elective Compulsory	ir learning lev	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient 2.70 Description g: Elective Compulsory eering: Elective Compulsory	ir learning lev	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient 2.70 Description g: Elective Compulsory eering: Elective Compulsory ing: Elective Compulsory	ir learning lev	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	as in the interim presentation, to assess the argets for new application-or research-orient argets for new applica	ir learning lev	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	as in the interim presentation, to assess the argets for new application-or research-orient argets for new applica	ir learning lev ted duties in a	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	as in the interim presentation, to assess the argets for new application-or research-orient argets for new application-orient arge	ir learning lev ted duties in a	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient application-or research-orient application-or research-orient application-or research-orient application-orient application-orientation-ori	ir learning lev ted duties in a	el and define furt
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient argets for new application a	ir learning lev ted duties in a	el and define furt accordance with
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient argets for new application application argets for new application arge	ir learning lev ted duties in a	el and define furt accordance with
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient argets for new application application argets for new application application argets for new application and new application argets for new application and new application argets for new application and new application are computed in the new application and new application are computed in the new application are new application and new application are considered in the new application are considered in the new application are new application and new application are new application and new application are new application are new application and new application are new application and new application are new application a	ir learning lev ted duties in a pulsory npulsory vive Compulso ry vive Compulso	el and define furt accordance with
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	l as in the interim presentation, to assess the argets for new application-or research-orient argets for new application application argets for new application application argets for new application argets for new application and new application argets for new application argets for new application and new application argets for new application arg	ir learning lev ted duties in a pulsory npulsory vive Compulso ry vive Compulso	el and define furt accordance with
Credit points Course achievement Examination Examination duration and scale Assignment for the	are capable, in consultation with supervisors as wel steps on this basis. Furthermore, they can define the potential social, economic and cultural impact. Independent Study Time 110, Study Time in Lecture 6 Compulsory Bonus Form Yes None Subject theoretical and practical work Presentation Elaboration and Presentation (15-25 minutes in ground in the process of	las in the interim presentation, to assess the argets for new application-or research-orient argets for new application application application application application argets for new application and new application argets for new application and new application argets for	ir learning lev ted duties in a pulsory npulsory vive Compulso ry vive Compulso	el and define furt accordance with

Course L0328: Waste and En	vironmental Chemistry
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	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		

Module M2025: Finite	e element modeling of structu	ras		
Module M2025. I mile	e element modeling of structu	165		
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	 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,	students can express the basic aspects of mod	delling 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 analystructures using appropriate computational methods.			
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and int	erdisciplinary discussions,		
	defend their own work results in fron	t of others		
	promote the scientific development of	of colleagues		
	Furthermore, they can give and acce	pt professional constructive criticism		
Autonomy	Students are able to gain knowledge of the	subject area from given and other sources an	d apply it to new pro	oblems Furthermo
Autonomy		ess for problems in the area of finite element n		
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	written elaboration of a project work (10-15	pages)		
scale				
Assignment for the	Civil Engineering: Specialisation Computation	onal Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural I	Engineering: Elective Compulsory		
	Computational Engineering: Core Qualificat	ion: Elective Compulsory		
	Theoretical Mechanical Engineering: Specia	lisation Simulation Technology: Elective Comp	ulsory	

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

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

Module M2033: Subsu	ırface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes (L2731)	Recitation Section	(small) 3	3
Subsurface Solute Transport (L272)	3)	Lecture	2	2
Subsurface Solute Transport (L272	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 have re	ached the following learning results	;	
Professional Competence				
Knowledge	Upon completion of this module, the student	s will understand the mechanisms	controlling solute trans	sport in soil and natural
	porous media and will be able to work with the	equations that govern the fate and	transport of solutes in I	porous media. Analytical,
	numerical and experimental tools and techniqu	es will be used in this module.		
Skills	In addition to the physical insights, the student			•
	this module. This provides them with an excellent	ent opportunity to improve their ski	lls on multiple fronts wh	ich will be useful in their
	future career.			
Personal Competence				
•	Teamwork & problem solving			
Autonomy				
	willingness to work independently and responsibly.			
Workload in Hours	Independent Study Time 96, Study Time in Lect	cure 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report			
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		
	Chemical and Bioprocess Engineering: Technical	al Complementary Course: Elective	Compulsory	
	Chemical and Bioprocess Engineering: Technical	al Complementary Course: Elective	Compulsory	
	Environmental Engineering: Core Qualification:	Compulsory		
	Process Engineering: Specialisation Environmen	ntal Process Engineering: Elective C	ompulsory	
	Process Engineering: Specialisation Process Engineering	gineering: Elective Compulsory		
	Water and Environmental Engineering: Speciali	sation Water: Compulsory		
	Water and Environmental Engineering: Speciali	sation Environment: Elective Comp	ulsory	

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

Module M0595: Exam	ination of Materials, Structural Cond	ition and Damages		
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 mate	rial science, for example by the mo	dule Building Ma	terials and Buildin
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tradir methods for the testing of building material propertie 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 and the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. They are able to describe an examination in form of a test report or expert opinion.			
Personal Competence Social Competence	The students can describe the different roles of man framework of material testing. They can describe the	- '	-	on bodies within th
Autonomy	The students are able to make the timing and the ope	eration steps to learn the specialist know	ledge of a very e	xtensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	66		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Enginee	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Comp	oulsory	
	Materials Science: Specialisation Engineering Material	s: 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 Materials, Structural Condition and Damages		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	dependent 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	CP	
Methods in Climate Informed Engin	_	Lecture	3	3	
Topics in Climate Informed Enginee	ı	Lecture	3	3	
Module Responsible	Prof. Nima Shokri				
Admission Requirements	None				
	· ·	dational understanding of environmental so			
Knowledge	,	knowledge includes climate science, data and		h engineering desi	
	processes. Analytical and critical thinking	g and creative problem-solving skills are also	beneficial		
Educational Objectives	After taking part successfully, students h	nave reached the following learning results			
Professional Competence					
Knowledge	This module explores next-generation c	limate models and high-resolution data, emp	phasizing their impact or	n environmental a	
J.	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.				
CL III.					
Skills					
	collaboration.				
Personal Competence					
Social Competence	e 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 ind			andust independs	
Autonomy	research and make informed decisions in climate-informed engineering.				
	research and make informed decisions in	reminate mornica 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	Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structur	al Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory			
	Civil Engineering: Specialisation Computer	ational Engineering: Elective Compulsory			
	Data Science: Specialisation III. Application	ons: Elective Compulsory			
	Environmental Engineering: Core Qualific	• •			
	Process Engineering: Specialisation Proce				
	Water and Environmental Engineering: S				
		pecialisation Environment: Elective Compulso	ory		
	Water and Environmental Engineering: S	pecialisation Water: Elective Compulsory			

Course L3347: Methods in Cl	ourse L3347: Methods in Climate 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	

urses					
le			Тур	Hrs/wk	СР
ter Protection (L3459)	I		Integrated Lecture	6	6
Module Responsible	Prof. Simon Michael	l Papalexiou			
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowle	dge in water manageme	ent;		
Kilowieuge	Good knowle	dge in urban drainage;			
	 Good knowle 	dge of wastewater treat	ment techniques;		
	Good knowle	edge of pollutants (e.g. C	OD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part su	ccessfully, students have	e reached the following learning results		
Professional Competence	<u> </u>	· · · · · · · · · · · · · · · · · · ·	-		
Knowledge	The students can de	escribe the basic princip	les of the regulatory framework related to	the international and Eu	ıropean water sec
	They can explain I	imnological processes,	substance cycles and water morphology	in detail. They are able	e to assess com
	problems related to	o water protection, such	n as ecosystem service and wastewater t	reatment with a special	focus on innova
	solutions, remediat	ion measures as well as	conceptual approaches.		
Skills	Students can accur	ately assess current pro	blems and situations in a country-specific	or local context. They o	can suggest conc
			omorrow's urban water cycle. Furthermo		
	administrative and	legislative solutions to s	olve these problems.		
Personal Competence					
•	The students can w	ork together in internati	onal groups		
Social competence	The students can w	one together in internation	onar groups.		
Autonomy	Students are able to organize their work flow to prepare presentations and discussions. They can acquire appropriate knowledge by making enquiries independently.				
	by making enquirie	s independently.			
Workload in Hours	Independent Study	Time 96, Study Time in	Lecture 84		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	Yes 20 %	Presentation	10-minütige Präsentation von Arbe	itsergebnissen	
Examination	Written exam				
Examination duration and	150 minutes				
scale					
Assignment for the	3 3		gineering: Elective Compulsory		
Following Curricula			al Engineering: Elective Compulsory		
			Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
	Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Environment: Compulsory				
	water and Environr	nental Engineering: Spec	cialisation Environment: 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					
Title	(12450)		Тур	Hrs/wk	СР
Jncertainty Modelling for Engineer	I	2	Integrated Lecture	6	6
Module Responsible		Papaiexiou			
Admission Requirements Recommended Previous	None				
Knowledge	General familia	arity with engineeri	ng concepts.		
Knowicuge	2. Elementary pr	obability and statist	tics, and mathematical skills.		
	· ·	er skills for handling			
	4. Interest in solv	ing engineering pro	oblems using statistical and probabilistic metho	ds.	
Educational Objectives	After taking part succ	cessfully, students h	nave reached the following learning results		
Professional Competence					
Knowledge	Students will develo	p a strong foundat	ion in uncertainty, probability, and risk analys	sis in engineering app	lications. The cour
	·	•	uncertainty, covering frequency-based metho		•
	1'		theory, joint probability distributions, and sto	•	
	,	• .	he course also covers linear and nonlinear reg		
	_	•	g. Additionally, students will gain insight into resian Decision Theory to optimize engineering		·
Skills	By the end of the cou	ırse students will b	e able to apply probabilistic models to quantify	uncertainty and asses	s risks in engineeri
Skins	_		tting probability distributions, performing extre	•	-
			allenges. Students will also develop skills in		
	enabling them to ana	alyze complex engir	neering datasets and improve risk predictions.	Through hands-on com	nputational exercise
	they will learn to imp	plement stochastic	methods and optimization techniques to support	ort reliability-based de	sign and engineeri
	decision-making.				
Personal Competence					
•	Students will develo	op the ability to w	vork collaboratively on engineering risk asse	ssments, communicat	ing technical resul
	effectively with peer	rs, engineers, and o	decision-makers. They will engage in discussion	ons on risk perception	n, safety factors, a
	uncertainty quantific	cation, ensuring th	at engineering analyses are both rigorous a	and applicable to rea	l-world infrastructu
	challenges.				
Autonomy	Students will learn to	o independently and	alyze and model engineering uncertainties, sel	ecting and applying a	ppropriate probabili
	distributions, regress	sion methods, and	stochastic techniques for various applications.	They will also gain th	he ability to evalua
	risks associated with natural and human-made hazards, ensuring they can make informed engineering decisions in design, safety				
	assessment, and disa	aster mitigation.			
Workload in Hours	Independent Study T	ime 96, Study Time	in Lecture 84		
Credit points	6				
Course achievement		Form	Description 10-minütige Präsentation von Arbeit	teorgobnicson	
Evamination	Yes 20 % Written exam	Presentation	10-minutige Prasentation von Arbeit	.sergebnissen	
Examination duration and					
scale	130 11111				
Assignment for the	Civil Engineering: Spe	ecialisation Coastal	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Spe	ecialisation Geotech	nnical Engineering: Elective Compulsory		
	Civil Engineering: Spe	ecialisation Structur	ral Engineering: Elective Compulsory		
	Civil Engineering: Spe	ecialisation Comput	ational Engineering: Elective Compulsory		
			nd Traffic: Elective Compulsory		
			Engineering: Elective Compulsory		
			nnical Engineering: Elective Compulsory		
			ral Engineering: Elective Compulsory rational Engineering: Elective Compulsory		
		•	nd Traffic: Elective Compulsory		
			cation: Elective Compulsory		
	_		cation: Elective Compulsory		
	Water and Environme	ental Engineering: S	Specialisation Cities: Elective Compulsory		
			Specialisation Environment: Elective Compulsor	y	
			Specialisation Water: Elective Compulsory		
	I Mater and Environme	ontal Enginoaring, C	nacialization Cities, Flactive Compulsory		
			Specialisation Cities: Elective Compulsory Specialisation Environment: 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		
analyzing complex datasets, as well as joint probability distributions and stochastic optimization to improve predictive m			
and reliability assessments. The course also introduces Bayesian Decision Theory, offering a structured approach to o			
	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

Triple waterwind Methods in Geotechnics (L0375) Lecture 3 3 3 4 Automotive Methods in Geotechnics (L0375) Lecture 3 3 3 4 Automotive Methods (Logineering (L0497) Lecture 3 2 2 2 Automotive Module Responsible (L0497) Recitation Section (large) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					
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Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points 6 Course achievement None Examination Written exam Examination duration and scale	Autonomy	_	es and, based on this, organize th	eir time and lea	arning management
Credit points 6 Course achievement None Examination Written exam Examination duration and scale		and think in terms of processes.			
Course achievement None Examination Written exam Examination duration and scale	Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Examination Written exam Examination duration and scale	Credit points	6			
Examination duration and scale 120 min	Course achievement	None			
scale	Examination	Written exam			
	Examination duration and	120 min			
And a second for the College to a few delibration for a few	scale				
Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory	Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	ilsory		
Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Compulsory	Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Cor	npulsory		
Civil Engineering: Specialisation Coastal Engineering: Compulsory		Civil Engineering: Specialisation Coastal Engineering: Compulso	ory		
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory		Civil Engineering: Specialisation Water and Traffic: Elective Cor	mpulsory		
Civil Engineering: Specialisation Computational Engineering: Compulsory		Civil Engineering: Specialisation Computational Engineering: Co	ompulsory		
International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory		International Management and Engineering: Specialisation II. C	ivil Engineering: Elective Compul	sory	

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

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

Course L0498: Advanced Fou	rse L0498: Advanced Foundation Engineering		
Тур	citation 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 (LI	1204)	Lecture	2	2	
Steel and Composite Structures (LI	1205)	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 II, BU	IBC)			
Knowledge					
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results			
Professional Competence					
Knowledge	After successful completition, students can				
	to the theory of the theory				
	describe the phenomenon of local buckling				
	explain warping torsion				
	illustrate the behaviour of composite structures				
	specify the principles in design of composite sttructure				
	 sketch the contructions of steel and composite bridg 	es			
Skills	After successful participation students are able to				
	check stiffened and unstiffened plated structures				
	 recognize and verify warping tosion in strucures 				
	design composite structures				
	design bridges and o perform the detailing				
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	180 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Co	npulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Electi	ve Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory			
	Civil Engineering: Specialisation Computational Engineering	: Elective Compulsory			
	International Management and Engineering: Specialisation	I. Civil Engineering: Elective Comp	oulsory		

Course L1204: Steel and Con	nposite Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	WiSe
Content	 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	ecitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	of. 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		
	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			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L05			Lecture	2	3
Structural Concrete Members (L05	78)		Recitation Section (larg	e) 2	2
Module Responsible	NN				
Admission Requirements	None				
Recommended Previous	Basics of structural a	nalysis, conception and	d dimensioning of structural concrete		
Knowledge	Modules: Reinforced	Concrete Structures I+	II, Structural Analysis I+II, Mechanics I+II		
	Modules. Reinforced	concrete structures in	n, Structural Analysis 1111, Mechanics 1111		
Educational Objectives	After taking part suc	cessfully, students hav	e reached the following learning results		
Professional Competence					
Knowledge	The students broade	n their skills in structur	al engineering, especially in the field of bui	ldings (houses, roofs, l	nalls). They dispose o
_	the knowledge for th	The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose o 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. Moreover,	, they can make design	and construction sketches and draw up tec	chnical descriptions.	
Personal Competence					
•		e to obtain results of hi	gh quality in teamwork.		
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			3 4 3		
Autonomy	The students are able	e to carry out complex	conception and dimensioning tasks of struc	tures under the guidar	nce of tutors.
Workload in Hours	Independent Study T	ime 110, Study Time ir	a Lecture 70		
Credit points					
Course achievement	†	Form	Description		
	No None	Presentation	Es werden 2 Referate ausgegeben		
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compulsory				
Following Curricula					
-			gineering: Elective Compulsory		
			Traffic: Elective Compulsory		
			onal Engineering: Elective Compulsory		
		•	: Specialisation II. Civil Engineering: Elective	e Compulsory	

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

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

Course L0578: Structural 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 M1/46: Const	ruction Robotics
Courses	
Title	Typ Hrs/wk CP
Construction Robotics (L2867)	Project-/problem-based Learning 6 6
Module Responsible	Prof. Kay Smarsly
Admission Requirements	None
Recommended Previous	Basics of project-oriented programming
Knowledge	
	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Basics of robotics
	Applications in civil engineering
	Kinematics
Skills	Use of specific hardware
	Development of software routines
	Python programming language
	Image processing
	Basics of localization (LIDAR, SLAM)
Personal Competence	
Social Competence	Teamwork
	Communication skills
Autonomy	Independent work
	Independent decisions
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	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

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

Module M2033: Subst	ırface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes (L2731)	Recitation Section (small)	3	3
Subsurface Solute Transport (L272)	3)	Lecture	2	2
Subsurface Solute Transport (L2729	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 have reach	ned the following learning results		
Professional Competence				
Knowledge	Upon completion of this module, the students will understand the mechanisms controlling solute transport in soil and natural porous media and will be able to work with the equations that govern the fate and transport of solutes in porous media. Analytical, numerical and experimental tools and techniques will be used in this module.			
Skills	In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools and techniques in this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in their future career.			
Personal Competence				
Social Competence	Teamwork & problem solving			
Autonomy	The students will be involved in writing individu willingness to work independently and responsibly	·	ntribute to the s	tudents' ability and
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			
scale	•			
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi			
	Civil Engineering: Specialisation Coastal Engineering			
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Civil Engineering: Specialisation Computational En	gineering: Elective Compulsory		
	Chemical and Bioprocess Engineering: Technical C	complementary Course: Elective Compulsory	1	
	Environmental Engineering: Core Qualification: Co	mpulsory		
	Process Engineering: Specialisation Environmental	Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engine	eering: Elective Compulsory		
	Water and Environmental Engineering: Specialisat	ion Water: Compulsory		
	Water and Environmental Engineering: Specialisat	ion Environment: Elective Compulsory		

Course L2731: Modeling of Subsurface Processes		
Тур	Recitation Section (small)	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	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 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	Structural Analysis I			
Knowledge	Structural Analysis I Structural Analysis II			
	Finite Element Methods			
	Time Element Methods			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the stude	nts can express the basic aspects of	the load-carryin	g behaviour of thin
	walled structures.			
Skills	After successful completion of this module, the studer	its will be able to predict load carryin	a boboviour of th	hin wallod structure
SKIIIS	using appropriate analytical and coputational methods.	its will be able to predict load-carrying	g bellaviour or ti	illi-walled structure
	using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdisciplinar 	ay discussions		
	defend their own work results in front of others	y discussions,		
	promote the scientific development of colleagues			
	Furthermore, they can give and accept professio			
	, τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ			
Autonomy	Students are able to gain knowledge of the subject are	a from given and other sources and ap	oply it to new pro	blems. Furthermore
	they are able to structure the solution process for probl	ems in the area of modelling and analy	ysis of thin-walle	d structures.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: El	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineeri			
	Civil Engineering: Specialisation Computational Engineer			
	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Simu	ulation Technology: Elective Compulso	ry	

Course L1199: Thin-walled st	tructures
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bastian Oesterle
Language	DE
Cycle	SoSe
Content	Plates loaded in-plane
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Airy stress function Plane stress / plane strain Structural behaviour of plates loaded in-plane 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	 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 s	Course 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				
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 following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic proc	esses that are related to the modelling	of flows in hy	draulic engineerin
	Besides, they can describe the basic aspects of nume	rical modelling and actual numerical mod	els for the sir	nulation of flows a
	waves.			
GL III.		and the second section of the section of the section of the second section of the secti	.1	
SKIIIS	Students are able to apply hydrodynamic-numerical m	odels to practical hydraulic engineering ta	SKS.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge	ge in simple applied problems. Additionaly	, they will be	able to work in tea
	with others.			
Autonomy	The students will be able to independently extend the	r 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 exa	amination includes tasks with respect to	the general (understanding of th
	lecture contents and calculations tasks.	·	-	-
Assignment for the	Civil Engineering: Specialisation Structural Engineering	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Computational Engine			

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 Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer
Literature	Strobi, Zunic: wasserbau, Kap. 11 Hydrauliscne Modelle, Springer

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

Course L0810: Modelling of F	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
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 Fular Equations
	Euler Equations Navier-Stokes equations
	Reynolds-averaged Navier-Stokes equations
	Shallow water equations
	Solving schemes
	Solving Schames
	Numerical discretization
	Solution algorithms Convergence
	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).
	Chow, verice (1999). Open channel Hydradies. New York ash Median Him Chan Engineering Schedy.
	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.
	Online vertuggar affer http://www.ioc.gov/eatail/enhancements/jyo/41/200/250555-b.nam.
	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 M1895: Digita	al Twinning in Civil Engine	eering		
Courses				
Title		Тур	Hrs/wk	СР
Digital Twinning in Civil Engineering		Lecture	2	2
Digital Twinning in Civil Engineering	g (L3137)	Seminar	2	4
Module Responsible	Alexander Chmelnizkij			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study 7	Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	20 min presentation and 5 pages han	ndout		
scale				
Assignment for the	Civil Engineering: Specialisation Computational Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Coas	stal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Geot	echnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Struc	ctural Engineering: Elective Compulsory		

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

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

Module M0663: Marin	e Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Complete modules: Geotechnics I-III, Mathematics I-III			
Knowledge	Courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students get a deeper knowledge of steel and grou	nd engineering as well as constructio	ns knowledge co	ncerning quay walls.
	Furthermore, the students get all the necessary knowle	dge to design singular construction e	lements for shee	et pile walls and they
	know how to choose the right construction elements de	pending on the influencing conditions.		
G				
SKIIIS	Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to choose the			
	suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile walls and combined sheet pile walls) and to dimension all construction elements and connections.			
	walls and combined sneet pile walls) and to dimension a	iii construction elements and connecti	ons.	
Personal Competence				
Social Competence				
Autonomy	Students are able to assess their own strengths and we	aknesses and organize their time and	learning manage	ment based on this.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineeri	ng: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Co	ompulsory		
	Civil Engineering: Specialisation Computational Enginee	ring: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Mari	ime Technology: 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 Cliff 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

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

Module M0999: Steel	Construction Project			
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 have reached the	following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the whole project a	and explain it to the others.		
Skills	Students can produce sketches and calculations of the	, ,	able to adjust their	work in reaction to
	changing conditions resulting from other participants of t	he project.		
Personal Competence				
Social Competence	Students can present their results to other members of the	ne group.		
	They have the ability to work for a broad agreement with	respect to intergroup depender	ncies.	
	They can distribute and process tasks independently.			
Autonomy	Students can handle their part of the project on their own	resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: C	' '		
	Civil Engineering: Specialisation Computational Engineeri	ng: 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.	

Modulo M0606: Numa	erical Algorithms in Structural	Mochanics		
Module Motoo: Nume	ericai Algorithms in Structural	Mechanics		
Courses				
Title		Тур	Hrs/wk	СР
Numerical Algorithms in Structural		Lecture	2	3
Numerical Algorithms in Structural		Recitation Section (small)	2	3
Module Responsible	Prof. Alexander Düster			
Admission Requirements				
	Knowledge of partial differential equations i	s recommended.		
Knowledge				
-	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
		ms that are used in finite element programs.		
	+ explain the structure and algorithm of fini		plain their mather	natical and computer
	science background.	s, to identify them in a given situation and to ex	piain their mather	natical and computer
	science background.			
Skills	Students are able to			
	+ construct algorithms for given numerical	methods.		
	+ select for a given problem of structural m	echanics a suitable algorithm.		
	+ apply numerical algorithms to solve probl	ems of structural mechanics.		
	+ implement algorithms in a high-level prog	gramming languate (here C++).		
	+ critically judge and verfiy numerical algor	ithms.		
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups.			
	+ present and discuss their results in front of	of others.		
	+ give and accept professional constructive	criticism.		
Autonomy	Students are able to	cicos and E Learning		
	+ assess their knowledge by means of exer			
	+ acquaint themselves with the necessary k			
	+ to transform the acquired knowledge to s	illillar 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	2h			
scale				
Assignment for the	Civil Engineering: Specialisation Computation	onal Engineering: Elective Compulsory		
Following Curricula	Materials Science: Specialisation Modeling:	Elective Compulsory		
	Naval Architecture and Ocean Engineering:	Core Qualification: Elective Compulsory		
	Technomathematics: Specialisation III. Engi	• • •		
	Theoretical Mechanical Engineering: Special	lisation Simulation Technology: Elective Compul	sory	

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

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

Courses				
litle little		Тур	Hrs/wk	СР
Computational Structural Dynamics		Lecture	3	4
Computational Structural Dynamics		Recitation Section (small)	1	2
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	re reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
	+ give an overview of the computational pr	rocedures for problems of structural dynamics.		
		programs to solve problems of structural dynamic		
		tural dynamics, to identify them in a given situa	tion and to explai	n their mathemation
	and mechanical background.			
Skills	Students are able to			
	+ model problems of structural dynamics.			
	+ select a suitable solution procedure for a	given problem of structural dynamics.		
	+ apply computational procedures to solve	problems of structural dynamics.		
	+ verify and critically judge results of comp	outational structural dynamics.		
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups			
	+ present and discuss their results in front of others.			
	+ give and accept professional constructive	e criticism.		
Autonomy	Students are able to			
	+ assess their knowledge by means of exer	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 i	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	Civil Engineering: Specialisation Computation	onal Engineering: Elective Compulsory		
Following Curricula	, ,	g: Specialisation II. Mechatronics: Elective Compul	sory	
-	Materials Science: Specialisation Modeling:	·	-	
	Mechatronics: Technical Complementary Co	ourse: Elective Compulsory		
	Naval Architecture and Ocean Engineering:	Core Qualification: Elective Compulsory		
	Theoretical Machanical Engineering, Specia	alisation Simulation Technology: Elective Compuls	orv	

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] KJ. Bathe, Finite-Elemente-Methoden, Springer, 2002.		
	[2] J.L. Humar, Dynamics of Structures, Taylor & Francis, 2012.		

ourse 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					
litle			Тур	Hrs/wk	СР
High-Order FEM (L0280)			Lecture	3	4
High-Order FEM (L0281)			Recitation Section	(large) 1	2
Module Responsible	Prof. Alexander Düste	er			
Admission Requirements	None				
Recommended Previous	Knowledge of partial	differential equations is	recommended.		
Knowledge					
Educational Objectives	After taking part succ	cessfully, students have	reached the following learning results	5	
Professional Competence					
Knowledge	Students are able to				
	+ give an overview o	of the different (h, p, hp)	finite element procedures.		
	+ explain high-order	finite element procedur	es.		
	+ specify problems	of finite element proce	dures, to identify them in a given s	ituation and to explain the	eir mathematical a
	mechanical backgrou	ınd.			
Skills	Students are able to				
Skills		nite elements to probler	ns of structural mechanics.		
			chanics a suitable finite element proc	edure.	
		ults of high-order finite			
		•	e elements to new problems.		
			·		
Personal Competence					
Social Competence					
	· ·	heterogeneous groups.			
	·	+ present and discuss their results in front of others.			
	+ give and accept pr	rofessional constructive	criticism.		
Autonomy	Students are able to				
	+ assess their knowle	edge by means of exerc	ises and E-Learning.		
	+ acquaint themselv	es with the necessary ki	nowledge to solve research oriented to	asks.	
	+ to transform the ac	cquired knowledge to sir	nilar problems.		
Workload in Hours	Independent Study T	ime 124, Study Time in	Lecture 56		
Credit points					
Course achievement	l	Form	Description		
	No 10 %	Presentation	Forschendes Lernen		
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Sp	ecialisation Computation	nal Engineering: Elective Compulsory		
Following Curricula	International Manage	ement and Engineering:	Specialisation II. Product Developmen	t and Production: Elective C	Compulsory
	Materials Science: Sp	pecialisation Modeling: E	lective Compulsory		
	Mechanical Engineer	ing and Management: S	pecialisation Product Development an	d Production: Elective Com	oulsory
	Mechatronics: Techni	ical Complementary Cou	rse: Elective Compulsory		
	Product Developmen	t, Materials and Product	ion: Core Qualification: Elective Comp	ulsory	
	Naval Architecture and Ocean Engineering: Core Qualification: Elective Compulsory				
	Technomathematics:	: Specialisation III. Engin	eering Science: Elective Compulsory		
	Theoretical Mechanic	cal Engineering: Core Qu	alification: Elective Compulsory		

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

Course L0281: High-Order FE	urse 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			

Module M0998: Statio	s and Dynamics of Structures			
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 sta	tically determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics I/
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the respective methods.	e student can explain the basic aspects of d	ynamic effects o	n structures and tl
Skills	After successful completion of this module, dynamics loading using the appropriate compu		ponse of materi	al and structures
Personal Competence Social Competence	Students can			
	 participate in subject-specific and interd 	isciplinary discussions,		
	 defend their own work results in front of 	others		
	 promote the scientific development of contract 	olleagues		
	 Furthermore, they can give and accept p 	professional constructive criticism		
Autonomy	Students are able to gain knowledge of the sul	plant area from given and other sources and	nnly it to now nr	blanc Furtherne
Autonomy	they are able to structure the solution process	•		blems. Furthermor
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Eng	ineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
	Civil Engineering: Specialisation Computational			
	International Management and Engineering: Sp		oulsory	
	J : J :			

Course L1202: Structural Dynamics			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. 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 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 anduse 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 Bemessungsmessungsregeln 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 2	

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 Modflow (L0543)		Lecture	1	1	
Groundwater Modeling using Modfl		Recitation Section (small)	2	2	
Modeling of Water Supply Network		Project-/problem-based Learning	2	3	
Module Responsible	•				
Admission Requirements					
Recommended Previous	Groundwater				
Knowledge	groundwater hydraulics and transport of substances				
	Pipe Systems				
	 Knowledge on urban water infrastructures, 	in particular drinking water systemsand u	rban drainac	ie systems includin	
	special structures	,		, ,	
	 Hydraulics of drinking water supply systems 	and sewer systems			
	Basic knowledge on water management				
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence					
Knowledge	The students are able to describe the modelling of g	groundwater flow and transport as well as urb	an water infr	astructures. They ca	
	carry out systems analyses and can detect technical	al and conceptual weak points within the sys	tems 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 scien	tific groundwater models indipendently. The	y can work o	n different scenarios	
	and can compare or assess different solutions for ex	xisting problems by application of selected so	ftware produ	cts. The students are	
	able to use different software solutions (e.g. EPANE	Γ, EPA-SWMM).			
Personal Competence					
Social Competence	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	2 70			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	30 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	, ,			
	Civil Engineering: Specialisation Coastal Engineering				
	Civil Engineering: Specialisation Water and Traffic: I				
	Civil Engineering: Specialisation Computational Eng				
	Water and Environmental Engineering: Specialisation	' '			
	Water and Environmental Engineering: Specialisation Water and Environmental Engineering: Specialisation	· ·			
	water and Environmental Engineering: Specialisation	n water: Elective Compulsory			

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

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

ourse L0875: Modeling of Water Supply 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.	

Module M0871: Hydro	ological Systems			
Courses				
Title		Тур	Hrs/wk	СР
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Project-/problem-based Learning	1	2
Interaction Water - Environment in	Fluvial Areas (L0295)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Fundamentals of Hydromechanics and Hyd	raulic Engineering: Hydraulic Engineering I and Hydra	ulic Engineeri	ng II
Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	The students are able to define the basic of	concepts of hydrology and water management. They	are able to d	describe and quantify
	the relevant processes of the hydrological	water cycle. Besides, the students know the main asp	ects of rainfa	all-run-off-models and
	are able to theoretically derive established	reservoir / storage models and a unit-hydrograph.		
Skills	The students are able to use the basic h	ydrological concepts and approaches and are able t	o theoretical	lv derive established
	·	graph as the basis for rainfall-run-off-models. The stu		-
		and hydrodynamic values in nature and are able to		
		they are able to apply a hydrological model to basic h		
Personal Competence				
Social Competence	. , ,	d knowledge in applied problems of the hydrology and	d water mana	agement. Additionaly,
	they will be able to work in team with engir	neers of other disciplines.		
Autonomy	The students will be able to independently	extend their knowledge and apply it to new problems		
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 90 min.	The examination includes tasks with respect to the ge	neral unders	tanding of the lecture
scale	contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Computation	onal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Environmental Engineering: Core Qualificat	ion: Elective Compulsory		
	Joint European Master in Environmental Stu	dies - Cities and Sustainability: Core Qualification: Co	mpulsory	
	Water and Environmental Engineering: Spe	cialisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Water: Elective Compulsory		

Course L0289: Applied Surfa	ce Hydrology
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/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 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	-		

Module M0723: Desig	n of Prestressed Structures an	d Concrete Bridges		
Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of concrete	e 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 have	reached the following learning results		
Professional Competence				
Knowledge	The students know the main bridge types, t	heir applications and the various loads. They	can explain the ba	asic design methods.
	They can explain the design of a prestressed	bridge.		
Skills	The students are able to design reinforced or	prestressed concrete bridges.		
Personal Competence				
Social Competence	The students can design in teamwork a real c	concrete bridge.		
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.			
Workload in Hours	Independent Study Time 110, Study Time in I	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural En	ngineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	l Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Computation	al Engineering: Elective Compulsory		
	International Management and Engineering: 5	Specialisation II. Civil Engineering: Elective Cor	npulsory	

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 • 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 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

M. J. J. MOZEC C. J.				
Module M0756: Soil N	Mechanics and -Dynamics			
Courses				
Title Soil Mechanics - Selected Topics (L Soil Dynamics (L0452)	0374)	Typ Lecture Lecture	Hrs/wk 2 2	CP 2 2
Experimental Researches in Geotec	chnics (L0706)	Practical Course	2	2
Module Responsible				
Admission Requirements	, ,			
Recommended Previous	Modules: Mathematics I-III, Mechanics I-II, Geotechnics I			
Knowledge	Courses: Soil laboratory course, (Applied structural dynam	ics)		
Educational Objectives	After taking part successfully, students have reached the f	following learning results		
Professional Competence				
Knowleage	describe wave propagation in the ground under dyn to measure vibrations and to interpret the data obta justify when elastodynamic methods are sufficient a to reproduce the collapse theorems of plasticity the describe the viscous behavior of cohesive soils as shear strengths as well as to determine the effect of partial saturations.	ained with regard to their effect and when plastodynamic effect ory, nd computationally account f	ct on people and struct ts must be taken into a for creep deformation	cures, account,
Skills	After the successful completion of the module the student	s should be able to:		
	 to derive and apply the basic equation of a simple response to understand the wave propagation in the soil understand the essential laboratory and field tests to design machine foundations to dynamic load, to measure shocks to perform vibration forecast, to evaluate shocks in terms of their effect on people to evaluate possibilities of isolation, to understand mechanisms that cause earthquakes to know methods to determine axial pile capacity, in to know the mechanisms that lead to a deformation mathematically, to distinguish the area of application of the method to detect the undrained shear strength as a function to capture the visous behaviour of cohesive soils at calculations, to consider the impact of the partly saturated of a second content of the consider the impact of the partly saturated of a second consider the impact of t	er dynamic excitation and to determine soil dynamic charact e and buildings, and evaluate earthquakes in the entegrity, and the dynamic bedin accumulation due to cyclic long of elastodynamics and plastodynomics and plastod	ternstics and to evaluate terms of their magniture ding modulus, beading and to estimate dynamics,	e them, de and intensity, e these deformations
Personal Competence				
Social Competence	Students will be able to work in teams to achieve results together at the end of the semester.	on measurement and experi	mental principles and	present their results
Autonomy	Students are able to assess their own strengths and weak	nesses and organize their time	e and learning manage	ment based on this.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	Compulsory Bonus Form Descript	ion		
	Yes None Subject theoretical and			
	practical work			
Examination				
Examination duration and scale	135 min			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: El	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	: Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elect	tive Compulsory		
	Civil Engineering: Specialisation Computational Engineerin	g: Elective Compulsory		

Course L0374: Soil Mechanic	s - Selected Topics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Hans Mathäus Stanford
Language	DE
Cycle	SoSe
Content	selected topis:
	 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)
Literature	 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		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Anne Hagemann	
Language		
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	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	 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: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Dif	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential Equations) (L1044)		Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1 1	1 1
Complex Functions (L1042)	Draf Marka Lindner	Recitation Section (large)	1	1
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous	Mathematics I - III			
Knowledge	After telice and every filling the death have an ele-	d the fellowing leaving provide		
Educational Objectives Professional Competence	After taking part successfully, students have reache	d the following learning results		
Knowledge Skills	 Students can name the basic concepts in Mat Students can discuss logical connections bet the help of examples. They know proof strategies and can reproduc Students can model problems in Mathematic capable of solving them by applying establish Students are able to discover and verify furth 	ween these concepts. They are capable e them. The structure of the concepts studied methods.	of illustrating th	ese connections with
Personal Competence Social Competence Autonomy	 For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. 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 can design examples to check and deepen the understanding of their peers. 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 solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. 			
Workload in Hours	Independent Study Time 68, Study Time in Lecture	112		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential E	Equations 2)		
scale	. ,			
Assignment for the	General Engineering Science (German program, 7 se	emester): Specialisation Electrical Enginee	ring: Compulsor	V
Following Curricula	General Engineering Science (German program,		· .	•
3	Compulsory	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 3.	
	General Engineering Science (German program, 7 se	emester): Specialisation Naval Architectur	e. Compulsory	
	General Engineering Science (German program, 7 s	•		peoretical Mechanica
	Engineering: Elective Compulsory	emester). Specialisation Mechanical Engli	eering, rocus ri	leoretical Mechanica
		neering: Flective Compulsors		
	Civil Engineering: Specialisation Computational Engi Electrical Engineering: Core Qualification: Compulso			
	Electrical Engineering: Core Qualification: Compulso Electrical Engineering and Information Technology:			
	General Engineering Science (English program, 7 se		ing: Compulsory	
	Computer Science in Engineering: Specialisation II.			
		• •		
	Mechanical Engineering: Specialisation Theoretical Machanical		эт у	
	Mechanical Engineering: Specialisation Mechatronics	s: compulsory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory	alamantan Causa Causa Cirilia and a said	O	
	Theoretical Mechanical Engineering: Technical Comp	piementary Course Core Studies: Elective	compulsory	

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

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

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

	Course L1038: Complex Functions		
Typ Le	.ecture		
Hrs/wk 2	?		
CP 1	L Company of the Comp		
Workload in Hours In	ndependent Study Time 2, Study Time in Lecture 28		
Lecturer D	Dozenten des Fachbereiches Mathematik der UHH		
Language D	DE .		
Cycle So	ioSe		
Content M	Main features of complex analysis		
Literature	 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 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 		

Course L1041: Complex Fund	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 Functions		
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	

Piodule Pizoszi Adva	nced Vadose Zone Hydrology			
Courses				
Title		Тур	Hrs/wk	СР
Modeling Processes in Vadose Zon	e (L2735)	Recitation Section (small)	2	2
Vadose Zone Hydrology (L2732)		Lecture	2	2
Vadose Zone Hydrology (L2733)		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements				
Recommended Previous				
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 results		
Professional Competence				
Knowledge		racterization (solid and liquid phase), the energ	y state of soil w	ater, the soil wat
, and the second		d unsaturated soil as well as about solute transport	-	
		·		
Skills	Students will work on practical examn	oles modelling transport processes in soil using	different quantit	ative tools includi
	· ·	s. This will help them to apply knowledge in order t	•	
Personal Competence				
Social Competence		and enthusiasm for new knowledge related to	water, soil and e	nvironment. This w
Social competence	positively contribute to shape their work		rater, son and e	
Autonomy	The students will be involved in mar	ny problem solving exercises. This will contribu	ite toward their	willingness to wo
riaconomy	independently and responsibly.	y problem solving exercises. This time contribute	ate torraid then	
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Report and Presentation			
scale	'			
Assignment for the		ational Engineering: Elective Compulsory		
Following Curricula				
	Environmental Engineering: Core Qualific	· · ·		
	Water and Environmental Engineering: Sp			
		pecialisation Environment: Elective Compulsory		

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

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 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	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 recon	nmended.			
Knowledge					
Educational Objectives	After taking part successfully, students have reach	ed the following learning results			
Professional Competence					
Knowledge	Students are able to				
	+ give an overview of the different nonlinear phenomena in structural mechanics.				
	+ explain the mechanical background of nonlinear phenomena in structural mechanics. + to specify problems of nonlinear structural analysis, to identify them in a given situation and to explain their mathem				
	mechanical background.				
Skills	Students are able to				
S.i.iis	+ model nonlinear structural problems.				
	+ select for a given nonlinear structural problem a	suitable computational procedure.			
	+ apply finite element procedures for nonlinear str				
	+ critically verify and judge results of nonlinear finite elements.				
	+ to transfer their knowledge of nonlinear solution	procedures to new problems.			
Dawas and Campanahanaa					
Personal Competence	Children and abla to				
Social Competence	Students are able to + solve problems in heterogeneous groups.				
	+ present and discuss their results in front of other				
	+ give and accept professional constructive criticis				
		•••			
Autonomy	Students are able to				
·	+ assess their knowledge by means of exercises a	nd E-Learning.			
	+ acquaint themselves with the necessary knowledge to solve research oriented tasks.				
	$+$ to transform the acquired knowledge to similar μ	roblems.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and					
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ring: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Computational En				
	Computational Engineering: Core Qualification: Elective Compulsory				
	International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				
	Mechanical Engineering - Product Development an	d Production: Core Qualification: Elective Co	ompulsory		
	Materials Science and Engineering: Specialisation Modeling: Elective Compulsory				
	Materials Science: Specialisation Modeling: Elective Compulsory				
	Mechatronics: Technical Complementary Course: Elective Compulsory				
	Mechatronics: Core Qualification: Elective Compuls	•			
	Product Development, Materials and Production: Core Qualification: Elective Compulsory				
	Naval Architecture and Ocean Engineering: Core Q	· · ·			
	Naval Architecture and Ocean Engineering: Core Q				
	Ship and Offshore Technology: Core Qualification:	ective Compuisory			

Course L0277: Nonlinear Structural 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 Scientific Working in Computationa	Typ I Engineering (L2764) Project	t-/problem-based Learning	Hrs/wk	CP 6
Module Responsible		- /p	-	
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String interest in topics related to	computing in civil engines	ering.	
Knowledge	3 . 3	, , , , , , , , , , , , , , , , , , ,	, J	
Educational Objectives	After taking part successfully, students have reached the following lear	ning results		
Professional Competence		-		
Knowledge	The students will learn to apply concepts and methods of scientific we course instructors and in collaboration with each other, the students we thinking, being able to accurately plan, implement and analyze scient will be conducted throughout the semester, which will contribute to the this course, a scientific paper will be developed based, which is a prerespect of the project conducted within this course. Project meetings scientific publications are further key activities.	ill also learn to understand tific projects, such as pros e grade. Since scientific wr requisite for the final exam	I the complex spective mast iting is of part nination. The p	process of scientif er theses. A projecticular importance in paper will be writte
Skills	The students will be capable (i) of solving a scientific problem following effectively in the form of a paper, and (iii) of sharing their work in a present the control of	•	gy, (ii) of docu	ımenting their wor
Personal Competence				
Social Competence	The students will be able to work in a multidisciplinary team and develop	ວp communication skills ne	ecessary for pr	oblem solving.
Autonomy	The students will be able to extend their knowledge and apply it to solv	e scientific problems by w	orking indepe	ndently in a projec
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	1		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co	npulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compuls	ory		
	Civil Engineering: Specialisation Structural Engineering: Elective Compu	ulsory		
	Civil Engineering: Specialisation Computational Engineering: Elective C	ompulsory		
	Computer Science: Specialisation II: Intelligence Engineering: Elective (Compulsory		
	Mechatronics: Core Qualification: Elective Compulsory			
	Mechatronics: Technical Complementary Course: 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.

Module M1906: Study	y work computational engineering
Courses	
Title	Typ Hrs/wk CP
Module Responsible	
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 of 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 science and society.
	Scientific work techniques that are used can be described and critically reviewed.
Skills	The students are able to independently select methods for the project work and to justify this choice. They can explain how these methods relate to the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.
Personal Competence Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
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	

Module M0964: Underground Constructions					
Courses					
Title	Typ Hrs/wk CP				
Applied Tunnel Constructions (L240	7)	Le	ecture	2	3
Introduction to tunnel construction	(L0707)	Le	ecture	1	2
Introduction to tunnel construction	(L1811)	R	ecitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules from Bachelor studies Civil an	d environmental engineering	g:		
Knowledge	Geotechnics I-II				
	Geotechnics I-II				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction.				
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 % Excercises				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Struct	ural Engineering: Elective Co	ompulsory		
Following Curricula	Civil Engineering: Specialisation Geote	chnical Engineering: Compul	Isory		
	Civil Engineering: Specialisation Coasta	al Engineering: Compulsory			
	Civil Engineering: Specialisation Water	and Traffic: Elective Compu	Isory		
	Civil Engineering: Specialisation Compu	utational Engineering: Electiv	ve Compulsory		
	International Management and Enginee	ering: Specialisation II. Civil I	Engineering: Elective Comp	oulsory	

Course L2407: Applied Tunne	ourse 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 t	ourse L1811: Introduction to tunnel construction		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Julian Bubel		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M1844: Mode	rn discretization methods in st	ructural 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			
	Flachentragwerke			
Educational Objectives	After taking part successfully, students have i	reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, st	tudents can express the basic aspects of mode	rn discretization r	methods in structura
	mechanics.			
CI-III-				
SKIIIS	problems in structural mechanics.	ne students will be able to use and further impr	ove modern discre	etization methods to
	problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	a participate in cubicat specific and inter	dissiplinary dissussions		
	 participate in subject-specific and inter defend their own work results in front of 			
	 promote the scientific development of 			
	Furthermore, they can give and accept	·		
	Turthermore, they can give and accept	professional constructive childism		
Autonomy	Students are able to gain knowledge of the si	ubject area from given and other sources and a	apply it to new pro	blems. Furthermore
	they are able to structure the solution process	s for problems in the area of modern discretizat	tion methods.	
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engir	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	, ,		
-	Civil Engineering: Specialisation Structural En			
	Civil Engineering: Specialisation Computation			
	Computational Engineering: Core Qualification	n: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialis	ation Simulation Technology: Elective Compuls	ory	

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	citation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	of. Bastian Oesterle	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Design of Composite Bridges (L3092)		Integrated Lecture	2	3
Analysis of Offshore Structures (L1		Lecture	1	1
Solid Matter Process Technology fo		Lecture	2	3
Innovative Timber Construction (L2	2666)	Lecture	2	4
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)	(1.22.70)	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 2
Special topics of civil engineering 2			2	3
Special topics of civil engineering 3 Structural Design (L2789)	3 LP (L2380)	Seminar	2	2
-	Prof. Frank Schmidt-Döhl	Seminal	2	2
Module Responsible				
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge				
	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	in selected areas of civil and structural engir	eering.	
Personal Competence				
•				
Social Competence				
Autonomy	Students can chose independently, in whi	ch fields they want to deepen their knowle	dge and skills th	rough the election o
	courses.		J	5
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	gineering: Elective Compulsory		
	I			
	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	

Course L1867: Analysis of Of	
Тур	
Hrs/wk	
CP Workland in House	1 Independent Study Time 16 Study Time in Lecture 14
Examination Form	Independent 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 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 I	Process Technology for Biomass
	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	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 landfill design and operation		
Тур	Integrated Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Klausur	
Examination duration and	60 min	
scale		
Lecturer	Dr. Marco Ritzkowski	
Language	EN	
Cycle	SoSe	
Content	The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context.	
Literature	 Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB 	

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

Course L2378: Special topics 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 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

Module M1956: Buildi	ing and Excavation Law				
Courses					
Title		Тур	Hrs/wk	СР	
Construction law BGB and VOB - law	·	Lecture	2	3	
Construction disputes from constru	ection (excavation) practice (L3181)	Lecture	2	3	
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
	Complete modules: Geotechnics I-III				
Knowledge					
	After taking part successfully, students have i	reached the following learning results			
Professional Competence Knowledge	Students will gain knowledge of				
	the history of civil engineering law,				
	basics of foundation and civil engineeri	ing law.			
	legal aspects of technical regulations in				
	the civil engineering contract,				
	 the liability of the designer and contract 	ctor in civil engineering,			
	 the subsoil risk and the system risk, 				
	the total debt in (civil) engineering law				
	· ·	idance models and the construction process	,		
	the systematics of construction contract	ct 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 plant construction management aspects in practice				
	to manage the construction project optimally.				
Personal Competence					
•	Students can work in groups and support each	h other in finding solutions.			
Autonomy	Students are able to assess their own strengt	hs and weaknesses and organize their time	and learning manage	ment based on this.	
Workload in Hours	Independent Study Time 124, Study Time in L	Lecture 56			
Credit points					
Course achievement					
Examination	Oral exam				
Examination duration and	30 min				
scale					
•	Civil Engineering: Specialisation Coastal Engir				
Following Curricula					
	Civil Engineering: Specialisation Structural En				
	Civil Engineering: Specialisation Water and Tr				
	Civil Engineering: Specialisation Computation	ar Engineering: 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	

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

Module M2025: Finite	e element modeling of structures			
Courses				
Title		Тур	Hrs/wk	СР
Finite element modeling of structure	res (L3046)	Lecture	2	3
Finite element modeling of structure	res (L3047)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	Finite Flement Methods			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, student	s can express the basic aspects of modelli	ng of structures v	with finite elements.
Skills	After successful completion of this module, the students will be able to model structures with finite elements and to analys structures using appropriate computational methods.			
Personal Competence				
Social Competence	Students can			
	participate in subject-specific and interdiscip defend their own work results in front of other	·		
	promote the scientific development of collea	gues		
	Furthermore, they can give and accept profe	essional constructive criticism		
Autonomy	Students are able to gain knowledge of the subject	area from given and other sources and a	pply it to new pro	blems. Furthermore
Ź	they are able to structure the solution process for p			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	e 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 Eng	ineering: Compulsory		<u> </u>
Following Curricula	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engir	neering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineer	ring: Elective Compulsory		
	Computational Engineering: Core Qualification: Elec	ctive Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Simulation Technology: Elective Compulso	ory	

	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	ndependent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Bastian Oesterle		
Language	EN		
Cycle	WiSe		
Content	ee interlocking course		
Literature	See interlocking course		

Module M2076: Intro	duction to Climate Informed Engi	neering		
Courses				
Title Methods in Climate Informed Engineering (L3347)		Typ Lecture Lecture	Hrs/wk CP 3 3 3 3	
Topics in Climate Informed Engine Module Responsible	1	Lecture	3 3	
Admission Requirements	None			
	Students are expected to have a foundational	dge includes climate science, data anal	ysis, and familiarity with engineering des	
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence Knowledge				
Skills	Climate data analysis, engineering adaptation strategies, problem-solving, research-based learning, and interdisciplinar collaboration.			
Personal Competence Social Competence Autonomy	climate-resilient engineering.			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ire 84		
Credit points	, ,	110 04		
Course achievement				
Examination	Subject theoretical and practical work			
Examination duration and scale	Report and Presentation			
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Enginee Civil Engineering: Specialisation Geotechnical En Civil Engineering: Specialisation Structural Engin Civil Engineering: Specialisation Water and Traffi Civil Engineering: Specialisation Computational E Data Science: Specialisation III. Applications: Ele Environmental Engineering: Core Qualification: E Process Engineering: Specialisation Process Engi	gineering: Elective Compulsory eering: Elective Compulsory ic: Elective Compulsory Engineering: Elective Compulsory ctive Compulsory Elective Compulsory		
	Water and Environmental Engineering: Specialisi Water and Environmental Engineering: Specialisi Water and Environmental Engineering: Specialisi	ation Environment: 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	

Module M2155: Unce	rtainty Modellir	ng for Engine	ers			
Courses						
Title	(4.2.450)			Тур	Hrs/wk	СР
Jncertainty Modelling for Engineer		I I .		Integrated Lecture	6	6
Module Responsible		'apalexiou				
Admission Requirements Recommended Previous						
Knowledge	 General familia 	arity with engineerin	ng concepts.			
Knowieuge		obability and statisti	tics, and mathematical s	kills.		
		r skills for handling				
	4. Interest in solv	ing engineering pro	oblems using statistical	and probabilistic methods	i.	
Educational Objectives	After taking part succ	essfully, students h	nave reached the followi	ng learning results		
Professional Competence						
Knowledge	Students will develop	o a strong foundati	ion in uncertainty, prob	ability, and risk analysis	in engineering appl	ications. The cour
				requency-based methods	•	-
	,		, , ,	distributions, and stoch		•
	,	• .		near and nonlinear regre s will gain insight into ris		
	_		•	o optimize engineering so		·
Skills	By the end of the cou	rse, students will be	e able to apply probabil	istic models to quantify u	ncertainty and assess	s risks in engineerir
	problems. They will g	gain expertise in fit	tting probability distribu	itions, performing extrem	ne value analysis, an	d applying Bayesia
				also develop skills in lir		
	-		•	prove risk predictions. Th	-	•
	decision-making.	nement stochastic i	methods and optimizati	on techniques to support	reliability-based des	sign and engineerii
	decision-making.					
Personal Competence						
Social Competence				engineering risk assess		
		•	•	will engage in discussion		-
	challenges.	ation, ensuring tha	at engineering analyse	es are both rigorous and	d applicable to real	-world intrastructui
	chancinges.					
Autonomy				ering uncertainties, selec		
	_			or various applications. T		
	assessment, and disa		n-made nazards, ensurir	ig they can make informe	ed engineering decisi	ons in design, sare
Workload in Hours		me 96, Study Time	in Lecture 84			
Credit points Course achievement	t	Form	Description			
course acmevement	Yes 20 %	Presentation	10-minütige	Präsentation von Arbeitse	ergebnissen	
Examination	Written exam					
Examination duration and	150 min					
scale	Civil Engineering, Spa	scialization Coastal I	Engineering, Floative Co	amanula anu		
Following Curricula			Engineering: Elective Co nnical Engineering: Elect			
ronowing curricula	3 ,		ral Engineering: Elective			
			ational Engineering: Ele			
		•	nd Traffic: Elective Com	, ,		
	Civil Engineering: Spe	ecialisation Coastal I	Engineering: Elective Co	ompulsory		
	Civil Engineering: Spe	ecialisation Geotech	nnical Engineering: Elect	ive Compulsory		
			ral Engineering: Elective			
		•	ational Engineering: Ele	, ,		
			nd Traffic: Elective Com			
	_		cation: Elective Compuls cation: Elective Compuls			
	_		Specialisation Cities: Elec	•		
				ent: Elective Compulsory		
			Specialisation Water: Ele			
	Water and Environme	ental Engineering: S	Specialisation Cities: Elec	ctive Compulsory		
	Water and Environme	ental Engineering: S	Specialisation Environme	nt: Elective Compulsory		
	Water and Environme	ental Engineering: S	Specialisation Water: Ele	ctive 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. Handson 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 Water and Traffic

Module M0964: Under	rground Constru	ctions				
Courses						
Title				Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	07)			Lecture	2	3
Introduction to tunnel construction				Lecture	1	2
Introduction to tunnel construction	(L1811)			Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe					
Admission Requirements	None					
Recommended Previous	Modules from Bachelor	studies Civil and	environmental enginee	ring:		
Knowledge	Geotechnics I-II					
Educational Objectives	After taking part succes	sfully, students h	nave reached the follow	ing learning results		
Professional Competence						
Knowledge	Knowledge of different t	tunnel constructi	on types as well as spec	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 proje	ct management and des	sign of tunnels.		
Autonomy	Promotion of independe	ent and creative v	vork flow in the framew	ork of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Course achievement		Form Excercises	Description			
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Speci-	alisation Structur	al Engineering: Elective	· Compulsory		
Following Curricula	Civil Engineering: Speci	alisation Geotech	nical Engineering: Com	pulsory		
	Civil Engineering: Speci	alisation Coastal	Engineering: Compulso	ry		
	Civil Engineering: Speci	alisation Water a	nd Traffic: Elective Com	pulsory		
	Civil Engineering: Speci	alisation Comput	ational Engineering: Ele	ective Compulsory		
	International Manageme	ent and Engineer	ing: Specialisation II. Ci	vil Engineering: Elective Com	oulsory	

Course L2407: Applied Tunne	ourse 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		
СР	2	
Workload in Hours	ndependent 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	ourse L1811: Introduction to tunnel construction		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Julian Bubel		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0595: Exam	ination of Materials, Structural Cond	lition and Damages		
Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	l Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura	l Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials or mate	erial science, for example by the mod	ule Building Ma	iterials and Building
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tradi methods for the testing of building material propertie 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 and the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. They are able to describe an examination in form of a test report or expert opinion.			
Personal Competence				
Social Competence	The students can describe the different roles of mar framework of material testing. They can describe the	• .	-	on bodies within the
Autonomy	The students are able to make the timing and the op-	eration steps to learn the specialist know	ledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: El	ective Compulsory		
	International Management and Engineering: Specialis	sation II. Civil Engineering: Elective Comp	ulsory	
	Materials Science and Engineering: Specialisation Eng	gineering Materials: Elective Compulsory		
	Materials Science: Specialisation Engineering Materia	ls: 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	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		

	rated Transportation Planning
Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	(L1068) 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 Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	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 measures.
	relate current issues in the area of integrated transport planning and formulate an opinion on them.
Skills	Students are able to:
	quantify important parameters, which influence travel demand or are influenced by it.
	 comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document the
	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, acquire the necessary knowledge and use appropriate means f
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective 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
Content	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 M0801: Wate	r Resources and -Supply			
Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treat	ment (L0311)	Lecture	2	1
Chemistry of Drinking Water Treat	ment (L0312)	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 key proce	esses involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas of confl	ict in water management, as well as the	ir mutual depend	ence for sustainable
	water supply. They will understand relevant econo	omic, environmental and social factors.	Students will be	able to explain and
	outline the organisational structures of water comp	anies. They will be able to explain the ava	ailable water trea	tment processes and
	the scope of their application.			
Skills	Students will be able to assess sempley problem	one in drinking water production and	ostablish soluti	one involving wate
SKIIIS	Students will be able to assess complex problems			
	management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students will be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and			
	· ·	ected treatment processes and apply ge	merany 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 co	omplex solutions	for the managemen
	and treatment of drinking water. They will be able	e to take an appropriate professional po	sition, for examp	le representing user
	interests. They will be able to develop joint solution	s in teams of diverse experts and present	these solutions to	o others.
Autonomy	Students will be in a position to work on a subject in	ndependently and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: 0	Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
	Chemical and Bioprocess Engineering: Technical Co		У	
	International Management and Engineering: Special	lisation II. Energy and Environmental Engi	neering: Elective	Compulsory
	Process Engineering: Specialisation Environmental I	• • • • • • • • • • • • • • • • • • • •	-	
	Process Engineering: Specialisation Process Engineering	ering: Elective Compulsory		
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Cities: Elective Compulsory		

Typ Lecture Hrs/wk 2 CP 1 Workload in Hours Independent Study Time 2, Study Time in Lecture 28 Lecturer Dr. Klaus Johannsen Language DE Cycle WiSe Content The topic of this course is water chemistry with respect to drinking water treatment and water distribution Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DINstandards). 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.
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 DINstandards). 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
Workload in Hours 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 DINstandards). 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
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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	ourse L0312: Chemistry of Drinking Water Treatment		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	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		

C	
Course L0402: Water Resour	
	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 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	

Module M1748: Const	ruction Robotics
Courses	
Title	Typ Hrs/wk CP
Construction Robotics (L2867)	Project-/problem-based Learning 6 6
Module Responsible	Prof. Kay Smarsly
Admission Requirements	None
Recommended Previous	Basics of project-oriented programming
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	Date follows
Knowieage	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	
Course achievement	
Examination	Written elaboration
Examination duration and	ca. 10 Seiten
scale	
Assignment for the	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

Course L2867: Construction Robotics		
Тур	Project-/problem-based Learning	
Hrs/wk	5	
СР	6	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	
Lecturer	Prof. Kay Smarsly, Jan Stührenberg	
Language	EN	
Cycle	WiSe	
Content	 Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization 	
Literature	Bock/Linner: Construction Robotics	
	Verl et al.: Soft Robotics	
	Pasquale: New Laws of robotics	

Module M1974: Envir	onmental microbiology and	analytics		
Courses				
Title		Тур	Hrs/wk	СР
Environmental Analysis (L0354)		Lecture	2	3
Environmental microbiology (L322)	3)	Lecture	2	3
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chem	nistry and biology (knowledge acquired at school).	
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence				
Knowledge	On completion of this module, students will be able to describe the mechanisms of biological systems. They will know the main biological metabolic routes and can categorise their influence on global metabolic routes. They will be familiar with the basic analytical methods for investigating and assessing the quality of various environmental compartments.			
Skills	conditions. Students will be able to apply the theore	will be able to categorise which metabolism wi etical principles they have learnt to exemplary sective. They will be able to draw comparisons and treated.	sites and assess the re	sulting relationship
Personal Competence Social Competence	The students are able to organize working	ng processes within a team in a targeted way an	d based on the divison	of labour.
Autonomy	Students can independently exploit sour	ces, acquire the particular knowledge of the sub	ject and apply it to ne	w problems.
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineering: C	Core Qualification: Compulsory		

Course L0354: Environmenta	l Analysis	
Тур	Lecture	
	2	
	3	
	Dr. Dorothea Rechtenbach, Dr. Henning Mangels EN	
	Sampling in different environmental compartments, sample transportation, sample storage	
	Sample preparation	
	Photometry	
	Wastewater analysis	
	Introduction into chromatography	
	Gas chromatography	
	HPLC	
	Mass spectrometry	
	Optical emission spectrometry	
	Atom absorption spectrometry	
	Quality assurance in environmental analysis	
Literature	Roger Reeve, Introduction to Environmental Analysis, John Wiley & Sons Ltd., 2002 (TUB: USD-728)	
	Pradyot Patnaik, Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes, CRC Press, Boca Raton, 2010 (TUB: USD-716)	
	Chunlong Zhang, Fundamentals of Environmental Sampling and Analysis, John Wiley & Sons Ltd., Hoboken, New Jersey, 2007 (TUB: USD-741)	
	Miroslav Radojević, Vladimir N. Bashkin, Practical Environmental Analysis RSC Publ., Cambridge, 2006 (TUB: USD-720)	
	Werner Funk, Vera Dammann, Gerhild Donnevert, Sarah lannelli (Translator), Eric lannelli (Translator), Quality Assurance in Analytical Chemistry: Applications in Environmental, Food and Materials Analysis, Biotechnology, and Medical Engineering, 2nd Edition, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2007 (TUB: CHF-350)	
	STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 21st Edition, Andrew D. Eaton, Leonore S. Clesceri, Eugene W. Rice, and Arnold E. Greenberg, editors, 2005 (TUB:CHF-428)	
	K. Robards, P. R. Haddad, P. E. Jackson, Principles and Practice of Modern Chromatographic Methods, Academic Press	
	G. Schwedt, Chromatographische Trennmethoden, Thieme Verlag	
	H. M. McNair, J. M. Miller, Basic Gas Chromatography, Wiley	
	W. Gottwald, GC für Anwender, VCH	
	B. A. Bidlingmeyer, Practical HPLC Methodology and Applications, Wiley	
	K. K. Unger, Handbuch der HPLC, GIT Verlag	
	G. Aced, H. J. Möckel, Liquidchromatographie, VCH	
	Charles B. Boss and Kenneth J. Fredeen, Concepts, Instrumentation and Techniques in Inductively Coupled Plasma Optical Emission Spectrometry Perkin-Elmer Corporation 1997, On-line available at: http://illes.instrument.com.com/blo/unfile/2006/301448.pdf	
	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: Environmental 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 (L0517)		Lecture	2	2
Biological Wastewater Treatment (Recitation Section (large)	1 2	1 2
Advanced Wastewater Treatment (Advanced Wastewater Treatment (Lecture Recitation Section (large)	1	1
Module Responsible	Dr. Joachim Behrendt			-
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management a	nd the key processes involved in wastewater treati	ment.	
Knowledge		,,		
Educational Objectives	After taking part successfully, students ha	ive reached the following learning results		
Professional Competence	3 (1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	3 3		
_	Students are able to outline key areas of the full range of treatment systems in waste water management, as well as their mutual dependence for sustainable water protection. They can describe relevant economic, environmental and social factors. Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application is			
	municipal and for some industrial treatme	ent plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on the subject.			
Workload in Hours	Independent Study Time 96, Study Time in	n Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechn	ical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	d Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A -	General Bioprocess Engineering: Elective Compuls	sory	
	Environmental Engineering: Specialisation	Water Quality and Water Engineering: Elective Co	mpulsory	
	International Management and Engineerin	g: Specialisation II. Process Engineering and Biotec	chnology: Elective	Compulsory
	International Management and Engineerin	g: Specialisation II. Energy and Environmental Eng	ineering: Elective	Compulsory
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Compulsory	1	
	Process Engineering: Specialisation Proces	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Sp			

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	

 $ISBN: \quad 3540343296 \ (Gb.) \quad URL: \quad http://www.gbv.de/dms/bs/toc/516261924.pdf \quad URL: \quad http://deposit.d-nb.de/cgi-bin/dokserv?$

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

 $ISBN: 3527312196 \ (Gb.) \ URL: \ http://deposit.ddb.de/cgi-bin/dokserv?id=2774611\&prov=M\&dok_var=1\&dok_ext=htm-provestare for the provestar for the prove$

Weinheim: WILEY-VCH, 2007

TUB_HH_Katalog

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

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

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

Module M0828: Urbai	n Environmental Management			
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 reasures 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 following learning results			
Professional Competence				
Knowledge	Students can describe urban development corridors as well as current and future urba	n environi	mental proble	ms. They are able t
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovations and explain why the	ese contri	bute to the in	provement of urba
	life. They can, for example, derive and discuss measures for effective noise abatement			
Skille	Students are able to develop specific solutions for correcting existing or future	onviron	ment-related	problems of urba
Skills	development. They can define a range of conceptual and technical solutions for environ			•
	paths. To solve specific urban environmental problems they can select technical inno			·
	context.	vacions a	na megrate	mem med ene arba
Personal Competence				
•	The students can work together in international groups.			
	g			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations	and cont	ributions to t	ne discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	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: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory			
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualific	ation: Co	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective	Compuls	ory	
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsor	У		
	Water and Environmental Engineering: Specialisation Cities: 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.

Module M0875: Nexus	s Engineering - Water, Soil, Food an	d Energy		
Courses				
Title		Тур	Hrs/wk	СР
Ecological Town Design - Water, Energy, Soil and Food Nexus (L1229)		Seminar	2	2
Water & Wastewater Systems in a	Global Context (L0939)	Lecture	2	4
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with rising	poverty, soil degradation, migra	ation to cities, lack of w	vater resources and
Knowledge	sanitation			
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	Students can describe the facets of the global water	situation. Students can judge the	enormous potential of th	e implementation of
	synergistic systems in Water, Soil, Food and Energy s	supply.		
Skille	Students are able to design ecological settlements	for different geographic and socio	a economic conditions fo	r the main climates
SKIIIS	around the world.	ioi dillerent geograpine and socie	p-economic conditions to	i the main climates
	around the world.			
Personal Competence				
Social Competence	The students are able to develop a specific topic in a	team and to work out milestones	according to a given pla	n.
Autonomy	Students are in a position to work on a subject an	nd to organize their work flow inc	denendently. They can a	also present on this
Autonomy	subject.	id to organize their work now me	acpendently. They can c	nso present on this
	subject.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	During the course of the semester, the students wo	rk towards mile stones. The work	includes presentations a	and papers. Detailed
scale	information can be found at the beginning of the sme	ester in the StudIP course module	handbook.	
Assignment for the	Civil Engineering: Specialisation Water and Traffic: El	lective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - General Bi	ioprocess Engineering: Elective Co	mpulsory	
	Chemical and Bioprocess Engineering: Specialisation	General Process Engineering: Elec	ctive Compulsory	
	Environmental Engineering: Core Qualification: Electi	ive Compulsory		
	Joint European Master in Environmental Studies - Citi	ies and Sustainability: Core Qualifi	cation: Compulsory	
	Process Engineering: Specialisation Environmental Pr	rocess Engineering: Elective Comp	ulsory	
	Process Engineering: Specialisation Process Engineer	ring: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	n Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation		ry	
	Water and Environmental Engineering: Specialisation	n Cities: Elective Compulsory		

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

Course L0939: Water & Wast	tewater Systems in a Global Context
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	
Litorotuvo	 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)

lodule M0922: City F	rianning
Courses	
itle ity Planning (L1066)	Typ Hrs/wk CP Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
	for "Principles of Urban Planning": none
Knowledge	100 Time piece of order in defining Thore
	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Tran
	Planning and Traffic Engineering"
51	
Professional Competence	After taking part successfully, students have reached the following learning results
	Students are able to:
Knowieuge	Students are able to.
	use technical terms of urban planning.
	describe the main determinants of urban development.
	explain and compare different possibilities of how urban development can be influenced.
	discuss requirements for public streetscapes.
	explain the importance of street design.
Skills	Students are able to:
	read and analyze urban development concepts and designs for streetscapes
	appraise such concepts in the context of competing requirements.
	design, justify and reflect their own solutions for concrete examples.
Personal Competence Social Competence	Students are able to: • discuss intermediate results with each other. • constructively accept feedback on their own work. • provide constructive feedback to others.
Autonomy	Students are able to: • independently complete a written report including drawings following a broadly pre-defined process. • assess the consequences of their proposed solutions. • independently acquire knowledge and apply this to new issues or problem areas.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	
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
<u> </u>	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	р	Hrs/wk	СР
Construction Logistics (L1163)	Lec	cture	1	2
Construction Logistics (L1164)		citation Section (small)	1	2
Project Development and Managen Project Development and Managen		cture oject-/problem-based Learning	1	1 1
Module Responsible		Ject-/problem-based Learning	1	1
Admission Requirements	None			
Recommended Previous				
Knowledge	Horic			
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence	·····			
•	Students can			
3				
	 give definitions of the main terms of construction logistics and 		anagement	
	name advantages and disadvantages of internal or external co	•		
	explain characteristics of products, demand and production of	f construction objects and th	eir consequer	nces for construction
	specific supply chains	m.c		
	 differentiate constructions logistics from other logistics system 	ns		
Skills	Students can			
	carry out project life cycle assessments			
	apply methods and instruments of construction logistics			
	apply methods and instruments of project development and m	nanagement		
	apply methods and instruments of conflict management			
	design supply and waste removal concepts for a construction	project		
Personal Competence				
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			
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 case
	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	npulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu	ulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso	ory		
	International Management and Engineering: Specialisation II. Civil En	ngineering: Elective Compulso	ory	
	International Management and Engineering: Specialisation II. Logistic	cs: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Production and L			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure an	nd Mobility: Elective Compulse	ory	

Course L1163: Construction	Logistics
	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.
Litanatura	Flämin Heiker Produktionslegistik in Stadtragionen In Forschungsverbund Ökologische Makilität (Ursa) Forschungsbericht Dd
Literature	Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000.
	13.2. Wuppertai 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)
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Course L1164: Construction	urse 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	

LI161: 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	ourse L1162: Project Development and Management	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
tepair of Structures (L0255)		Lecture	1	1
Mineral Building Materials (L0253)		Lecture	2	2
echnology of mineral Building Mat		Project-/problem-based Learning	1	2
	erials and Damage Processes (L0254)	Lecture	1	1
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials, building	physics and building chemistry, for exam	ple by the m	nodules Principles
Knowledge	Building Materials and Building Physics and Building	Materials and Building Chemistry.		
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Sville	manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlat of their material parameters. They are able to show the principles of anchor technology and design.			
	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. The able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select and strengthening measures.			
Personal Competence				
Social Competence	The students are able to develop in small grous the other students. In a critical discussion they defend building material on the basis of this feedback.			
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to get missing components.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Course achievement	Compulsory Bonus Form D	escription		
	Yes 20 % Subject theoretical and			
	practical work			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engine	ering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineeri	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: El			

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

Course L0253: Mineral Buildi	ing Materials		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Lecturer Prof. Frank Schmidt-Döhl		
Language	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 or	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	ourse L0254: Transport Processes in Building Materials and Damage Processes	
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Transport Processes in Building Materials and Damage Processes	
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung	

Module M0998: Statio	s and Dynamics of Structures				
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 st	atically determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics I	
Knowledge	Differential equations I				
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge	After successful completion of this module, t respective methods.	he student can explain the basic aspects of d	ynamic effects o	n structures and t	
Skills	After successful completion of this module, dynamics loading using the appropriate comp	the students will be able to predict the resutational approaches and methods.	ponse of materi	al and structures	
Personal Competence Social Competence	Students can				
	 participate in subject-specific and interest 	disciplinary discussions,			
	 defend their own work results in front o 	f others			
	 promote the scientific development of of 	colleagues			
	Furthermore, they can give and accept	professional constructive criticism			
Autonomy	•	ibject area from given and other sources and a		oblems. Furthermoi	
	they are able to structure the solution process	for problems in the area of Structural Analysis	•		
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	150 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Eng	nineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Structural Engineering: Specialisation Geotechnical				
i ollowing curricula	Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Coastal Engin	, ,			
	Civil Engineering: Specialisation Water and Tra				
	Civil Engineering: Specialisation Computational		aulcan,		
	International Management and Engineering: S	pecialisation II. Civil Engineering: Elective Com	buisory		

Course L1202: Structural Dynamics	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. 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
	 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	

Course L0564: Fracture mec	hanics and fatigue in steel structures
Тур	Lecture
Hrs/wk	1
СР	
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 anduse 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 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

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

Module M0982: Trans	portation Modelling		
Courses			
Title Transportation Modelling (L1180)	Typ Project-/problem-based Learning	Hrs/wk	CP 6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport P	Planning and T	raffic 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.		
Autonomy	Students are able to: • 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 scale	written assignment with presentation during the semester		
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 landuse and transport models as well as the use of models for evaluating locations) Practice-oriented project for assessing consequences of infrastructure projects and changes in land-use
Literature	Lohse, Dieter und Schnabel, Werner (2011): Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung – Band 2. 3. Auflage. Beuth. Ortúzar, Juan de Dios und Willumsen, Luis G. (2011): Modelling Transport. 4. Auflage. John Wiley & Sons.

Module M0827: Mode	ling in Water Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modfl	ow (L0543)	Lecture	1115/WK	1
Groundwater Modeling using Modfl		Recitation Section (small)	2	2
Modeling of Water Supply Network		Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge	a groundwater budgaulies and transport of subs	tangag		
	 groundwater hydraulics and transport of subs 	tances		
	Pipe Systems			
	 Knowledge on urban water infrastructures, 	in particular drinking water systemsand u	ırban drainag	e systems including
	special structures			
	 Hydraulics of drinking water supply systems a 	and sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling of g	roundwater flow and transport as well as urb	an water infra	astructures. They can
	carry out systems analyses and can detect technical			-
	are able to analyse interdependencies of hydraulic a	and toxic phenomena in soil and water.		Ť
Skills	The students are able to construct and apply scien	tific groundwater models indipendently. The	v can work o	n different scenarios
	and can compare or assess different solutions for ex			
	able to use different software solutions (e.g. EPANET	*		
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
,				
	Independent Study Time 110, Study Time in Lecture	70		
Credit points				
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory		
Following Curricula		, ,		
	Civil Engineering: Specialisation Coastal Engineering	' '		
	Civil Engineering: Specialisation Water and Traffic: E			
	Civil Engineering: Specialisation Computational Engi			
	Water and Environmental Engineering: Specialisatio			
	Water and Environmental Engineering: Specialisatio	· ·		
	Water and Environmental Engineering: Specialisatio	n 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	Course L0544: Groundwater Modeling using Modflow	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Module M0870: Mana	gement of Surface Water			
Courses				
Title		Тур	Hrs/wk	СР
Modelling of Flow in Rivers and Est	uaries (L0810)	Lecture	3	4
Nature-Oriented Hydraulic Enginee	ring / Integrated Flood Protection (L0961)	Project-/problem-based L	earning 2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Fundamentals of Hydromechanics, Hydraulics	, Hydrology and Hydraulic Engineering	; Hydraulic Engineer	ing I and Hydrauli
Knowledge	Engineering II			
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering. Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows and waves. They can also depict the concepts of nature oriented hydraulic engineering.			
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. Furthermore, the students are able to set up flood-risk management concepts and are able to apply basic concepts of renaturation to practical problems.			
Personal Competence				
Social Competence	The students are able to deploy their gained k	nowledge in applied problems of the pra	ctical nature-based h	ydraulic engineering
	Additionaly, they will be able to work in team w	ith engineers of other disciplines.		
Autonomy	The students will be able to independently exte	nd their knowledge and apply it to new p	roblems.	
Workload in Hours	Independent Study Time 110, Study Time in Led	cture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min.	The examination includes tasks with res	spect to the general (understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Water and Traf	fic: Compulsory		
Following Curricula	Environmental Engineering: Core Qualification:	Elective Compulsory		
	Joint European Master in Environmental Studies	- Cities and Sustainability: Core Qualifica	ation: Compulsory	
	Water and Environmental Engineering: Specialis	sation Water: Compulsory		
	Water and Environmental Engineering: Specialis	sation Environment: Compulsory		
	Water and Environmental Engineering: Specialis	sation Cities: Elective Compulsory		

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

Course L0961: Nature-Orient	ted Hydraulic Engineering / Integrated Flood Protection
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Natasa Manojlovic, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 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

Module M0860: Harbo	ur Engineering and Harbour Planning			
Courses				
Title	Тур	р	Hrs/wk	СР
Harbour Engineering (L0809)	Lect	cture	2	2
Harbour Engineering (L1414)	·	ject-/problem-based Learning	1	2
Port Planning and Port Construction	(L0378) Lect	ture	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 following le	earning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design app	proaches for the functional de	esign of a por	t and apply them to
	design tasks. They can design the fundamental elements of a port.			
Skills	The students are able to select and apply appropriate approaches for	r the functional design of por	ts.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied	problems such as the functi	ional design o	f ports. Additionaly,
·	they will be able to work in team with engineers of other disciplines.			
Autonomy	The students will be able to independently extend their knowledge ar	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 inclu	udes tasks with respect to t	the general u	nderstanding of the
	lecture contents and calculations tasks.		3	3
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Com	npulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	Compulsory		
_	Civil Engineering: Specialisation Coastal Engineering: Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso	ory		
	International Management and Engineering: Specialisation II. Civil En	•	ory	

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

Course L0378: Port Planning	and Port Construction
Тур	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
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762)		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 modeling, progra	amming, and sensor technological	ogies are helpful	. Interest in mod
Knowledge	research and teaching areas, such as Internet of Things, Indust	cry 4.0 and cyber-physical sy	stems, as well as	s the will to deep
	skills of scientific working, are required. Basic knowledge in scien	itific writing and good English	skills.	
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence		ig rearring results		
Knowledge		ctices of smart monitoring	The students wil	I be able to des
	decentralized smart systems to be applied for continuous (r			
	environment. In addition, the students will learn to design and to			
	analysis techniques, modern software design concepts, and emb			
	also part of this module, which will be conducted throughout th		-	
	students will design smart monitoring systems that integrate a n		-	
	Specific focus will be put on the application of machine learnin	g techniques. The smart mo	nitoring systems	will be mounted
	real-world (built or natural) systems, such as bridges or slopes, o	or on scaled lab structures for	validation purpo	ses. The outcome
	every group will be documented in a paper. All students of this n	nodule will "automatically" pa	articipate with the	eir smart monitor
	system in the annual "Smart Monitoring" competition. The writte	n papers and oral examination	ns form the final	grades. The mod
	will be taught in English. Limited enrollment.			
CL III.	The state of the s			
SKIIIS	The students will gain insights into operating state-of-the-art sm			
	processes relevant to engineering, such as environmental, str			
	devising monitoring strategies of physical processes as part of			
	implement the strategies in smart wireless sensor nodes, using be able to document the findings of their projects in short reports		ograffiffiling. Fiffa	ily, the students
	be able to document the infamings of their projects in short reports	o.		
Personal Competence				
Social Competence	The students will be able to work in groups, share parts of the w	vork for their projects, and de	evelop communic	ation skills, towa
	achieving the common project goals.			
Autonomy	The students will be able to gain a solid basis on approaching	and colving problems in and	ineering as well	as on document
Autonomy	results, through their involvement in their monitoring group proje		illeering, as well	as on document
	results, through their involvement in their monitoring group proje			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the		•		
Following Curricula				
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	' '		
	Civil Engineering: Specialisation Structural Engineering: Elective			
	Computer Science: Specialisation II: Intelligence Engineering: Ele			
	Environmental Engineering: Specialisation Energy and Resources			
	Environmental Engineering: Specialisation Environment and Clim	, ,	nulson,	
	Environmental Engineering: Specialisation Water Quality and War Mechatronics: Technical Complementary Course: Elective Compu		ipuisui y	
	Mechatronics: Technical Complementary Course: Elective Computer Mechatronics: Core Qualification: Elective Compulsory	ii soi y		
	Theoretical Mechanical Engineering: Specialisation Robotics and	Computer Science: Flective C	Compulsory	
	Water and Environmental Engineering: Specialisation Cities: Elec-	•	ompuisory	
	acc. and Environmental Engineering. Specialisation cities. Elec	are compaisory		
	Water and Environmental Engineering: Specialisation Environmental	nt: 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 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.

Module M1721: Wate	r and Environment: Theory and Application			
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, Hydrolog	у		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Common research tools and techniques together with the fundamental knowledge relevant to multi-scale and multi-phase challenges present in water and environmental research will be discussed in this module. Both theory and application will be considered.			
Skills	In addition to the fundamental knowledge, the students will be exposed to several analytical, experimental and numerical tools and techniques relevant to water and environmental research at different scales. This will provide the students with an excellent 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 Research	ch-Based Teaching approaches v	vill be at the core	e of this module.
Autonomy	The students will be involved in writing individual reports an willingness to work independently and responsibly.	d presentation. This will contri	bute to the stu	dents' ability and
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Co	mpulsory		
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	Environmental Engineering: Specialisation Environment and Clim	ate: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Elec	tive Compulsory		
	Water and Environmental Engineering: Specialisation Water: Elec	ctive Compulsory		
	Water and Environmental Engineering: Specialisation Environme	nt: 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 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 NA	

Module M2002: Wasto	e and Resource Management				
Courses					
Title			Тур	Hrs/wk	СР
Waste management (L3261)			Project-/problem-based Learning	3	3
International waste concepts (L325	9)		Lecture	2	2
International waste concepts (L326	0)		Recitation Section (small)	1	1
Module Responsible	Prof. Kerstin Kuchta				
Admission Requirements	None				
Recommended Previous	Basics in process engineering				
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following	ng learning results		
Professional Competence					
Knowledge	The students are able to describe waste as	a resource as well a	as advanced technologies for re	cycling and red	covery of resources
	from waste in detail. This covers collection, t	transport, treatment	and disposal in national and inte	rnational conte	exts.
Skille	Students are able to select suitable processe	os for the treatment	with respect to the national or co	ultural and day	elenmental context
Skills	They can evaluate the ecological impact and		•		
	They can evaluate the ecological impact and	the technical enore	or different teenhologies and me	magement sys	terris.
Personal Competence					
Social Competence	Students can work together as a team of	2-5 persons, particip	oate in subject-specific and inte	rdisciplinary d	iscussions, develop
	cooperated solutions and defend their own work results in front of others and promote the scientific development of colleagues.				
	Furthermore, they can give and accept profe	essional constructive	criticisms.		
Autonomy	Students can independently gain additiona	I knowledge of the	subject area and apply it in so	lying the give	n course tasks and
Autonomy	projects.	r knowledge of the	subject area and apply it in so	iving the give	ii course tusks und
	p. 0,000.0				
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	Yes 20 % Written elaboration				
Examination	Presentation				
Examination duration and	PowerPoint presentation (10-15 minutes)				
scale					
Assignment for the	Civil Engineering: Specialisation Water and 1				
Following Curricula	Chemical and Bioprocess Engineering: Speci				
	Chemical and Bioprocess Engineering: Speci	•		•	
	Chemical and Bioprocess Engineering: Speci		•		
	Chemical and Bioprocess Engineering: Speci			tive Compulsor	ТУ
	Chemical and Bioprocess Engineering: Core				
	Environmental Engineering: Specialisation E			l===.	
	International Management and Engineering:			isory	
	Process Engineering: Specialisation Environm	-			
	Water and Environmental Engineering: Spec		• •		
	Water and Environmental Engineering: Spec	ialisation Environme	nt: Elective Compulsory		

Course L3261: Waste manage	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 EN
Cycle	SoSe 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:
	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	Course L3260: International waste concepts		
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	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0871: Hydro	ological Systems			
Courses				
Title		Тур	Hrs/wk	CP
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Project-/problem-based Learning	1	2
Interaction 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 Hydra	aulic Engineering: Hydraulic Engineering I and Hydra	ulic Engineeri	ng II
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students are able to define the basic co	oncepts of hydrology and water management. The	are able to d	lescribe and quantify
	the relevant processes of the hydrological w	rater cycle. Besides, the students know the main as	pects of rainfa	ll-run-off-models and
	are able to theoretically derive established r	eservoir / storage models and a unit-hydrograph.		
a				
Skills		drological concepts and approaches and are able		
	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 statistically			
	assess these measurements. Furthermore, the	hey are able to apply a hydrological model to basic	nyarological p	robiems.
Personal Competence				
Social Competence	The students are able to deploy their gained	knowledge in applied problems of the hydrology ar	nd water mana	gement. Additionaly,
	they will be able to work in team with engine	eers of other disciplines.		
Autonomy	The students will be able to independently e	xtend their knowledge and apply it to new problem:	5	
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 90 min. T	he examination includes tasks with respect to the g	eneral underst	tanding of the lecture
scale	contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Computation	nal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and T	raffic: Compulsory		
	Environmental Engineering: Core Qualification	on: Elective Compulsory		
	Joint European Master in Environmental Stud	lies - Cities and Sustainability: Core Qualification: Co	ompulsory	
	Water and Environmental Engineering: Spec	ialisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Speci	ialisation Water: Elective Compulsory		

Course L0289: Applied Surfa	ce Hydrology
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/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 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	-				

Trouble Files I Aura	nced Vadose Zone Hydrology			
Courses				
Γitle		Тур	Hrs/wk	СР
Modeling Processes in Vadose Zone	e (L2735)	Recitation Section (s		2
Vadose Zone Hydrology (L2732)		Lecture	2	2
Vadose Zone Hydrology (L2733)	T	Recitation Section (Ia	arge) 2	2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge				
Knowledge	Comfortable with math and physics, critic	al thinking, creative problem solving		
	A male this political			
	Analytic skills			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students will learn about soil chai	racterization (solid and liquid phase), the	e energy state of soil	water, the soil water
	characteristic curve, flow in saturated and	d unsaturated soil as well as about solute tr	ansport in soil	
Skills	Students will work on practical examp	les modelling transport processes in soi	l using different quan	titative tools includin
	computer simulations and analytical tools	s. This will help them to apply knowledge in	order to solve problem:	s and tasks.
Personal Competence				
Social Competence	The module aims at raising awareness	and enthusiasm for new knowledge rela	ted to water, soil and	environment. This wi
	positively contribute to shape their work a	and life environment.		
Autonomy		y problem solving exercises. This will	contribute toward the	ir willingness to wor
	independently and responsibly.			
Workland in U	Indonordant Study Time Of Study Time	n Lactura 94		
Workload in Hours Credit points	, , , , ,	II LECLUIE 04		
Course achievement				
Examination				
Examination duration and				
scale	'			
Assignment for the		tional Engineering: Elective Compulsory		
Following Curricula				
i onowing curricula	Environmental Engineering: Core Qualification	· ·		
	Water and Environmental Engineering: Sp			
		pecialisation Environment: Elective Compulsory	sorv	

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

Course L2732: Vadose Zone	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	Course 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		

Module M0822: Proce	ss Modeling in Water Technology			
Courses				
Title Process Modelling of Wastewater T Process Modeling in Drinking Water		Typ Project-/problem-based Learning Project-/problem-based Learning	Hrs/wk 2 2	CP 3 3
Module Responsible		ojece, problem basea Zearning	_	
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge of the most important processes in drinking	water and waste water treatment.		
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
	Students are able to explain selected processes of dri basics as well as possibilities and limitations of dynamic	c modeling.		,
Skills	Students are able to use the most important features Modelica offers. They are able to transpose selected processes in drinking water and waste water treatment into a mathematical model in Modelica with respect to equilibrium, kinetics and mass balances. They are able to set up and apply models and assess their possibilities and limitations.			
Personal Competence Social Competence	Students are able to solve problems and document sol able to give appropriate feedback and can work constru	uctively with feedback concerning their wo		oackground. They are
Autonomy	Students are able to define a problem, gain the require	d knowledge and set up a model.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
Following Curricula	Chemical and Bioprocess Engineering: Technical Compl Chemical and Bioprocess Engineering: Technical Compl Environmental Engineering: Specialisation Water Qualit Process Engineering: Specialisation Environmental Proc Process Engineering: Specialisation Process Engineering: Water and Environmental Engineering: Specialisation W Water and Environmental Engineering: Specialisation E	ementary Course: Elective Compulsory y and Water Engineering: Elective Compu ess Engineering: Elective Compulsory g: Elective Compulsory /ater: Elective Compulsory	lsory	

Course L0522: Process Mode	elling 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
	Tracer modelling
	Activated Sludge Model
	Wastewater Treatment Plant Modelling (continously and SBR)
	wastewater Treatment Flant Modelling (continuously and 35N)
	Sludge Treatment (ADM, aerobic autothermal)
	Biofilm Modelling
	- Committee of the control of the co
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 Modeling 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: Conci	rete Structure	s			
Courses					
Title			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L05			Lecture	2	3
Structural Concrete Members (L05	78)		Recitation Section	(large) 2	2
Module Responsible					
Admission Requirements	+				
Recommended Previous	Basics of structural	analysis, conception an	d dimensioning of structural concrete		
Knowledge	Modules: Reinforced	Concrete Structures I+	-II, Structural Analysis I+II, Mechanics I-	+11	
			,		
Educational Objectives	After taking part suc	ccessfully, students hav	e reached the following learning results	3	
Professional Competence					
Knowledge	The students broade	en their skills in structu	ral engineering, especially in the field o	f buildings (houses, roofs, h	nalls). They dispose o
	the knowledge for the	he conception and design	gn of concrete buildings and structural r	members that are often use	ed.
G					
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	r, they can make desigr	n and construction sketches and draw u	p technical descriptions.	
Personal Competence					
Social Competence	The students are ab	le to obtain results of h	igh quality in teamwork.		
Autonomy	The students are ab	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	n Lecture 70		
Credit points		<u> </u>			
Course achievement	Compulsory Bonus	Form	Description		
	No None	Presentation	Es werden 2 Referate ausgegeb	oen	
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compulsory				
Following Curricula	Civil Engineering: S	pecialisation Geotechnic	cal Engineering: Elective Compulsory		
-			gineering: Elective Compulsory		
			Traffic: Elective Compulsory		
			onal Engineering: Elective Compulsory		
			: Specialisation II. Civil Engineering: Ele	ctive Compulsory	

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

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

Course L0578: Structural 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	CP
Steel and Composite Structures (L1		Lecture	2	2
Steel and Composite Structures (L1	205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I and I	I, BUBC)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he 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 sttr			
	 sketch the contructions of steel and composite be 	oriages		
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structure:	S		
	 recognize and verify warping tosion in strucures 			
	 design composite structures 			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	• •		
	Civil Engineering: Specialisation Coastal Engineering: E			
	Civil Engineering: Specialisation Water and Traffic: Elec			
	Civil Engineering: Specialisation Computational Engineer			
	International Management and Engineering: Specialisation		ulsorv	

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 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		
	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 M1401: Study	y work Water and Traffic
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	
Knowledge	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 water management and waste. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society.
	Scientific work techniques that are used can be described and critically reviewed.
Skills	The students are able to independently select methods or planning approaches for the project work and to justify their choice. They can explain how these methods or approaches relate to solutions in the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.
Personal Competence	
Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
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 Following Curricula	Civil Engineering: Specialisation Water and Traffic: Compulsory

Module M0802: Meml	orane Technology			
Courses				
Title		Тур	Hrs/wk	СР
Membrane Technology (L0399)		Lecture	2	3
Membrane Technology (L0400)		Recitation Section (small)	1	2
Membrane Technology (L0401)		Practical Course	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Basic knowledge of water chemistry. Knowledge	of the core processes involved in water, gas	and steam treatr	nent
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students will be able to rank the technical appli	cations of industrially important membrane p	rocesses. They w	vill be able to expla
	the different driving forces behind existing me	embrane separation processes. Students wil	l be able to nan	ne materials used
	membrane filtration and their advantages and	disadvantages. Students will be able to exp	lain the key diffe	erences in the use
	membranes in water, other liquid media, gases	and in liquid/gas mixtures.		
Ckilla	Students will be able to proper mathematical	aguations for material transport in persus	nd calution diffus	ian mambranas a
SKIIIS	Students will be able to prepare mathematical			
	calculate key parameters in the membrane sep			
	available boundary data and provide recomme experiments, students will be able to classify			
	membrane materials. Students will be able to classify			
	measures to control this.	laracterise the formation of the founing layer i	ii dillerent water	s and apply techni
	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 undertaken jointly and present these to ot	hers.	
4.4		the state of the test of the state of the st		201.16.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.
Autonomy	'		dependently. The	y will be capable
	finding creative solutions to technical questions.			
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 Water and Traff	ic: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - Gener	ral Bioprocess Engineering: Elective Compulso	ory	
	Bioprocess Engineering: Specialisation B - Indus	trial Bioprocess Engineering: Elective Compul	sory	
	Chemical and Bioprocess Engineering: Specialise	ation General Process Engineering: Elective C	ompulsory	
	Chemical and Bioprocess Engineering: Specialisa	ation Chemical Process Engineering: Elective	Compulsory	
	Chemical and Bioprocess Engineering: Technica	Complementary Course: Elective Compulsor	y	
	Chemical and Bioprocess Engineering: Technica	Complementary Course: Elective Compulsor	y	
	Environmental Engineering: Specialisation Wate	r Quality and Water Engineering: Elective Cor	npulsory	
	Process Engineering: Specialisation Process Eng	ineering: Elective Compulsory		
	Process Engineering: Specialisation Environmen	tal Process Engineering: Elective Compulsory		
	Water and Environmental Engineering: Specialis	ation Water: Elective Compulsory		
	Water and Environmental Engineering: Specialis	ation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialis	ation Cities: Elective Compulsory		

Course L0399: Membrane Technology			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Mathias Ernst		
Language	EN		
Cycle	WiSe		
	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		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Mathias Ernst		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0401: Membrane 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	
Fitle Adaptation to climate change in hy	Typ Hrs/wk CP rdraulic engineering (L2291) Project-/problem-based Learning 4 6
Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	Hydrology Hydraulic Engineering
3	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
	 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	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	We Use Scholars and a second second
	Working in heterogenous groups Working a with different orientific disciplines.
	Working with different scientific / non-scientific disciplines Self reflection
	• Sell Tellection
Autonomy	
	Application oriented use of knowledge and skills Autonomous work on complex tasks.
	Autonomous work on complex tasks
	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
Examination	
Examination duration and scale	Preparation of a written report and a presentation of a complex task.
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Following Curricula	
i onowing curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Vater and Traffic: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory

Course L2291: Adaptation to	climate change in hydraulic engineering
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.

Module M1720: Emer	ging Trends in Environmental E	Engineering		
Courses				
Title		Тур	Hrs/wk	СР
Environmental Research Trends (L		Seminar	2	2
Microplastics in Environment (L275		Lecture	2	2
Scientific Communication and Meth		Lecture	1	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge on water, soil and environm	iental research.		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence	After taking part successfully, students have	reactied the following learning results		
Knowledge	The students will be exposed to up-to-date research topics focused on soil, water and climate related challenges with a particula focus on the effects of microplastics in environment. Data analysis, data measurement, curation and presentation will be othe skills that the students will develop in this module.			
Skills	Students' research skills will be improved in this module. How to prepare and deliver an effective presentation, how to write ar abstract, research paper and proposal will be discussed in this module. Moreover, through Research-Based Learning approaches the students will be exposed to current research trends in environmental engineering.			
Personal Competence				
Social Competence	Developing teamwork and problem solving sl	kills through Research-Based Teaching approa	aches will be at the c	ore of this module.
Autonomy	The students will be involved in writing individual reports and presentation. This will contribute to the students' ability and willingness to work independently and responsibly.			
Workload in Hours	Independent Study Time 110, Study Time 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 T	raffic: Elective Compulsory		
Following Curricula	Environmental Engineering: Specialisation Er	nvironment and Climate: Elective Compulsory		
	Water and Environmental Engineering: Speci	alisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Speci	· · ·		
	Water and Environmental Engineering: Speci	alisation Water: Elective Compulsory		

Course L2752: Environmental Research Trends		
Тур	Seminar	
Hrs/wk	2	
СР	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	
	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	- Introduction, objectives, expectations, format, importance
	- Sources of microplastics in environment
	- Microplastics sampling; Characterization of microplastics
	- Distribution of microplastics in terrestrial environments
	- Fate of microplastics in terrestrial environments
	- Project discussion
	- Effects of microplastics on terrestrial environments
	- Health risks of microplastics in environments
	- Project presentations by all students
Literature	- Microplastics in Terrestrial Environments (2021), Edited by Defu He and Yongming Luo
	- Particulate Plastics in Terrestrial and Aquatic Environments (2020), Edited by Nanthi S. Bolan et al.
	- Microplastic Pollutants (2017), by Christopher B. Crawford and Brian Quinn

Course L2751: Scientific Communication and Methods		
Тур	Lecture	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Nima Shokri	
Language	EN	
Cycle	WiSe	
Content	Introduction - course objectives, expectations and format	
	Analyzing the Audience, purpose and occasion	
	Constructing and delivering effective technical presentations	
	How to write an abstract	
	How to create a scientific poster	
	How to write a scientific paper	
	Developing competitive and persuasive research proposals	
	Individual project (report and presentation) related to soil, water and environmental research	
Literature	The Craft of Scientific Writing Fourth edition Author: Michael Alley Springer-Verlag New York, Copyright 2018, DOI 10.1007/978-1-4419-8288-9	
	Supplemental materials and web links which will be available to registered students.	

Courses				
Title	Torre		Hrs/wk	СР
Title Scientific Working in Computationa	Typ 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 topics related to computing in ci	ivil engine	ering.	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Kilowieuge	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 scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A project will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance in this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be written based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.			
Skills	The students will be capable (i) of solving a scientific problem following a scientific reffectively in the form of a paper, and (iii) of sharing their work in a presentation.	methodolo	gy, (ii) of doc	umenting their wo
Personal Competence				
Social Competence	The students will be able to work in a multidisciplinary team and develop communicati	on skills ne	ecessary for p	roblem solving.
Autonomy	The students will be able to extend their knowledge and apply it to solve scientific prob	olems by w	orking indep	endently in a projec
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: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory			
	Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory			
	Mechatronics: Core Qualification: Elective Compulsory			
	Mechatronics: Technical Complementary Course: 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
Design of Composite Bridges (L309	(12)	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 (L2666)		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 3			1 2	1 2
Special topics of civil engineering 3 Special topics of civil engineering 3			3	3
Structural Design (L2789)	, El (L2300)	Seminar	2	2
	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				
	Students are able to find their way through			
	Students are able to explain basic models a		civil and structur	al engineering.
	Students are able to interrelate scientific at	nd technical knowledge.		
Skills		n colored areas of sixil and structural angin	a a sin a	
	Students are able to apply basic methods in	n selected areas of civil and structural engir	ieering.	
Personal Competence				
Social Competence				
•				
Autonomy				
Autonomy	Students can chose independently, in which	ch fields they want to deepen their knowle	dge and skills thi	ough the election o
Autonomy	Students can chose independently, in whice courses.	ch fields they want to deepen their knowle	dge and skills thi	ough the election o
	courses.	ch fields they want to deepen their knowle	dge and skills thi	ough the election o
Workload in Hours	courses. Depends on choice of courses	ch fields they want to deepen their knowle	dge and skills thi	ough the election o
Workload in Hours Credit points	courses. Depends on choice of courses 6		dge and skills thi	ough the election o
Workload in Hours Credit points Assignment for the	courses. Depends on choice of courses 6 Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory	dge and skills th	ough the election o
Workload in Hours Credit points	courses. Depends on choice of courses 6 Civil Engineering: Specialisation Structural Engine Civil Engineering: Specialisation Geotechnical Eng	ering: Elective Compulsory Jineering: Elective Compulsory	dge and skills thi	ough the election o
Workload in Hours Credit points Assignment for the	courses. Depends on choice of courses 6 Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory jineering: Elective Compulsory ing: Elective Compulsory	dge and skills thi	ough the election o

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

Course L1867: Analysis of Of Typ	
Hrs/wk	
CP	1
	Independent Study Time 16, Study Time in Lecture 14
Examination Form	
Examination duration and	30 min
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 I 0052: Solid Matter I	Process Technology for Biomass
	Lecture Lecture
Hrs/wk	
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 Structur	res
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	
scale	
Lecturer	Marvin Matzik
Language	DE
Cycle	WiSe
Content	Glass structures
	- Introduction of the material glass (production, refinement, material characteristic)
	- design of facades
	- facade types
	- static calculation of glazing
	- static calculation of facades
	- load bearing behavior of glazing (plate or membrane stiffness)
	- vertical / horizontal glazing with safety-related requirements
	- glass structures
	- fire safety of glass facades
	- construction physics of facades and glazing
Literature	

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

Course L3270: Sustainable la	Course L3270: Sustainable landfill design and operation			
Тур	Integrated Lecture			
Hrs/wk	3			
CP	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	Course L3091: Special Topics in Steel Design		
Тур	Integrated Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Examination Form	Klausur		
Examination duration and	90 min		
scale			
Lecturer	Prof. Marcus Rutner, Nikolay Lalkovski		
Language	DE		
Cycle	SoSe		
Content			
Literature			

Course L2378: Special topics	Course L2378: Special topics of civil engineering 1CP		
Тур			
Hrs/wk	1		
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	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	s 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 De	sign
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Dr. Jan Mittelstädt
Language	DE/EN
Cycle	SoSe
Content	
Literature	[1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761
	Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and
	Sons; 1st edition (Sept 2009), ISBN-10: 047017465X
	[2] Peter Rice: An Engineer Imagines, ISBN-10: 1849944237
	[3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10:
	9783038601104
	[4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, (June 2018), ISBN-10: 3955533948
	[5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition edition (Mar 2003), ISBN-10: 0300097867
	[6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of Modern Art (Jul 2019), ISBN-10: 1633450562
	[7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015), ISBN-10: 3038600253

Courses				
Title		Тур	Hrs/wk	СР
	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible				
Admission Requirements				
Recommended Previous				
Knowledge	Hydraulic Engineering			
	Hydromechanics, Hydraulics Fundamentals of Contal Engineering, Contal on	d Flood Bushostics		
	Fundamentals of Coastal Engineering, Coastal- ar	a 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	me and Water Cycle		
	Consequences of Climate Change for Coastal Prod			
	Coastal Protection in Taiwan and Germany			
	Fundamentals of Climate Adaptation			
	Nature-based Solutions (NBS) for Coastal Protecti	on		
Skills				
	Critical thinking: analysis of processes and relation	ns, assessment of needs for action		
	Creative thinking: development of adaptation stra			
	 Practical thinking: inclusion of restrictions, appl 	cation of calculation approaches, meth	nods, numerica	ıl models, plannin
	methods			
	Consideration of complex tasks			
Personal Competence				
Social Competence	Working in heterogenous groups			
	Working in international groups			
	Working with different scientific / non-scientific di	sciplines		
	Self reflection	·		
4.4				
Autonomy	Application oriented use of knowledge and skills			
	Autonomous work on complex tasks			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	n the complex tas
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineerin	g: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elect			
	Environmental Engineering: Specialisation Environment			
	Water and Environmental Engineering: Specialisation Cit			
	Water and Environmental Engineering: Specialisation En			
	Water and Environmental Engineering: Specialisation Wa	iter. Elective Compulsory		

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

Module M1956: Buildi	ing and Excavation Law			
Courses				
Title		Тур	Hrs/wk	СР
Construction law BGB and VOB - law in (excavation) practice (L3182)		Lecture	2	3
·	action (excavation) practice (L3181)	Lecture	2	3
Module Responsible				
Admission Requirements				
Kecommended Previous Knowledge	Complete modules: Geotechnics I-III			
	After taking part successfully, students have r	reached the following learning results		
Professional Competence	Arter taking part successionly, students have i	eached the following learning results		
•	Students will gain knowledge of			
	 the history of civil engineering law, 			
	 basics of foundation and civil engineeri 	ng law,		
	legal aspects of technical regulations in	n civil engineering (with case studies),		
	the civil engineering contract,			
	the liability of the designer and contract the subsell risk and the system risk	ctor in civil engineering,		
	 the subsoil risk and the system risk, the total debt in (civil) engineering law, 			
	. , , , , , , , , , , , , , , , , , , ,	dance models and the construction process	i.	
	the systematics of construction contract		,	
	the BGB construction contract law,			
	 responsibilities on the construction site 	,		
	 remuneration and contract management 	nt,		
	 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 planr	ning and construction in a legally balanced	way. Students learn h	now to use legal and
	construction management aspects in practice	e (planning and construction) on the constr	uction site in a target	ted manner and how
	to manage the construction project optimally.			
Personal Competence	Chudanta and walking a constant			
Social Competence	Students can work in groups and support each	n other in finding solutions.		
Autonomy	Students are able to assess their own strength	hs and weaknesses and organize their time	and learning manage	ment based on this.
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
•	Civil Engineering: Specialisation Coastal Engin			
Following Curricula				
	Civil Engineering: Specialisation Structural En			
	Civil Engineering: Specialisation Water and Tra			
	Civil Engineering: Specialisation Computation	ar Engineering: Elective Compulsory		

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

Course L3181: Construction	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				
Title	(1.0000)	Тур	Hrs/wk	СР
Waste and Environmental Chemist Biological Waste Treatment (L0318		Practical Course Project-/problem-based Learning	2	2
Module Responsible		Project-/problem-based Learning	3	-
Admission Requirements				
Recommended Previous				
Knowledge	Chemical and biological basics			
	After taking part successfully, students have	e reached the following learning results		
Professional Competence	The calling part succession, seconds have	s reaction and tollowing realtiming results		
•	design and layout of anaerobic and aerobic	rning the planning of biological waste treatment plan waste treatment plants in detail, describe different t and explain different methods for waste analytics.		
Skills	control measurements. The students can re	ation of design and layout of plants. They can critica echerché and evaluate literature and date connecte of reflecting and evaluating findings in the group.	-	
Personal Competence				
·		and interdisciplinary discussions, develop cooperat	ted solutions a	nd defend their o
,	work results in front of others and promot accept professional constructive criticism.	te the scientific development in front of colleague	s. Furthermore	e, they can give a
Autonomy	are capable, in consultation with supervisors	from literature, business or test reports and transf s as well as in the interim presentation, to assess th define targets for new application-or research-ories ict.	eir learning lev	el and define furt
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
Course achievement	Compulsory Bonus Form	Description		
	Yes None Subject theoretica	l and		
	practical work			
	Presentation			
Examination				
Examination Examination and	Elaboration and Presentation (15-25 minute	s in groups)		
Examination duration and scale	·			
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic	gineering: Elective Compulsory al Engineering: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation A - G	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Spec	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Com	pulsory	
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory	npulsory mpulsory	ory
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and T Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory Eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Comialisation Chemical Process Engineering: Elective Co	npulsory mpulsory ctive Compulso	ory
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and ¹ Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Com ialisation Chemical Process Engineering: Elective Co ialisation Chemical and Bioprocess Engineering: Elec	npulsory mpulsory ctive Compulso ory	
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Eng Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and ¹ Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec Chemical and Bioprocess Engineering: Spec	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Com ialisation Chemical Process Engineering: Elective Co ialisation Chemical and Bioprocess Engineering: Elective ialisation Bioprocess Engineering: Elective Compulsory ialisation Chemical and Bioprocess Engineering: Elective Compulsory	npulsory mpulsory ctive Compulso ory	
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation A - G Chemical Bi	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Com ialisation Chemical Process Engineering: Elective Co ialisation Chemical and Bioprocess Engineering: Elective ialisation Bioprocess Engineering: Elective Compulsory ialisation Chemical and Bioprocess Engineering: Elective Compulsory	npulsory mpulsory ctive Compulso ory ctive Compulso	
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation A - G Chemical	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Com ialisation Chemical Process Engineering: Elective Co ialisation Chemical and Bioprocess Engineering: Elective ialisation Bioprocess Engineering: Elective Compulsor ialisation Chemical and Bioprocess Engineering: Election: Compulsory	npulsory mpulsory ctive Compulso ory ctive Compulso	
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Specialisation A - G Chemical and Bioprocess Engineering: Specialisation and Bioprocess Engineering: Specialisation and Bioprocess Engineering: Specialisation and Bioprocess Engineering: Specialisation Environmental Engineering: Spec	gineering: Elective Compulsory al Engineering: Elective Compulsory Engineering: Elective Compulsory Traffic: Elective Compulsory eneral Bioprocess Engineering: Elective Compulsory ialisation General Process Engineering: Elective Com ialisation Chemical Process Engineering: Elective Co ialisation Chemical and Bioprocess Engineering: Elective ialisation Bioprocess Engineering: Elective Compulsor ialisation Chemical and Bioprocess Engineering: Elective Compulsory Specialisation II. Renewable Energy: Elective Compunental Process Engineering: Elective Compulsory	npulsory mpulsory ctive Compulso ory ctive Compulso	

Course L0328: Waste and Environmental Chemistry				
Тур	ractical Course			
Hrs/wk				
СР	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	oject-/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	N	
Cycle	/iSe	
Content	Content 1. Introduction 2. biological basics 3. determination process specific material characterization 4. aerobic degradation (Composting, stabilization) 5. anaerobic degradation (Biogas production, fermentation) 6. Technical layout and process design 7. Flue gas treatment 8. Plant design practical phase	
Literature		

Module M2006: Wast	e Treatment and Recycling			
Courses				
Title		Тур	Hrs/wk	СР
Planning of waste treatment plants		Project-/problem-based Learning	3	3
Recycling technologies and therma Recycling technologies and therma		Lecture Recitation Section (small)	2 1	2
Module Responsible		Recitation Section (small)	_	-
Admission Requirements				
Recommended Previous				
Knowledge	Basics of thermo dynamics			
	Basics of fluid dynamics fluid dynamics chemistry			
	fluid dynamics chemistry			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students can name, describe current issue and pro	oblems in the field of waste treatment (n	nechanical, ch	nemical and thermal)
	and contemplate them in the context of their field.			
	The industrial application of unit operations as part of pr	rocess engineering is explained by actual	examples of	waste technologies .
	Compostion, particle sizes, transportation and dosing of	wastes are described as important unit of	operations .	
	Students will be able to design and design waste treatn	nent technology equipment.		
Skills	The students are able to select suitable processes for the	he treatment of wastes or raw material w	vith respect to	their characteristics
	and the process aims. They can evaluate the efforts and		•	
Barranal Carranton				
Personal Competence Social Competence				
Social Competence	Students can			
	 respectfully work together as a team and discuss 			
	participate in subject-specific and interdisciplinar	y discussions,		
	 develop cooperated solutions promote the scientific development and accept p 	professional constructive criticism		
	promote the scientific development and decept p	ororessional constructive endersin.		
Autonomy	Students can independently tap knowledge of the			
	consultation with supervisors, to assess their learning			-
	targets for new application-or research-oriented duties i	in accordance with the potential social, e	conomic and c	cultural impact.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement				
	Written exam			
Examination duration and	120 min			
Scale Assignment for the	Civil Engineering: Specialisation Water and Traffic Flact	ivo Compulsory		
Assignment for the Following Curricula				
i onouning curricula	Chemical and Bioprocess Engineering: Specialisation Ge		pulsory	
	Chemical and Bioprocess Engineering: Specialisation Bio	oprocess Engineering: Elective Compulso	ry	
	Chemical and Bioprocess Engineering: Specialisation Ch	emical Process Engineering: Elective Cor	npulsory	
	Chemical and Bioprocess Engineering: Specialisation Ch	emical and Bioprocess Engineering: Elec	tive Compulso	ry
	Chemical and Bioprocess Engineering: Specialisation Ch	·	tive Compulso	ry
	Environmental Engineering: Specialisation Energy and R		ulcon.	
	International Management and Engineering: Specialisati Renewable Energies: Specialisation Bioenergy Systems:		11501 y	
	Process Engineering: Specialisation Chemical Process Er			
	Process Engineering: Specialisation Process Engineering			
	Process Engineering: Specialisation Environmental Process	• •		
	Water and Environmental Engineering: Specialisation Er	nvironment: Compulsory		
	Water and Environmental Engineering: Specialisation Ci	ties: Elective Compulsory		

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

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

Module M2033: Subsu	urface Processes				
Courses					
Title		Тур)	Hrs/wk	СР
Modeling of Subsurface Processes (L2731)	Rec	itation Section (small)	3	3
Subsurface Solute Transport (L272)	3)	Lect	ture	2	2
Subsurface Solute Transport (L272	9)	Rec	itation 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 re	eached the following le	arning results		
Professional Competence					
Knowledge	Upon completion of this module, the student	s will understand the	mechanisms controlling	solute transport	t in soil and natural
	porous media and will be able to work with the	equations that govern	n the fate and transport of	of solutes in poro	us media. Analytical,
	numerical and experimental tools and techniqu	ies will be used in this	module.		
GL'III.	The state of the s				territoria de la composición dela composición de la composición de la composición de la composición de la composición dela composición dela composición dela composición de la composición de la composición de la composición de la composición dela composi
Skills	In addition to the physical insights, the student	•			·
	this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in their				
	future career.				
Personal Competence					
Social Competence	Teamwork & problem solving				
Autonomy	The students will be involved in writing individual reports and presentation. This will contribute to the students' ability and				
	willingness to work independently and respons				
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84			
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Report				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Eng	ineering: Elective Com	pulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compu	ilsory		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulso	ory		
	Civil Engineering: Specialisation Computational	l Engineering: Elective	Compulsory		
	Chemical and Bioprocess Engineering: Technic	al Complementary Cou	urse: Elective Compulsory	/	
	Chemical and Bioprocess Engineering: Technic	al Complementary Cou	urse: Elective Compulsory	/	
	Environmental Engineering: Core Qualification:	Compulsory			
	Process Engineering: Specialisation Environment	ntal Process Engineeri	ng: Elective Compulsory		
	Process Engineering: Specialisation Process En	gineering: Elective Cor	mpulsory		
	Water and Environmental Engineering: Special	isation Water: Compul	sory		
	Water and Environmental Engineering: Special	isation Environment: E	lective 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	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	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		

Module M2076: Intro	duction to Climate Informed Eng	ineering		
Courses				
Title		Тур	Hrs/wk	СР
Methods in Climate Informed Engi	_	Lecture	3	3
Topics in Climate Informed Engine		Lecture	3	3
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous	Students are expected to have a foundation	•	-	
Knowledge	,	•	•	th engineering design
	processes. Analytical and critical thinking and c	reative problem-solving skills are also b	eneficial	
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	This module explores next-generation climate	models and high-resolution data, emp	hasizing their impact o	n environmental ar
	engineering products and processes. It covers I	now various engineering disciplines can	benefit from climate in	nformation. Researc
	based learning activities, expert talks, and pr	esentations will expose students to st	ate-of-the-art modeling	g, measurement, ar
	analysis in climate-informed engineering.			
Skill	Climate data analysis, engineering adaptat	ion strategies problem-solving rese	arch-hased learning	and interdisciplina
Juli.	collaboration.	ion strategies, problem solving, rese	aren basea Tearning,	and meeralselpina
	Conaboration			
Personal Competence	•			
Social Competence	Collaboration, interdisciplinary teamwork, communication skills, problem-solving, ethical responsibility, and decision-making in			
	climate-resilient engineering.			
Autonomy	Time management, self-directed learning, cri	tical thinking, accountability, initiative	e. and the ability to o	conduct independe
	research and make informed decisions in clima	•	.,	
Workload in Hours		ture 84		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale		and a finally a Constant		
Assignment for the				
Following Curricula				
	Civil Engineering: Specialisation Structural Engi Civil Engineering: Specialisation Water and Traf			
	Civil Engineering: Specialisation Water and Trail Civil Engineering: Specialisation Computational	• •		
	Data Science: Specialisation III. Applications: El			
	Environmental Engineering: Core Qualification:			
	Process Engineering: Specialisation Process Engineering:			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali		ry	
	Water and Environmental Engineering: Speciali	·	-	

Course L3347: Methods in Climate 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	

Module M2055: Adva						
Courses						
Title			Ту	р	Hrs/wk	СР
Seminar Advanced Foundation Eng	ineering (L3310)		Se	minar	2	2
Advanced Foundation Engineering				cture	2	2
Advanced Foundation Engineering			Re	citation Section (large)	2	2
Module Responsible						
Admission Requirements	None					
Recommended Previous	Soil Mechanics and F	Foundation Engineering, M	athematics I-III			
Knowledge						
Educational Objectives	After taking part suc	cessfully, students have re	eached the following I	earning results		
Professional Competence						
Knowledge	After successfully co	empleting the module, stud	dents will be able to			
	describe indiv	vidual procedures for the g	eotechnical monitorin	g of civil engineering me	asures,	
	reproduce exp	ploration and investigation	methods of the subs	oil,		
	select suitable	e types of field and laborat	tory tests for subsoil in	nvestigation and evaluate	e 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,					
	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,					
	• periorii, evai	uate and interpret tests for	r the description and	ciassification of soils acco	ording to applicab	ie standards,
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	as and weaknesses an	d based on this organiz	a thair time and le	arning managemen
Autonomy		-	is and weaknesses an	u, baseu on tilis, organizi	e trieli tirrie ariu ie	arriing managemen
	and think in terms of processes.					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Written elaboration	ca 20 Seiten zu \	ortrag oder eigenem Th	ema	
Examination	Written exam					
Examination duration and	90 min					
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Coastal Engine	eering: Compulsory			
Following Curricula	a Civil Engineering: Specialisation Geotechnical Engineering: Compulsory					
	Civil Engineering: Specialisation Structural Engineering: Compulsory					
	Civil Engineering: Specialisation Computational Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory					

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

Course L0498: Advanced Foundation Engineering				
Тур	Recitation Section (large)			
Hrs/wk	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			

ourses						
tle ater Protection (L3459)			Typ Integrated Lecture	Hrs/wk 6	CP 6	
	Prof. Simon Michael	Panaloviou	integrated Lecture	0	0	
Module Responsible Admission Requirements	None	rapalexiou				
Recommended Previous	None					
Knowledge	Basic knowled	lge in water manageme	nt;			
3 -	Good knowled	lge in urban drainage;				
		lge of wastewater treatr				
	Good knowled	lge of pollutants (e.g. CC	DD, BOD, TS, N, P) and their properties;			
Educational Objectives	After taking part suc	cessfully, students have	reached the following learning results			
Professional Competence		·				
Knowledge	The students can de	scribe the basic principle	es of the regulatory framework related to th	ne international and Eu	ropean water sect	
	They can explain lir	mnological processes, s	substance cycles and water morphology in	detail. They are able	e to assess comp	
	problems related to	water protection, such	as ecosystem service and wastewater tre	atment with a special	focus on innovat	
	solutions, remediation	on measures as well as o	conceptual approaches.			
Skills	Students can accura	itely assess current prob	blems and situations in a country-specific o	r local context. They o	an suggest concr	
Skiiis			omorrow's urban water cycle. Furthermore			
		egislative solutions to so		, , , , , , , , , , , , , , , , , , , ,		
Personal Competence						
Social Competence	The students can wo	ork together in internation	onal groups.			
Autonomy	Students are able to	organize their work flo	w to prepare presentations and discussions	s. They can acquire ap	propriate knowled	
	by making enquiries	independently.				
Workload in Hours	Independent Study T	ime 96, Study Time in L	ecture 84			
Credit points						
Course achievement	Yes 20 %	Form Presentation	Description 10-minütige Präsentation von Arbeits	sergehnissen		
Examination		Tresentation	10-militarye Fraschication von Arbeit.	3CT GCDT1133CT1		
Examination duration and	150 minutes					
scale	250 1111114103					
Assignment for the	Civil Engineering: Sp	ecialisation Coastal Eng	ineering: Elective Compulsory			
Following Curricula		-				
. ooiig carricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory					
			/ater Quality and Water Engineering: Electiv	e Compulsory		
	International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory					
	Water and Environm	ental Engineering: Spec	ialisation Environment: 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							
Title			Тур	Hrs/wk	СР		
Jncertainty Modelling for Engineer	s (L3458)		Integrated Lecture	6	6		
Module Responsible	Prof. Simon Michael F	Papalexiou					
Admission Requirements	None	<u> </u>					
Recommended Previous							
Knowledge		arity with engineering	•				
		er skills for handling o	cs, and mathematical skills.				
		3	plems using statistical and probabilistic method	ls.			
Professional Competence	After taking part succ	cessfully, students na	ave reached the following learning results				
•	Students will develor	n a strong foundatio	on in uncertainty, probability, and risk analysi	is in engineering ann	lications. The cou		
Knowicage			uncertainty, covering frequency-based method				
			theory, joint probability distributions, and stoc				
	uncertainty in engine	eering problems. The	e course also covers linear and nonlinear reg	ression methods, esse	ential for data-driv		
	decision-making and	predictive modeling	. Additionally, students will gain insight into ri	sk assessment as a fi	unction of probabi		
	and disutility and lea	rn how to apply Baye	esian Decision Theory to optimize engineering s	solutions under uncert	ainty.		
Skills	By the end of the cou	urse, students will be	able to apply probabilistic models to quantify	uncertainty and asses	s risks in engineer		
	problems. They will	gain expertise in fitt	ing probability distributions, performing extre	me value analysis, ar	nd applying Bayes		
	inference to real-wo	rld engineering cha	llenges. Students will also develop skills in I	inear and nonlinear i	regression modeli		
	_		eering datasets and improve risk predictions. T	-	•		
		plement stochastic n	nethods and optimization techniques to suppo	rt reliability-based de	sign and engineer		
	decision-making.						
Personal Competence							
Social Competence	Students will develo	op the ability to wo	ork collaboratively on engineering risk asses	sments, communicati	ing technical resu		
	,	-	ecision-makers. They will engage in discussio		•		
		cation, ensuring tha	t engineering analyses are both rigorous ar	nd applicable to real	-world infrastructi		
	challenges.						
Autonomy	Students will learn to	o independently anal	lyze and model engineering uncertainties, sele	ecting and applying ap	propriate probabi		
	_		tochastic techniques for various applications.	,	-		
	assessment, and disa		made hazards, ensuring they can make inform	ned engineering decisi	ons in design, safe		
	assessment, and also	aster magation.					
	Independent Study Ti	ime 96, Study Time i	n Lecture 84				
Credit points Course achievement		Form	Description				
course acmevement	Yes 20 %	Presentation	10-minütige Präsentation von Arbeits	sergebnissen			
Examination	Written exam						
Examination duration and	150 min						
scale Assignment for the	Civil Engineering: Spe	ocialisation Coastal F	Engineering: Elective Compulsory				
Following Curricula	3 3 1		nical Engineering: Elective Compulsory				
. ccg caca.a	3 3 1		, ,				
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Computational Engineering: Elective Compulsory						
	Civil Engineering: Spe	ecialisation Water an	d Traffic: Elective Compulsory				
	Civil Engineering: Spe	ecialisation Coastal E	Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Computational Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Environmental Engineering: Core Qualification: Elective Compulsory						
	_						
	Environmental Engineering: Core Qualification: 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						
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory						
			pecialisation Environment: Elective Compulsory pecialisation 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. Handson 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	

Thesis

Module M1801: Maste	er thesis (dual study program)				
Courses					
Title	Тур	Hrs/wk	СР		
Module Responsible	Professoren der TUHH				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	Dual students				
Skills	use the specialised knowledge (facts, theories and methods) from their fie knowledge confidently to deal with technical and practical professional issues. can explain the relevant approaches and terminologies in depth in one of describe current developments and take a critical stance. formulate their own research assignment to tackle a professional problem and They ascertain the current state of research and critically assess it. Dual students can select suitable methods for the respective subject-related professional pr	or more of their subjected contextualise it withing the subjected phases and appeared manner.	it's specialist areas, n their subject area. develop them further		
	acquire new academic knowledge in their subject area and critically evaluate i	t.			
Personal Competence					
Social Competence	Dual students				
Autonomy	 can present a professional problem in the form of an academic question in a structured, comprehensible and factually correct manner, both in writing and orally, for a specialist audience and for professional stakeholders. answer questions as part of a professional discussion in an expert, appropriate manner. They represent their own points of view and assessments convincingly. Dual students can structure their own project into work packages, work through them at an academic level and reflect on them with regard to feasible courses of action for professional practice. work in-depth in a partially unknown area within the discipline and acquire the information required to do so. apply the techniques of academic work comprehensively in their own research work when dealing with an operational problem and question. 				
Wandaad in Harre	Indian and out Childs Time 2000 Childs Time in Landson 2				
	Independent Study Time 900, Study Time in Lecture 0				
Credit points					
Course achievement					
Examination duration and					
Examination duration and	According to General Regulations				
Scale Assignment for the	Civil Engineering: Thesis: Compulsory				
Following Curricula					
1 ollowing curricula	Chemical 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				
	Computer Science in Engineering: Thesis: Compulsory				
	Information and Communication Systems: Thesis: Compulsory				
	International Management and Engineering: Thesis: Compulsory				
	Logistics, Infrastructure and Mobility: Thesis: Compulsory Aeronautics: Thesis: Compulsory				
	Mechanical Engineering - Product Development and Production: Thesis: Compulsory				
	Materials Science and Engineering: Thesis: Compulsory Materials Science: Thesis: Compulsory				
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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
Theoretical Mechanical Engineering: Thesis: Compulsory
Process Engineering: Thesis: Compulsory
Water and Environmental Engineering: Thesis: Compulsory