

Module Manual

Master of Science

Water and Environmental Engineering

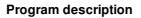
Cohort: Winter Term 2015

Updated: 11th May 2016

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TUHH

Content

Master of Science in 'Water and Environmental Engineering'

The Master of Science in Water and Environmental Engineering gives students a choice of three areas of specialization – Water, Environment and City. Graduates of the Master in Water and Environmental Engineering are able to translate the engineering, mathematical and scientific knowledge gained on the course into practice in order to analyze problems scientifically and solve them even when they are unusually or incompletely defined and have complex specifications. Graduates have the ability to work independently, to apply the methods and processes required to solve technical and planning problems, and to apply, critically scrutinize, and further develop new findings. They are also qualified to plan exacting (household) water management projects and projects geared to environmental protection and to plan them paying due attention to the necessary clarifications and examination of existing information and resources. They can

- · Collaborate successfully with professional and non-professional players in public administration, industry, and academia
- Independently define research tasks for theoretical and experimental exploration of environmental and water management issues and plan and execute projects in those areas
- · Responsibly assess and take into account the concerns of those affected by planning and implementation and of society in general
- work together in international teams on international subjects with cross-cultural competence.



Core qualification

Module M0523: Business	& Management	
Module Responsible	Prof. Matthias Meyer	
Admission Requirements	None	
Recommended Previous	None	
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge Skills	 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. 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 Autonomy	• Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.	
Workload in Hours	Depends on choice of courses	
Credit points	6	
	·	

Courses

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



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

Personal Competence



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

Courses

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



Module M0826: Biology, G	eology and Chemistry			
Courses				
Title		Тур	Hrs/wk	CP
Biology WUMS (L1428)		Lecture	2	2
Geology and Soil Science (L0903)		Lecture	2	2
Environmental Analysis (L0354)		Lecture	2	2
Module Responsible	Dr. Holger Gulyas			
Admission Requirements	none			
Recommended Previous	Fundamentals of inorganic/organic chemistry	and biology		
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	With the completion of this module students a	acquire profound knowledge of the geo- and pedos	phere, biogeochemical p	rocesses and the fate of
	migrating compounds in soil and groundwater	r. They learn about methods to investigate sites for	different use.	
Skills		an apply the acquired theoretical knowledge to mo		,
	conceptually. They are able to draw comparis	ons on different investigation strategies and technic	ques. Model projects can t	be devised and treated.
Personal Competence				
Social Competence	Students can discuss technical and scientific t	tasks within a seminar subject specific and interdisc	ciplinary .	
Autonomy	Students can independently exploit sources,	acquire the particular knowledge of the subject and	apply it to new problems.	
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points				
	Written exam			
Examination duration and scale				
	Water and Environmental Engineering: Core of	gualification: Compulsory		
Curricula	water and Environmental Engineering. Core (quameaton. Compusory		
Curricula				

Course L1428: Biology WUMS	ourse L1428: Biology WUMS	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des SD B	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L0903: Geology and Soil Se	cience
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Gerth, Prof. Wilfried Schneider
Language	DE
Cycle	WiSe
Content	Geology: formation of the Earth, plate tectonics, macroscopic rock identification, introduction to Earth history, introduction to halokinesis.
	Soil science: soil use and function in ecosystems, faktors and processes of soil formation, mineral and organic components, surface types and properties, retention of nutrients and pollutants, hazards from faulty land use, erosion, salinization, and contamination, measures to preserve soils
Literature	R. Vinx (2011): "Gesteinsbestimmung im Gelände"
	H. Bahlburg & C. Breitkreutz (2012): "Grundlagen der Geologie", TUB Signatur GWB-318
	R. Walter (2003): "Ergeschichte" TUB Signatur: 2816-1769
	F.Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308
	W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317



-	lysis
	Lecture
Hrs/wk	
	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	EN
Cycle	WiSe
Content	Introduction
	Sampling in different environmental compartments, sample transportation, sample storage
	Sample preparation
	Photometry
	Wastewater analysis
	Introduction into chromatography
	Gas chromatography
	HPLC
	Mass spectrometry
	Optical emission spectrometry Atom absorption spectrometry
	Ouality 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, 20 (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 Chemist 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, Euge 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 Emiss
	Spectrometry Perkin-Elmer Corporation 1997, On-line available at:
	http://files.instrument.com.cn/bbs/upfile/2006291448.pdf
	Atomic absorption spectrometry: theory, design and applications, ed. by S. J. Haswell 1991 (TUB: 2727-5614)
	Royal Society of Chemistry, Atomic absorption spectometry (http://www.kau.edu.sa/Files/130002/Files/6785 AAs.pdf)



Courses				
Title		Тур	Hrs/wk	CP
Safety, Reliability and Risk Assessment	(L1145)	Seminar	2	3
Environment and Sustainability (L0319)		Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	Students are able to describe single techniques and to give	e an overview for the field of safety a	nd risk assessment as we	II as environmental a
	sustainable engineering, in detail:			
	 basics in safety and reliability of technical facilities 			
	 safety and reliability analysis methods 			
	 risk assessment 			
	 Production and usage of bio-char 			
	 energy production and supply 			
	 sustainable product design 			
Skills	Students are able apply interdisciplinary system-oriented and costs for processes and select economically feasible tr		stainability reporting. They	r can evaluate the eff
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the subject area from giv			
	new application or research-oriented duties in for risk ma	nagement and sustainability concep	ts accordance with the po	tential social, econon
	and cultural impact.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 minutes in groups)			
Assignment for the Following	Civil Engineering: Core qualification: Compulsory			
Curricula	International Management and Engineering: Specialisation	II. Civil Engineering: Elective Compu	lsory	
	Product Development, Materials and Production: Specialisa	ation Product Development: Elective (Compulsory	
	Product Development, Materials and Production: Specialisa	ation Production: Elective Compulsor	/	
	Product Development, Materials and Production: Specialisa	ation Materials: Elective Compulsory		
	Water and Environmental Engineering: Core qualification:	Compulson		

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



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



Specialization Cities

Module M0830: Environm	ental Protection and Management			
Courses				
Title		Тур	Hrs/wk	СР
Integrated Pollution Control (L0502)		Lecture	2	2
Health, Safety and Environmental Mana	gement (L0387)	Lecture	2	3
Health, Safety and Environmental Mana		Recitation Section (small)	1	1
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous				
Knowledge	 Environmental Technologies 			
	Environmental Legislation			
	Environmental Assessment			
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence	The shide the set of t		Radical Academics 1	-4 1105 1- 1 1 1
Knowledge	•			-
	14001, EMAS and Responsible Care ISO 14001 rec			
	and approaches from end-of-pipe technology to eco-effici		-	
	problems. They are able to judge environmental issues			
	measures and further interventions as well as conceptual	problem solving approaches in the full rar	ge of problems in diller	ent moustrial sectors
Skillo	Students are able to access surrent problems and situ	ations in the field of any ironmental prot	action They can cone	ider the best sucils
Skills	Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available			
	techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.			
Personal Competence				
	a The students can work together in international groups.			
,				
Autonomy	Students are able to organize their work flow to prepare	e themselves for presentations and contr	butions to the discuss	ions. They can acqu
	appropriate knowledge by making enquiries independent			, ,
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Energy and Environmental Engineering: Specialisation En	nvironmental Engineering: Elective Comp	Ilsory	
Curricula	Environmental Engineering: Core qualification: Compulso	ory		
	International Production Management: Specialisation Man	nagement: Elective Compulsory		
	Joint European Master in Environmental Studies - Cities a	and Sustainability: Specialisation Water: El	ective Compulsory	
	Joint European Master in Environmental Studies - Cities a	and Sustainability: Specialisation Energy: I	Elective Compulsory	
	Product Development, Materials and Production: Specialis	sation Product Development: Elective Con	npulsory	
	Product Development, Materials and Production: Specialis	sation Production: Elective Compulsory		
	Product Development, Materials and Production: Specialis	sation Materials: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environmental	vironment: Compulsory		
	Water and Environmental Engineering: Specialisation Citi	es: Compulsory		



Course L0502: Integrated Pollution	n Control
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stephan Köster
Language	EN
Cycle	WiSe
Content	The lecture focusses on:
	 The Regulatory Framework Pollution & Impacts, Characteristics of Pollutants Approaches of Integrated Pollution Control Sevilla Process, Best Available Technologies & BREF Documents Case Studies: paper industry, cement industry, automotive industry Field Trip
Literature	

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

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



Module M0902: Wasterwa	ter Treatment and Air Pollution Abatem	ent		
Courses				
Title		Тур	Hrs/wk	CP
Biological Wastewater Treatment (L0517	7)	Lecture	2	3
Air Pollution Abatement (L0203)	,	Lecture	2	3
Module Responsible	Dr. Ernst-Ulrich Hartge			
Admission Requirements				
Recommended Previous	Basic knowledge of biology and chemistry			
Knowledge	basic knowledge of solids process engineering and s	eparation technology		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completion of the module students an	e able to		
	 name and explain biological processes for water 	aste water treatment,		
	 characterize waste water and sewage sludge 			
	 discuss legal regulations in the area of emissions and air quality 			
	 classify off gas tretament processes and to define their area of application 			
Skills	Students are able to			
	choose and design processs steps for the biological waste water treatment			
	combine processes for cleaning of off-gases d	epending on the pollutants contained in the	gases	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General E	Bioprocess Engineering: Elective Compulso	ry	
Curricula	Chemical and Bioprocess Engineering: Specialisation	n General Process Engineering: Elective Co	ompulsory	
	Energy and Environmental Engineering: Specialisation	on Environmental Engineering: Elective Cor	npulsory	
	Environmental Engineering: Specialisation Waste and	d Energy: Elective Compulsory		
	International Management and Engineering: Speciali	sation II. Energy and Environmental Engine	ering: Elective Compulsor	у
	Joint European Master in Environmental Studies - Cit	ies and Sustainability: Specialisation Water	Elective Compulsory	
	Process Engineering: Specialisation Environmental F	Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engine	ering : Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	n Cities: Compulsory		

Course L0517: Biological Wastewa	ater Treatment		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Joachim Behrendt		
Language	DE/EN		
Cycle	WiSe		
Content	Charaterisation of Wastewater		
	Metobolism of Microorganisms		
	Kinetic of mirobiotic processes		
	Calculation of bioreactor for wastewater treatment		
	Concepts of Wastewater treatment		
	Design of WWTP		
	Excursion to a WWTP		
	Biofilms		
	Biofim Reactors		
	Anaerobic Wastewater and sldge treatment		
	resources oriented sanitation technology		
	Future challenges of wastewater treatment		
Literature	Gujer, Willi		
	Siedlungswasserwirtschaft : mit 84 Tabellen		
	ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv?		
	id=2842122&prov=M&dok_var=1&dok_ext=htm		



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



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



Courses				
Title		Тур	Hrs/wk	СР
ntegrated Transportation Planning (L10	68)	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 undergrad	duate class "Transport Plannin	g and Traffic Engine	erin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	Students are able to:			
	• describe interdencedencies between land was/lacation aboves and	ad tuon on outotion (mobility hobs		
	 describe interdependencies between land-use/location choice ar explain and evaluate the social, ecological and economic effects 			
	 relate current issues in the area of integrated transport planning a 			
Skills	Students are able to:			
Onino Onino				
	 quantify important parameters, which influence travel demand or a 	are influenced by it.		
	comprehensively examine a pre-defined or self-selected topic	from a transportation studies	s perspective and d	ocument the results
	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 activiti independently plan working on a pre-defined project topic, acquir 		nd una appropriato m	anna far ita avagutian
	• Independently plan working on a pre-defined project topic, acquir	e ine necessary knowledge a	no use appropriate n	leans for its execution
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written elaboration			
Examination duration and scale				
	Civil Engineering: Specialization Structural Engineering: Elective Commu	leon		
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compu Civil Engineering: Specialisation Geotechnical Engineering: Elective Cor	•		
Gurricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Con Civil Engineering: Specialisation Coastal Engineering: Elective Compuls			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mo	,		
	Water and Environmental Engineering: Specialisation Mater: Elective Co			
	Water and Environmental Engineering: Specialisation Water. Elective Co			



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



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Courses				
Title		Тур	Hrs/wk	CP
Renewable Energy Projects in Emerged	Markets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013) Wind Turbine Plants (L0011)		Lecture Lecture	1	3
Wind Energy Use – Focus Offshore (LC	012)	Lecture	2	3
Module Responsible				
Admission Requirements	none			
Recommended Previous	Thermodynamics, Fluid Mechanics, Fundamen	tals of Fluid Flow Engines		
Knowledge	,,,,,,			
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence	with taking part buccessiany, stadents have rec			
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore condition and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use water power to generate electricity. The students reproduce and explain the basic procedure in the implementation of renewable energy project in countries outside Europe.			
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technical 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		the context of the emphasis of the lecture material to	clear the contents of th	ne lecture and to acqu
	the particular knowledge about the subject area	a.		
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	Civil Engineering: Specialisation Structural Eng	nineering: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical			
0000.10	Civil Engineering: Specialisation Coastal Engir			
		alisation Energy Engineering: Elective Compulsory		
		pecialisation II. Renewable Energy: Elective Computery	lsorv	
		pecialisation II. Energy and Environmental Engineer		20
		n: Specialisation II: Energy and Environmental Engineer	•	' y
			mpulsory	
		n: Specialisation Production: Elective Compulsory		
		n: Specialisation Materials: Elective Compulsory		
	Renewable Energies: Core qualification: Comp			
	Water and Environmental Engineering: Special			
	Water and Environmental Engineering: Special	lisation Cities: Elective Compulsory		



Course L0014: Renewable Energy	Projects in Emerged Markets	
Тур	Project Seminar	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Andreas Wiese	
Language	DE	
Cycle		
Content		
	1. Introduction	
	 Development of renewable energies worldwide 	
	History	
	Future markets	
	 Special challenges in new markets - Overview 	
	2. Sample project wind farm Korea	
	• Survey	
	Technical Description	
	Project phases and characteristics	
	3. Funding and financing instruments for EE projects in new markets	
	Overview funding opportunitie	
	Overview countries with feed-in laws	
	Major funding programs	
	4. CDM projects - why, how , examples	
	Overview CDM process	
	◦ Examples	
	Exercise CDM	
	5. Rural electrification and hybrid systems - an important future market for EE	
	Rural Electrification - Introduction	
	Types of Elektrizifierungsprojekten	
	 The role of the EEInterpretation of hybrid systems 	
	 Project example: hybrid system Galapagos Islands 	
	6. Tendering process for EE projects - examples	
	South Africa	
	• Brazil	
	7. Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank	
	 Geothermal 	
	Wind or CSP	
Literature	Folien der Vorlesung	

Course L0013: Hydro Power Use			
· · ·			
Тур			
Hrs/wk			
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dr. Stephan Heimerl		
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 Plant	s
Тур	Lecture
Hrs/wk	2
CP	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 -	
	Lecture
Hrs/wk	1
CP	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 M0703: Soil and G	Groundwater Contamination			
Courses				
Title		Тур	Hrs/wk	CP
Contamination and Remediation (L0547))	Project Seminar	3	3
NAPL in Soil and Groundwater (L0545)		Lecture	1	1
NAPL in Soil and Groundwater (L0546)		Recitation Section (small)	2	2
Module Responsible	Prof. Wilfried Schneider			
Admission Requirements	None			
Recommended Previous	Groundwater hydrology, Hydromechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students are able to analyse contamination in soils	and groundwater. They are able to create re	mediation concepts a	s monitored attenuat
	and pump and treat.			
Skills	s The students are able to analyse contaminations in soils and groundwater using special engineering methods. They can do transport modelling			
	the unsaturated zone, estimations of groundwater pollution and analyse the impacts of remediation measures. They can forecast die distribution			
	mobility and remediation of non aquaous phase liquids i	n soil and groundwater.		
Personal Competence				
Social Competence	The students are able to prepare complex contamination	issues in teamwork and are able to find rem	ediation measures.	
Autonomy	none			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	Klausur 60 min; Referat 15 min;			
Assignment for the Following	Energy and Environmental Engineering: Specialisation I	Environmental Engineering: Elective Compul	sory	
Curricula	Water and Environmental Engineering: Specialisation W	ater: Elective Compulsory		
	Water and Environmental Engineering: Specialisation En	nvironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation C	ities: Elective Compulsory		

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

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

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



Module M0749: Waste Tre	atment and Solid Matter Process Technol	ogy			
-					
Courses					
Title	(1.0050)	Тур	Hrs/wk	CP	
Solid Matter Process Technology for Bic Thermal Waste Treatment (L0320)	mass (L0052)	Lecture	2	2	
Thermal Waste Treatment (L1177)		Recitation Section (large)	1	2	
Module Responsible	Prof. Kerstin Kuchta				
Admission Requirements	none				
Recommended Previous	Basics of				
Knowledge					
	thermo dynamics				
	fluid dynamics				
	chemistry				
Educational Objectives	After taking part successfully, students have reached the	following learning results			
Professional Competence					
Knowledge	The students can describe current issue and problems in	the field of thermal waste treatment and pa	article process enginee	ering.	
	The industrial application of unit operations as part of pro	cess engineering is explained by actual ex	amples of waste incin	eration technologies and	
	The industrial application of unit operations as part of process engineering is explained by actual examples of waste incineration technologies and solid biomass processes. Composition, particle sizes, transportation and dosing, drying and agglomeration of renewable resources and wastes are				
	described as important unit operations when producing solid fuels and bioethanol, producing and refining edible oils, electricity, heat and minera				
	recyclables.				
Skills	The students are able to select suitable processes for th	e treatment of wastes or raw material with	respect to their charac	teristics and the proces	
	aims. They can evaluate the efforts and costs for process	es and select economically feasible treatm	ent concepts.		
Personal Competence					
Social Competence	Students can				
	respectfully work together as a team and discuss technical tasks				
	 participate in subject-specific and interdisciplinary 	/ discussions,			
	develop cooperated solutions				
	 promote the scientific development and accept p 	rofessional constructive criticism.			
Autonomy	Students can independently tap knowledge of the sul	pject area and transform it to new ques	tions. They are capa	ole, in consultation with	
	supervisors, to assess their learning level and define further steps on this basis. Furthermore, they can define targets for new application or				
	research-oriented duties in accordance with the potential social, economic and cultural impact.				
Workload in Hours					
Credit points					
Examination	Written exam				
Examination duration and scale	120 min				
	Bioprocess Engineering: Specialisation A - General Biop		ative Committee		
Curricula	Energy and Environmental Engineering: Specialisation E				
	International Management and Engineering: Specialisation II. Process Engineering and Biotechnology: Elective Compulsory				
	Renewable Energies: Specialisation Bio energies: Electi				
	Process Engineering: Specialisation Chemical Process E				
	Process Engineering: Specialisation Process Engineerin				
	Water and Environmental Engineering: Specialisation Er				
	Water and Environmental Engineering: Specialisation Ci	ies. Elective Compulsory			



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

Course L0320: Thermal Waste Tre	atment
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta, Dr. Joachim Gerth, Dr. Ernst-Ulrich Hartge
Language	EN
Cycle	SoSe
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 L1177: Thermal Waste Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Ernst-Ulrich Hartge, Dr. Joachim Gerth
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses					
Title		Тур	Hrs/wk	CP	
Applied Groundwater Modeling (L0543)		Lecture	1	1	
Applied Groundwater Modeling (L0544)		Recitation Section (small)	2	2	
Modeling of Water Supply and Sewer Ne		Problem-based Learning	2	3	
Module Responsible	Prof. Wilfried Schneider				
Admission Requirements	none				
Recommended Previous	Groundwater				
Knowledge	groundwater hydraulics and transport of substances				
	Pipe Systems				
	 Knowledge on urban water infrastructur 	res, in particular drinking water systemsand urban dr	ainage systems includi	ing special structures	
	 Hydraulics of drinking water supply system 	tems and sewer systems			
	Basic knowledge on water management	nt			
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence	-	-			
Knowledge	The students are able to describe the modell	ing of groundwater flow and transport as well as u	urban water infrastructu	ures. They can carry o	
Ũ		nd conceptual weak points within the systems in c			
	interdependencies of hydraulic and toxic pheno			, ,	
01:11-	The students are able to construct and combine				
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare				
	or assess different solutions for existing problems by application of selected software products. The students are able to use different software				
	solutions (e.g. EPANET, EPA-SWMM).				
Barconal Competance					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70			
Credit points	6				
Examination	Written exam				
Examination duration and scale					
Assignment for the Following	Civil Engineering: Specialisation Structural Eng	gineering: Elective Compulsory			
Curricula	Civil Engineering: Specialisation Geotechnical				
	Civil Engineering: Specialisation Costal Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specia				
	Water and Environmental Engineering: Specia				

Course L0543: Applied Groundwat	ter Modeling
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wilfried Schneider
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

Content Literature



Course L0544: Applied Groundwater Modeling			
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Wilfried Schneider		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		
Course L0875: Modeling of Water	Supply and Sewer Network		
Тур	Problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Klaus Johannsen, NN		
Language	DE		
Cycle	SoSe		



Module M0828: Urban Env	vironmental Management				
Courses					
Title		Тур	Hrs/wk	СР	
Noise Protection (L1109)		Lecture	2	2	
Urban Infrastructures (L0874)		Problem-based Learning	2	4	
Module Responsible	NN				
Admission Requirements	none				
Recommended Previous					
Knowledge	Urban planning	a adaptation			
	 Measures for climate protection and climate chang Basics of urban drainage 	e avapialion			
	Basics of urban drainage				
Educational Objectives	After taking part successfully, students have reached the for	llowing learning results			
Professional Competence					
Knowledge					
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Examination	Written exam				
Examination duration and scale					
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: E	lective Compulsory			
Curricula	Civil Engineering: Specialisation Geotechnical Engineerin	g: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Ele	ctive Compulsory			
	Joint European Master in Environmental Studies - Cities a	nd Sustainability: Core qualification: Compu	lsory		
	Logistics, Infrastructure and Mobility: Specialisation Infrast	ructure and Mobility: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Env	ironment: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Citie	es: Compulsory			

Course L1109: Noise Protection	ourse L1109: Noise Protection		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Bitte auswählen		
Language	EN		
Cycle	SoSe		
Content			
Literature			

Course L0874: Urban Infrastructu	res
Тур	Problem-based Learning
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
	 Problem/Project Based Learning Main topics are: Design of future cities, concepts and technical approaches for future-proof drinking water supply and wastewater disposal Climate Change Impacts, Adaptation and Mitigation Rainwater Management & urban flash floods New water sources: rainwater harvesting and wastewater reuse Urban greening & urban agriculture Water sensitive urban design How to better link urban planning and urban water issues
Literature	



Module M0857: Geochem	ical Engineering			
Courses				
Title		Тур	Hrs/wk	CP
Contaminated Sites and Landfilling (L090	06)	Lecture	2	2
Contaminated Sites and Landfilling (L090)7)	Recitation Section (large)	1	2
Geochemical Engineering (L0904)		Lecture	2	2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	none			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	With the completion of this module students acquire profe	ound knowledge of biogeochemical pro	ocesses, the fate of	f pollutants in soil and
Skills	groundwater, and techniques to deposit contaminated waste material. They are able to describe in principle the behaviour of chemicals in the environment. Students can explain and report the approach to remediate contaminated sites. With the completion of this module students can apply the acquired theoretical knowledge to model cases of site pollution and critically assess the situation technically and conceptually. They are able to draw comparisons on different remediation strategies and techniques. Model projects can be devised and treated.			
Personal Competence Social Competence	Students can discuss technical and scientific tasks within a s	eminar subject specific and interdisciplina	ary.	
Autonomy	Students can independently exploit sources , acquire the part	ticular knowledge of the subject and apply	y it to new problems.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 hours			
Assignment for the Following	Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory			
Curricula	Environmental Engineering: Core qualification: Elective Com	pulsory		
	Water and Environmental Engineering: Specialisation Water:	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	nment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities:	Elective Compulsory		

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



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

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



Module M0870: Managem				
Courses				
Title		Тур	Hrs/wk	CP
Modelling of Flow in Rivers and Estuarie		Lecture	3	4
Nature-Oriented Hydraulic Engineering	• . <i>.</i>	Problem-based Learning	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge		•		•
	describe the basic aspects of numerical modelling		n of flows and waves.	They can also depict 1
	concepts of nature oriented hydraulic engineering.			
Skills	Students are able to apply hydrodynamic-numeric	al models to practical hydraulic engineering tasl	ks. Furthermore, the stu	udents are able to set
	flood-risk management concepts and are able to a	oply basic concepts of renaturation to practical p	roblems.	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lectur	e 70		
Credit points				
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The ex	xamination includes tasks with respect to the gen	neral understanding of	the lecture contents a
	calculations tasks.			
Assignment for the Following	• • •			
Curricula			npulsory	
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat	ion Glies. Elective Compulsory		
Course L0810: Modelling of Flow in	n Rivers and Estuaries			
Typ				
Hrs/wk	3			
CP	4			
Workload in Hours		40		
		42		
Lecturer				
Language				
Cycle				
Content	Basics of numerial models / application of models			
	 classification of models 			

- model concept
- modelling

1D Working Equation

Mathematical description of physical processes

- Equation of motions
 - conservation of mass
 - conservation of momentum
- Initial conditions and boundary conditions

Numerical Methods

.

- Time step procedure
- Finite differences
- Finite volumes

Literature Vorlesungsskript



Course L0961: Nature-Oriented Hy	ourse L0961: Nature-Oriented Hydraulic Engineering / Integrated Flood Protection			
Тур	Problem-based Learning			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Peter Fröhle			
Language	DE/EN			
Cycle	SoSe			
Content	 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 M0871: Hydrologi	cal Systems			
Courses				
Title		Тур	Hrs/wk	CP
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Problem-based Learning	1	2
Interaction Water - Environment in Fluvia	al Areas (L0295)	Problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to define the basic concepts of hydrolog	gy and water management. They are	able to describe an	nd quantify the relevant
	processes of the hydrological water cycle. Besides, the students know the main aspects of rainfall-run-off-models and are able to theoretically			
	derive established reservoir / storage models and a unit-hydrograph.			
Clvilla	The students are able to use the basis budyslasical economic and	d approaches and are able to theory	tiaallu davius astabli	abad reconvoir (storege
Skiiis	The students are able to use the basic hydrological concepts ar models or a unit hydrograph as the basis for rainfall run off m		•	÷
	models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the basic concepts of measurements of hydrological and hydrodynamic values in nature and are able to perform, analyze and statistically assess these measurements. Furthermore, they			
	are able to apply a hydrological model to basic hydrological prob			ienta. i urtiferniore, trey
		internet.		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 90 min. The examination inc	ludes tasks with respect to the genera	al understanding of t	he lecture contents and
	calculations tasks.			
Assignment for the Following	Environmental Engineering: Core qualification: Elective Compute	sory		
Curricula	Water and Environmental Engineering: Specialisation Water: Ele	ective Compulsory		
	Water and Environmental Engineering: Specialisation Environmental	ent: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Ele	ctive Compulsory		

Course L0289: Applied Surface Hydrology	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle, Sandra Hellmers
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	Problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0295: Interaction Water - Environment in Fluvial Areas	
Тур	Problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle, Sandra Hellmers
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 M0874: Wastewate	or Systems			
WOULIE WOO74. Wastewat	er Systems			
Courses				
Title		Тур	Hrs/wk	CP
Wastewater Systems - Collection, Treatment and Reuse (L0934)		Lecture	2	2
Wastewater Systems - Collection, Treatment and Reuse (L0943)		Recitation Section (large)	1	1
Advanced Wastewater Treatment (L035	7)	Lecture	2	2
Advanced Wastewater Treatment (L035	8)	Recitation Section (large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management and the keep	ey processes involved in wastewater treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students are able to outline key areas of the full r	ange of treatment systems in waste water manager	nent, as well as their	mutual dependence fo
	sustainable water protection. They can describe re	elevant economic, environmental and social factors.		
01:11-				
Skills		vailable wastewater treatment processes and the s	cope of their application	tion in municipal and fo
	some industrial treatment plants.			
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject and	t to organize their work flow independently. They ca	n also present on this	s subject.
Workload in Hours	Independent Study Time 96, Study Time in Lecture	9 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
	Bioprocess Engineering: Specialisation A - Genera	al Bioprocess Engineering: Elective Compulsory		
	Energy and Environmental Engineering: Specialis	ation Environmental Engineering: Elective Compute	sory	
	International Management and Engineering: Spec	ialisation II. Energy and Environmental Engineering	: Elective Compulsor	У
	International Management and Engineering: Spec	ialisation II. Process Engineering and Biotechnolog	y: Elective Compulso	ry
	Process Engineering: Specialisation Environment	al Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engi	ineering : Elective Compulsory		
	Water and Environmental Engineering: Specialisa	tion Water: Compulsory		
	Water and Environmental Engineering: Specialisa	tion Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisa	tion Cities: Compulsory		

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



Course L0943: Wastewater System	Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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



Course L0358: Advanced Wastewater Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	DE
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 Manual M. Sc	. "Water and Environmental Eng	ineering"		TUHHH Technische Universität Hamburg-Han
Module M0875: Water & W	astewater Systems			
Courses				
Title		Тур	Hrs/wk	СР
Ecological Town Design - Water, Energy	r, Soil and Food Nexus (L1229)	Lecture	2	2
Nater & Wastewater Systems in a Glob	al Context (L0939)	Lecture	2	4
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with rising p	poverty, soil degradation, migration to cities,	lack of water resources and	sanitation
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students can describe the facets of the global water situation. Students can judge the enormous potential of the implementation of synergis			
	systems in Water, Soil, Food and Energy supply.			
Skills	Students are able to design ecological settlements	for different geographic and socio-economic	conditions for the main clin	nates around the world
		···· ···· ··· ··· ··· ··· ··· ··· ···		
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject and	to organize their work flow independently. The	ney can also present on this	s subject.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	e 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Bioprocess Engineering: Specialisation A - Genera	I Bioprocess Engineering: Elective Compuls	ory	
Curricula	Chemical and Bioprocess Engineering: Specialisat	ion General Process Engineering: Elective C	Compulsory	
	Environmental Engineering: Core qualification: Elec	ctive Compulsory		
	Joint European Master in Environmental Studies - C	Cities and Sustainability: Core qualification: (Compulsory	
	Process Engineering: Specialisation Environmenta	I Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engin	neering : Elective Compulsory		
	Water and Environmental Engineering: Specialisati	ion Water: Elective Compulsory		

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	esign - Water, Energy, Soil and Food Nexus		
	Lecture		
Hrs/wk			
СР			
	Independent Study Time 32, Study Time in Lecture 28		
	Prof. Ralf Otterpohl		
Language			
Cycle	SoSe		
Content	Participants Workshop: Design of the most attractive productive Town		
	Keynote lecture and video		
	The limits of Urbanization / Green Cities The transition of the Durch Ositi de modeling a superbolic training training to site of the Durch Ositi de modeling a superbolic training training to site of the Durch Ositi de modeling a superbolic training train		
	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 		
	 Participants Workshop: Resources for thriving rural areas, Short presentations by participants, video competion TUHH Rural Development Toolbox 		
	TUHH Rural Development Toolbox (cont.)		
	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		
	Exam with color pencils: Design of a New Town		
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 		

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



ourse L0939: Water & Wastewate	
	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	 Participants Workshop: Awareness of global water problems; role play's, theatre, pantomime, developing a song and else 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 Video contest: Participants groups search, introduce, show and discuss excellent short water videos Why are there excreta in water? Public Health, Awareness Campaigns Seminar: Participants prepare and give 5 min presentations Rehearsal session, Q&A Exam
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 an Rwanda) http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation an Sanitation)



Module M0922: City Plann				
Courses				
Title		Тур	Hrs/wk	CP
Prinicples of City Planning (L1066)		Problem-based Learning	2	3
Street Design (L1067)		Problem-based Learning	2	3
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	for "Principles of Urban Planning": none			
Knowledge	for "Designing Urban Streetscapes": some knowledge of tran Traffic Engineering"	sport planning, e.g. through taking the ur	ndergraduate class "	Transport Planning
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	Students are able to:			
-				
	use technical terms of urban planning.			
	describe the main determinants of urban developmen			
	explain and compare different possibilities of how urb	an 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 d 			
	appraise such concepts in the context of competing re-			
	design, justify and reflect their own solutions for concr	ne examples.		
Personal Competence				
	Students are able to:			
oodal oompotonoo				
	 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 dra 	vings following a broadly pre-defined pro	cess	
	 assess the consequences of their proposed solutions 	angs following a broadly pre-defined pro	0033.	
	 independently acquire knowledge and apply this to ne 	w issues or problem areas		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Project			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Elec	tive Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering:			
	Civil Engineering: Specialisation Coastal Engineering: Electri			
	Logistics, Infrastructure and Mobility: Specialisation Infrastruc			
	Water and Environmental Engineering: Specialisation Water:			
	Water and Environmental Engineering: Specialisation Enviro			
	Water and Environmental Engineering: Specialisation Cities:	Compulsory		



Course L1066: Prinicples of City F	lanning
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
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 project work deals with a real life scenario and includes drawing up a development plan, an urban design concept as well as a building masterplan.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

True	
Тур	Problem-based Learning
Hrs/wk 2	2
CP 3	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer F	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content "	"Designing Urban Streetscapes" covers the various functional and aesthetic requirements for designing streetscape as the most important
e	elements of public space. The class deals with:
	technical and design requirements,
	 the effects of streetscapes on the behaviour of their users,
	 possible measures relating to changes in traffic development.
	For their applied project, students will be required to redesign the streetscape of an actual case study.
Г	For their applied project, suddents will be required to redesign the streetscape of an actual case study.
Literature F	Forschungsgesellschaft für Straßen- und Verkehrswesen (2011) Empfehlungen zur Straßenraumgestaltung innerhalb bebauter Gebiete - ESG.
	FGSV-Verlag. Köln (FGSV, 230).
	Forschungsgesellschaft für Straßen- und Verkehrswesen (2007) Richtlinien für die Anlage von Stadtstraßen – RASt 06. FGSV-Verlag. Köln
((FGSV, 200).



Module M0968: Subsoil ei	ngineering and Numerics			
Courses				
Title		Тур	Hrs/wk	CP
Numerical Methods in Geotechnics (L03	375)	Lecture	3	3
Underground Constructions (L0707)		Problem-based Learning	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Basics in construction and design of reinforced of	concrete structures, Soil Mechanics and Foundation Er	ngineering	
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lec	cture 70		
Credit points	6			
Examination	Oral exam			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engi	ineering: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical E	Engineering: Compulsory		
	Water and Environmental Engineering: Speciali	isation Water: Elective Compulsory		
	Water and Environmental Engineering: Speciali	isation Environment: Elective Compulsory		
	Water and Environmental Engineering: Speciali	sation Cities: Elective Compulsory		

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



Course L0707: Underground Cons	tructions
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
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 in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources
Literature	 Vorlesung/Übung s. www.tu-harburg.de/gbt



urses				
litle		Тур	Hrs/wk	СР
Fransportation Modelling (L1180)		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 Plannin	g and Traffic Engine	ering"
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	llowing learning results		
Professional Competence				
Knowledge	Students are able to understand the operation and potentia	al applications of transport models.		
Skills	Students are able to:			
	 use travel demand modelling software packages fo design a database structure for travel demand mod assess modelling results. appraise potential applications and limitations of su 	els.		
Personal Competence				
	Students are able to independently develop and document solutions.			
Autonomy	Students are able to:			
	• independently organise, manage and solve set task	<s.< td=""><td></td><td></td></s.<>		
	independently prepare written reports.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination				
Examination duration and scale				
Assignment for the Following		ation Systems: Elective Compulsory		
Curricula				
	Water and Environmental Engineering: Specialisation Citie			

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



Courses				
Title		Тур	Hrs/wk	СР
	agement and Hydraulic Engineering (L0963)	Problem-based Learning	2	2
Water Protection and Wastewater Mana		Lecture	2	2
Water Protection and Wastewater Mana		Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements				
Recommended Previous				
Knowledge	 Basic knowledge in water management; 			
	 Good knowledge in urban drainage; 			
	 Good knowledge of wastewater treatment techniques 			
	 Good knowledge of pollutants (e.g. COD, BOD, TS, N 	P) and their properties;		
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	The lang part bubbebbinity, statents have reached the long			
	The students can describe the basic principles of the regu	latory framework related to the internation	nal and European	water sector They o
	explain limnological processes, substance cycles and wa			
	problems. Finally, the students can demonstrate to achieve			
	able to judge environmental and wastewater related issu			
	interventions as well as conceptual problem solving approact		,	
Skills	Students can accurately assess current problems and situ	ations in a country-specific or local cont	ext They can suga	est concrete actions
entite	s Students can accurately assess current problems and situations in a country-specific or local context. They can suggest concrete actions contribute to the planning of tomorrow's urban water cycle. Furthermore, they can suggest appropriate technical, administrative and legislati			
	solutions to solve these problems.			
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare	themselves before presentations and	discussion. They ca	an acquire appropria
	knowledge by making enquiries independently.			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	60 min			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering:			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Environmental Engineering: Specialisation Water: Elective C	ompulsory		
	International Management and Engineering: Specialisation I	. Civil Engineering: Elective Compulsory		
	Joint European Master in Environmental Studies - Cities and	Sustainability: Specialisation Water: Elect	ive Compulsory	
	Water and Environmental Engineering: Specialisation Water	Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	nment: Compulsory		



Course L0963: Geo-Information-Systems in Water Management and Hydraulic Engineering	
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	WiSe
Content	Theoretical basics of Geo-Information-Systems
	 Data models, geographical coordinates, geo-referencing, map-views Data mining and – analyses of geo-data Analysis techniques
Literature	None

Course L0226: Water Protection a	nd Wastewater Management	
Тур	octure	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	EN	
Cycle	WiSe	
	The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips	
Literature	 The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. 	

Course L0227: Water Protection a	Course L0227: Water Protection and Wastewater Management	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Stephan Köster	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0619: Waste Tre	atment Technologies			
Courses				
Title Waste and Environmental Chemistry (LC Biological Waste Treatment (L0318)	328)	Typ Laboratory Course Problem-based Learning	Hrs/wk 2 3	CP 2 4
	Prof. Kerstin Kuchta	Frobient-based Learning	5	4
Module Responsible Admission Requirements	none			
Recommended Previous	chemical and biological basics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The module aims possess knowledge concerning the p layout of anaerobic and aerobic waste treatment plants treatment plants and explain different methods for waste	in detail, describe different techniques for w		
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.			
Personal Competence Social Competence				
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define further steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Project			
Examination duration and scale	Elaboration and presentation (15-25 minutes in groups),	successful participation at Praktikum		
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ring: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: E	Elective Compulsory		
	Energy and Environmental Engineering: Specialisation I	Environmental Engineering: Elective Compu	lsory	
	Environmental Engineering: Core qualification: Compuls	,		
	International Management and Engineering: Specialisat	ion II. Energy and Environmental Engineerin	g: Elective Compulsor	у
	Joint European Master in Environmental Studies - Cities		lective Compulsory	
	Water and Environmental Engineering: Specialisation En			
	Water and Environmental Engineering: Specialisation C	ities: Elective Compulsory		



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

Course L0318: Biological Waste Tr	Course L0318: Biological Waste Treatment	
Тур	Problem-based Learning	
Hrs/wk	3	
CP	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 M0620: Special As	spects of Waste Resource Management			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Topics in Waste Resource M	anagement (L1055)	Problem-based Learning	3	3
International Waste Management (L0317)	Problem-based Learning	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	none			
Recommended Previous	basics in waste treatment technologies			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	The students are able to describe waste as a resource	e as well as advanced technologies for recycli	ng and recovery of	resources from waste in
	detail. This covers collection, transport, treatment and d	isposal in national and international contexts.		
01.11	o			
Skills	Students are able to select suitable processes for the evaluate the ecological impact and the technical effort of			ental context. They can
	evaluate the ecological impact and the technical enorities	or otherent technologies and management syste	ans.	
Personal Competence				
Social Competence	Students can work together as a team of 2-5 persons, participate in subject-specific and interdisciplinary discussions, develop cooperated		ns, develop cooperated	
	solutions and defend their own work results in front of	others and promote the scientific development	nt of colleagues. Fur	thermore, they can give
	and accept professional constructive criticisms.			
Autonomy	Students can independently gain additional knowledge	of the subject area and apply it in solving the	ivon courso tasks a	ad projects
Autonomy	oldenis can independently gain additional knowledge	or the subject area and apply it in solving the g		la projecta.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Project			
Examination duration and scale	PowerPoint presentation (10-15 minutes)			
Assignment for the Following	Environmental Engineering: Specialisation Waste and Energy: Elective Compulsory			
Curricula	Joint European Master in Environmental Studies - Cities	s and Sustainability: Specialisation Energy: Ele	ctive Compulsory	
	Water and Environmental Engineering: Specialisation V	Nater: Elective Compulsory		
	Water and Environmental Engineering: Specialisation E	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation C	Cities: Elective Compulsory		

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



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



Module M0705: Groundwa	iter			
Courses				
Title		Тур	Hrs/wk	CP
Geohydraulic and Solute Transport (L05	339)	Lecture	2	2
Geohydraulic and Solute Transport (L05	540)	Recitation Section (small)	1	1
Simulation in Groundwater Hydrology (L		Lecture	1	1
Simulation in Groundwater Hydrology (L	0542)	Recitation Section (small)	2	2
Module Responsible	Prof. Wilfried Schneider			
Admission Requirements	None			
Recommended Previous Knowledge	Ground water hydrologyHydromechanics			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students are able to describe the fate of solutes in the subsurface along the path between soil and water body quantitatively and qualitatively			
	They are able to do this with simulation models.			
Skills	The students are able to describe conceptually mover	nent and storage of water in the unsaturated z	one. They are able	to analyse pF- function
	and Ku functions. They can model transport of solutes	in the unsaturated and saturated zoned. They	are able to determin	ne dispersiities, sorption
	coefficients, decay rates and dissolution rates for organ	ic and inorganic substances.		
Personal Competence				
Social Competence	The students can help to each other.			
Autonomy	none			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min written exam and written papers			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering	g: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Process Engineering: Specialisation Environmental Pro	ocess Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineer	ing: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Nater: Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

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

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



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

Course L0542: Simulation in Groundwater Hydrology				
Тур	Recitation Section (small)			
Hrs/wk	2			
CP	2			
Workload in Hours	endent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Wilfried Schneider			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			



Admission Requirements Non Recommended Previous Know Knowledge Educational Objectives After Professional Competence	12) of. Mathias Ernst ne owledge of water management and the key processes involved in v er taking part successfully, students have reached the following lear idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	rning results nent, as well as their mutual depen Students will be able to explain ar						
istry of Drinking Water Treatment (L031) istry of Drinking Water Treatment (L031) Resource Management (L0402) Resource Management (L0403) Module Responsible Prof Admission Requirements Non Recommended Previous Know Knowledge Educational Objectives After Professional Competence	12) of. Mathias Ernst ne owledge of water management and the key processes involved in v er taking part successfully, students have reached the following lear idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	Lecture Recitation Section (large) Lecture Recitation Section (small) vater treatment. rning results ment, as well as their mutual depen Students will be able to explain an	2 1 2 1	1 2 2 1 able water supply. They				
istry of Drinking Water Treatment (L031) Resource Management (L0402) Resource Management (L0403) Module Responsible Prof. Admission Requirements Non Recommended Previous Know Knowledge Educational Objectives After Professional Competence	12) of. Mathias Ernst ne owledge of water management and the key processes involved in v er taking part successfully, students have reached the following lear idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	Lecture Recitation Section (large) Lecture Recitation Section (small) vater treatment. rning results ment, as well as their mutual depen Students will be able to explain an	2 1 2 1	1 2 2 1 able water supply. They				
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Resource Management (L0403) Module Responsible Prof. Admission Requirements Non Recommended Previous Know Knowledge After Professional Competence Recommended Previous	ne owledge of water management and the key processes involved in v er taking part successfully, students have reached the following lear idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	vater treatment. rning results nent, as well as their mutual depen Students will be able to explain an	idence for sustain	able water supply. They				
Admission Requirements Non Recommended Previous Know Knowledge Educational Objectives After Professional Competence	ne owledge of water management and the key processes involved in v er taking part successfully, students have reached the following lear idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	rning results nent, as well as their mutual depen Students will be able to explain ar						
Recommended Previous Know Knowledge Educational Objectives After Professional Competence	owledge of water management and the key processes involved in v er taking part successfully, students have reached the following lear idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	rning results nent, as well as their mutual depen Students will be able to explain ar						
Knowledge Educational Objectives After Professional Competence	er taking part successfully, students have reached the following lear udents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	rning results nent, as well as their mutual depen Students will be able to explain ar						
Educational Objectives After Professional Competence	idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	nent, as well as their mutual depen Students will be able to explain an						
Professional Competence	idents will be able to outline key areas of conflict in water manager I understand relevant economic, environmental and social factors.	nent, as well as their mutual depen Students will be able to explain an						
	I understand relevant economic, environmental and social factors.	Students will be able to explain an						
	I understand relevant economic, environmental and social factors.	Students will be able to explain an						
Knowledge Stud			nd outline the org	anisational structures of				
will	ter companies. They will be able to explain the available water treat	tment processes and the scope of t		will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of				
wate	water companies. They will be able to explain the available water treatment processes and the scope of their application.							
<i>Skills</i> Stud	idents will be able to assess complex problems in drinking water pr	roduction and establish solutions in	volving water mai	nagement and technical				
	Is Students will be able to assess complex problems in drinking water production and establish solutions involving water management and techni 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							
	selected treatment processes and apply generally accepted technical rules and standards to these processes.							
Personal Competence								
Social Competence World	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the management and treatment o							
	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 Stud	Students will be in a position to work on a subject independently and present on this subject.							
Workload in Hours Inde	Independent Study Time 96, Study Time in Lecture 84							
Credit points 6								
Examination Writt	Written exam							
amination duration and scale 60 m	min (chemistry) + presentation							
Assignment for the Following Civil	vil Engineering: Specialisation Structural Engineering: Elective Com	npulsory						
Curricula Civil	vil Engineering: Specialisation Geotechnical Engineering: Elective C	Compulsory						
Civil	vil Engineering: Specialisation Coastal Engineering: Elective Comp	ulsory						
Ene	ergy and Environmental Engineering: Specialisation Energy and Er	nvironmental Engineering: Elective	Compulsory					
Inter	ernational Management and Engineering: Specialisation II. Energy	and Environmental Engineering: El	lective Compulsor	у				
Wate	ater and Environmental Engineering: Specialisation Water: Compute	sory						
Wat	ater and Environmental Engineering: Specialisation Environment: E	lective Compulsory						
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory							

Course L0311: Chemistry of Drinking Water Treatment				
Тур	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 DIN-standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course "Water resources management" in the beginning of the semester.			
Literature	MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung – Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.			



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

Course L0402: Water Resource M	anagement					
Тур	ture					
Hrs/wk	2					
CP						
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28					
Lecturer	Prof. Mathias Ernst					
Language	E					
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	
CP	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 M0802: Membrane	e Technology						
Courses							
Title		Тур	Hrs/wk	CP			
Membrane Technology (L0399)		Lecture	2	3			
Membrane Technology (L0400)		Recitation Section (small)	1	2			
Membrane Technology (L0401)	Laboratory Course 1 1						
Module Responsible	Prof. Mathias Ernst						
Admission Requirements	None	None					
Recommended Previous	Basic knowledge of water chemistry. Knowledge of the core processes involved in water, gas and steam treatment						
Knowledge							
Educational Objectives	After taking part successfully, students have reached the following	ng learning results					
Professional Competence							
Knowledge	Students will be able to rank the technical applications of indu	strially important membrane process	es. They will be able	to explain the different			
	driving forces behind existing membrane separation processes	s. Students will be able to name ma	terials used in memb	orane filtration and their			
	advantages and disadvantages. Students will be able to explain	n the key differences in the use of me	embranes in water, ot	her liquid media, gases			
	and in liquid/gas mixtures.						
Chille	Chudente will be able to prepare methometical equations for a	esterial transport in paraus and cal	tion diffusion mombr	anaa and aalaulata kau			
Skills	Students will be able to prepare mathematical equations for n						
	parameters in the membrane separation process. They will be able to handle technical membrane processes using available bound						
	provide recommendations for the sequence of different treatment processes. Through their own experiments, students will be able to classify the separation efficiency, filtration characteristics and application of different membrane materials. Students will be able to characterise the formation						
			ents will be able to ch	aracterise the formation			
	of the fouling layer in different waters and apply technical measu	ires 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 able to make decisions within their group						
	on laboratory experiments to be undertaken jointly and present these to others.						
Autonomi	Or dente will be in a position to calve homewark on the tenio	of mombrono toobaalaari indonondo	nthy They will be see	able of finding exective			
Autonomy		or memorane technology independe	nuy. They will be cap	bable of linding creative			
	solutions to technical questions.						
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56						
Credit points	6						
Examination	Written exam						
Examination duration and scale	90 min						
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess	• • • • •					
Curricula	Bioprocess Engineering: Specialisation B - Industrial Bioprocess						
	Chemical and Bioprocess Engineering: Specialisation Chemica						
	Chemical and Bioprocess Engineering: Specialisation General I						
	Energy and Environmental Engineering: Specialisation Energy a		tive Compulsory				
	Environmental Engineering: Specialisation Water: Elective Com						
	Joint European Master in Environmental Studies - Cities and Su		ctive Compulsory				
	Process Engineering: Specialisation Environmental Process Eng						
	Process Engineering: Specialisation Process Engineering: Elect						
	Water and Environmental Engineering: Specialisation Water: Ele						
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory						
	Water and Environmental Engineering: Specialisation Cities: Ele	ective Compulsory					



Course L0399: Membrane Techno	logy
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
	The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane 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 Technology					
Тур	Recitation Section (small)				
Hrs/wk	1				
CP					
Workload in Hours	ependent Study Time 46, Study Time in Lecture 14				
Course work	Students can voluntarily hand in solutions to exercises. They can gather extra points with the handed-in solutions. The students are given m				
	detailed information at the beginning of the course.				
Lecturer	Prof. Mathias Ernst				
Language	EN				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Course L0401: Membrane Technology				
Тур	Laboratory Course			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Course work	ompulsory report: Students hand in a report about the carried out experiments.			
Lecturer	Prof. Mathias Ernst			
Language	EN			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			



Module M0822: Process Modeling in Water Technology							
Courses							
Title			Тур	Hrs/wk	СР		
Process Modelling of Wastewater Treatment (L0522)			Problem-based Learning	2	3		
Process Modeling in Drinking Water Treatment (L0314)			Problem-based Learning	2	3		
Module Responsible	Dr. Klaus Johannsen						
Admission Requirements	none						
Recommended Previous	Knowledge of the most important processes in d	rinking water and waste	water treatment.				
Knowledge							
Educational Objectives	After taking part successfully, students have read	ched the following learni	ng results				
Professional Competence							
Knowledge	Students are able to explain selected processes of drinking water and waste water treatment in detail. They are able to explain basics as well as possibilities and limitations of dynamic modeling.						
Skills	Students are able to use the most important features Modelica offers. They are able to transpose selected processes in drinking water and was water treatment into a mathematical model in Modelica with respect to equilibrium, kinetics and mass balances. They are able to set up and app models and assess their possibilities and limitations.						
Personal Competence							
Social Competence	Students are able to solve problems and document solutions in a group with members of different technical background. They are able to gi appropriate feedback and can work constructively with feedback concerning their work.				. They are able to giv		
Autonomy	Students are able to define a problem, gain the required knowledge and set up a model.						
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56					
Credit points	6						
Examination	Written exam						
Examination duration and scale	1,5 hours						
Assignment for the Following	Environmental Engineering: Specialisation Wate	er: Elective Compulsory					
Curricula	Joint European Master in Environmental Studies		ity: Specialisation Water: Ele	ctive Compulsory			
	Water and Environmental Engineering: Specialis	sation Water: Elective Co	ompulsory				
	Water and Environmental Engineering: Specialis	sation Environment: Elec	tive Compulsory				
	Water and Environmental Engineering: Specialis	sation Cities: Elective Co	ompulsory				



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



Course L0314: Process Modeling	in Drinking Water Treatment
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE/EN
Cycle	WiSe
Content	In this course selected drinking water treatment processes (e.g. aeration or activated carbon adsorption) are modeled dynamically using the programming language Modelica, that is increasingly used in industry. In this course OpenModelica is used, an free access frontend of the programming language Modelica. In the beginning of the course the use of OpenModelica is explainded by means of simple examples. Together required elements and structure of the model are developed. The implementation in OpenModelica and the application of the model is done individually or in groups respectively. Students get feedback and can gain extra points for the exam.
Literature	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.

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Module M0847: Analytical	Methods and Treatment Technologies	for Wastewaters		
Courses				
Title		Тур	Hrs/wk	СР
Low-Cost Procedures for Water and Wa	stewater Analysis (L0505)	Lecture	2	3
Physico-Chemical Water Treatment (L0	482)	Lecture	2	3
Module Responsible	Dr. Holger Gulyas			
Admission Requirements	none			
Recommended Previous	Fundamental knowledge in chemistry and physics (kn	nowledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students know some non-biological processes for the treatment of water and wastewater as well as the fundamentals of mass transfer which is essential for many treatment processes. They have knowledge about analytical procedures which can be applied even without the availability of a laboratory and which are useful for evaluating the performance of (waste)water treatment processes and the assessment of surface water quality in an economically feasible way.			
Skills	The students are able to select suitable processes for the treatment of wastewaters with respect to their characteristics. They can evaluate the efforts and costs for analytical procedures for the characterization of waters/wastewaters and select economically feasible analytical procedures.			
Personal Competence				
Social Competence	The students have the competence to plan and to perform wastewater analyses together with colleagues in small groups and to efficientl distribute the respective tasks within the group.			
Autonomy	The students are capable to make their own decisions with respect to the selection of suitable water/wastewater treatment processes as well as economically feasible analytical procedures for water/wastewater characterization.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture S	56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General E	Bioprocess Engineering: Elective Compulsor	У	
Curricula	Energy and Environmental Engineering: Specialisation	on Energy and Environmental Engineering:	Elective Compulsory	
	Environmental Engineering: Specialisation Water: Ele	ective Compulsory		
	Joint European Master in Environmental Studies - Cit	ies and Sustainability: Specialisation Water:	Elective Compulsory	
	Process Engineering: Specialisation Environmental F	Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engine	ering: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	n Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	n Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	n Cities: Elective Compulsory		



Course L0505: Low-Cost Procedu	res for Water and Wastewater Analysis	
Тур	Lecture	
Hrs/wk		
CP Workload in Hours	3 Independent Study Time 62, Study Time in Lecture 28	
	NN	
Language		
Cycle		
Content	1 Introduction	
	2 Costing of wastewater and water analyses	
	3 Parameters routinely measured in municipal wastewater effluents	
	4 Surrogate parameters	
	5 Field methods	
	6 Basic laboratory instruments and equipment	
	6.1 Balances	
	6.2 Volumetric dosing instruments	
	6.3 Photometer	
	6.3.1 General	
	6.3.2 Principle of photometry	
	6.3.3 Elements of a photometer	
	6.4 Deionised water supply	
	6.5 Safety equipment	
	7 Inorganic parameters	
	7.1 Inorganic parameters by probes/electrodes	
	7.1.1 Dissolved oxygen	
	7.1.1.1 Polarographic measurement of dissolved oxygen	
	7.1.1.2 Optical probe for measuring dissolved oxygen utilising luminescence quenching of oxygen	
	7.1.1.3 Titrimetric determination of dissolved oxygen	
	7.1.2 pH	
	7.1.3 Alkalinity	
	7.1.4 Electric conductivity/salinity	
	7.2 Nitrogen and phosphorus compounds (nutrients)	
	7.2.1 Colorimetric methods without expensive instruments	
	7.2.2 Reflectometric methods	
	7.2.3 Photometric methods	
	8 Particles in water and wastewater	
	9 Organic sum parameters	
	9.1 Overview	
	9.2 Chemical Oxygen Demand: Why to avoid COD analyses by the dichromate method?	
	9.3 TOC cuvette tests	
	9.4 Absorption of UV light (254 nm) as a surrogate parameter for COD	
	9.5 Volatile Solids as surrogate for COD	
	9.6 Biological oxygen demand	
	10 Microbiological parameters determined in a low-cost way	
	11 Toxicity toward activated sludge	
Literature	Skript auf StudIP	
Enterature		



ourse L0482: Physico-Chemical	Water Treatment
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	EN
Cycle	WiSe
Content	- Stripping
	- Evaporation
	- Wastewater Incineration
	- Wet Air Oxidation
	- Ozonation
	- Advanced Oxidation Processes
Literature	Physical-Chemical Treatment of Water and Wastewater, A.P. Sincero, G.A. Sincero, CRC Press, Boca Raton 2003;
	Handbook of Separation Techniques for Chemical Engineers, P.A. Schweitzer, ed., McGraw-Hill, New York 1988
	Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney, eds., McGraw-Hill, New York 1984
	Chemical Engineering, Vol. 2, J.M. Coulson, J.F. Richardson, Pergamon Press, Oxford 1991
	Ozone in Water Treatment, B. Langlais, D.A. Reckhow, D.R. Brink, eds., Lewis Publishers, Chelsea 1991
	- Wet Air Oxidation - Ozonation - Ozonation - Advanced Oxidation Processes Physical-Chemical Treatment of Water and Wastewater, A.P. Sincero, G.A. Sincero, CRC Press, Boca Raton 2003; Handbook of Separation Techniques for Chemical Engineers, P.A. Schweitzer, ed., McGraw-Hill, New York 1988 Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney, eds., McGraw-Hill, New York 1984 Chemical Engineering, Vol. 2, J.M. Coulson, J.F. Richardson, Pergamon Press, Oxford 1991



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Courses				
Title		Тур	Hrs/wk	CP
Practical Course in Water and Wastewa		Laboratory Course	2	3
Practicle Course of Wastewater Techno	5, (),	Laboratory Course	3	3
Module Responsible				
Admission Requirements	none			
Recommended Previous	Basic knowledge in chemistry and physics (knowledge)	owledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students know basic analytical procedures for evaluating the quality of water and wastewater. They have knowledge about fundamenta			
	process engineering features of important water and wastewater treatment technologies.			
Skills	ills The students are able to understand and to practically apply methodologies for wastewater analysis as well as descriptions of experimer		ons of experiments a	
	experimental setups in wastewater technology.			
Personal Competence				
Social Competence				
Autonomy	The students are able to conduct experiments following written procedures without external assistance.			
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	ca. 5 Stunden			
Assignment for the Following	Water and Environmental Engineering: Specia	lisation Water: Elective Compulsory		
Curricula	Water and Environmental Engineering: Specia	lisation Environment: Elective Compulsory		

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

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



Module M0949: Rural Dev	elopment and Sanitation for differe	nt Climate Zones		
Courses				
Title		Тур	Hrs/wk	CP
Rural Development in Different Climates	(L0941)	Lecture	2	2
Resources Oriented Sanitation: High and	d Low-Tech Options (L0942)	Lecture	2	3
Resources Oriented Sanitation: High - a	nd Low - Tech Options (L0504)	Laboratory Course	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with risi	ng poverty, soil degradation, lack of water resourc	es and sanitation	
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students can describe resources oriented wa	stewater systems mainly based on source cont	trol in detail. They can c	comment on techniqu
·	designed for reuse of water, nutrients and soil c	onditioners.		
	Students are able to discuss a wide range of pro	oven approaches in Rural Development from and	for many regions of the w	orld.
Skillo	Students are able to design law tech/law cost	sanitation, rural water supply, rainwater harvestir	na ovotomo, monouros for	the rehabilitation of t
- China		curity. Students can consult on the basics of soi		
	developed by Allan Savory.	unty. Students can consult on the basics of sol	r building through Thonsi	to Trainieu Grazing
	developed by Alian Savory.			
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject a	nd to organize their work flow independently. The	ey can also present on this	s subject.
Workload in Hours	Independent Study Time 110, Study Time in Lea	cture 70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	During the course of the semester, the students	work towards five mile stones. The work include	s presentations and pape	ers. Detailed informati
	can be found at the beginning of the smester in			
Assignment for the Following		eral Bioprocess Engineering: Elective Compulsor	v	
Curricula		isation General Process Engineering: Elective Co		
0.1.100.10		lisation Energy and Environmental Engineering:		
	Environmental Engineering: Specialisation Wat			
	• • •	ecialisation II. Energy and Environmental Engine	ering: Elective Compulsor	- V
		s - Cities and Sustainability: Specialisation Water:	•	у
	Process Engineering: Specialisation Environme			
	Process Engineering: Specialisation Process En			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali	sation Cities: Elective Compulsory		



Course L0941: Rural Development	t in Different Climates
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Literature	 Small Breakout Groups on "Rural Development" and presentation of results Living Soil – THE key element of Rural Development Permaculture Principles of Rural Development Case Studies: Global Ecovillage Network, Complementary Currencies Going Further: The TUHH Toolbox for Rural Development Rainwater Harvesting, Participatory planning principles Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos EMAS Technologies, Hand-Pump and wells Practical Pump/Well-Building Seminar: Participants prepare and give short 5 min presentations "Best Practice cases in Rural Development" In Depth: Rural Drinking Water Supply (Dr. Bendinger) cont. Rural Drinking Water Supply (Dr. Bendinger) Exam
Literature	 Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation: http://youtu.be/9hmkgn0nBgk Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press

Course L0942: Resources Oriente	d Sanitation: High and Low-Tech Options		
Тур	Lecture		
Hrs/wk			
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	WiSe		
Literature	 Small Breakout Groups on "The horrific global situation in Sanitation " and presentation of results Keynote lecture: Resources Oriented Sanitation around the World Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos In Depth: Terra Preta Sanitation, an emerging concept based on historic global best practice in the Amazon Region Seminar: All participants prepare and give 10 min presentations (choice of topics) cont. cont. cont. Rehearsal and final panel discussion Exam 		
Literature	 J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek) Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download) Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys 		



Course L0504: Resources Oriente	ed Sanitation: High - and Low - Tech Options
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	Practical course: Preparation and execution of four experiments and written report about the experiments.
Lecturer	Dr. Holger Gulyas
Language	EN
Cycle	WiSe
Content	- Construction of urine-diverting toilets
	- Comparison of stored and fresh urine: ammonia concentration
	- Comparison of stored and fresh urine: alkalinity
Literature	Skript
	Steven A. Esrey, Jean Gough, Dave Rapaport, Ron Sawyer, Mayling Simpson-Hébert, Jorge Vargas and Uno Winblad: Ecological Sanitation, SIDA, Stockholm 1998, http://www.ecosanres.org/pdf_files/Ecological_Sanitation.pdf



Cours	es				
itle			Тур	Hrs/wk	CP
	Module Responsible	Dozenten des SD B			
	Admission Requirements	none			
	Recommended Previous Knowledge	 Basics of Urban Planning Urban Infrastructures (Water, Energy, Heat) Environmental Technologies (Solid Waste Disposal, 	Air Quality Control, Wastewater Tre	atement, etc.)	
	Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
	Professional Competence Knowledge The students are able to demonstrate their detailed knowledge in the field of Water and Environmental Engineering. They can exemplify the 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 and Environmental Engineering.			society. ter and Environment	
		Engineering. They may apply theory based procedures and society. Scientific work techniques that are used can be described a		I, ethical, and economic view	<i>i</i> points of science ar
	Skills	The students are able to independently select methods or how these methods or approaches relate to solutions in the and further developments may essentially be outlined.	• • • • • • •		
	Personal Competence Social Competence	The students are able to condense the relevance and the s and discussion in front of a bigger group. They can lead the			
	Autonomy	The students are capable of independently planning and do includes the ability to accurately procure the newest scient progress of the work, and to accomplish results on the state	fic information. Furthermore, they c	an obtain feedback from exp	-
	Workload in Hours	Independent Study Time 180, Study Time in Lecture 0			
	Credit points	6			
	Examination	Project (accord. to Subject Specific Regulations)			
Exan	nination duration and scale				
As	signment for the Following	Water and Environmental Engineering: Specialisation Cities	: Compulsory		
	Curricula				



ses				
•		Тур	Hrs/wk	СР
ration of Public Transportation System	ems (L1179)	Problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	some knowledge of transport planning, e.g. through	n taking the undergraduate class "Transport Plannin	g and Traffic Engine	ering"
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	Students are able to:			
	 describe public transport (PT) systems in te 	chnical language.		
	outline the entire PT system including the in			
	explain the requirements for a PT system from	om different perspectives.		
	explain the role of PT in the transport syster	n.		
Skills	Students are able to:			
	 systematically develop a public transport sy 	stem when there are no clear cut correct or incorrec	tapproaches.	
	cope with imprecise and incomplete data.			
	 develop and appraise alternative solutions. 			
	 distinguish or develop appropriate methods 	of analysis and modes of presentation.		
	 reflect and evaluate their own transport con 	cept, considering competing requirements.		
Personal Competence				
Social Competence	Students are able to:			
	 carry out and complete a group project, incl 	usive of an appropriate allocation of tasks.		
	 constructively provide and accept feedback 			
	 present their own results to others. 			
Autonomy	 independently develop a bus PT concept w 	ithin a given framework.		
	• determine and justify the focus of their work			
	 organize and follow their work process regardered 	arding time and content.		
	• independently author a written report.			
	 assess the consequences of the solutions the solutions to the solutions to the solution of the so	ney develop.		
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points	6			
Examination	Project			
xamination duration and scale				
Assignment for the Following	Logistics, Infrastructure and Mobility: Core qualification	tion: Compulsory		
Curricula	Water and Environmental Engineering: Specialisat	ion Cities: Elective Compulsory		



Course L1179: Operation of Public	Transportation Systems
Тур	Problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	WiSe
Content	The course primarily deals with the planning and operational challenges of public transport systems. A bus-system is the example for studying these problems in depth. The following topics and systemic elements are covered:
	 PT network planning timetabling operational concepts requirements for vehicle technology and operation infrastructural requirements inter- and multimodal connections financing and competition organisational structures The topics are discussed with guests lecturers from the public transport sector and are considered in practice during an excursion.
Literature	Verband Deutscher Verkehrsunternehmen / VDV-Förderkreis (Hrsg.) (2010) Nachhaltiger Nahverkehr. Köln. (2 Bände) Wuppertal Institut (2009) Handbuch zur Planung flexibler Bedienungsformen im ÖPNV : ein Beitrag zur Sicherung der Daseinsvorsorge in nachfrageschwachen Räumen. Bundesministerium für Verkehr, Bau und Stadtentwicklung / Bundesinstitut für Bau-, Stadt- und Raumforschung Bonn. Forschungsgesellschaft für Straßen- und Verkehrswesen (2009) HVÖ - Hinweise für den Entwurf von Verknüpfungsanlagen des öffentlicher Personennahverkehrs. FGSV Verlag. Köln. Kirchhoff, Peter (2002) Städtische Verkehrsplanung – Konzepte, Verfahren, Maßnahmen. Vieweg+Teubner Verlag. Wiesbaden. Kirchhoff, Peter & Tsakarestos, Antonius (2007) Planung des ÖPNV in ländlichen Räumen, Ziele – Entwurf- Realisierung. Vieweg+Teubner Verlag. Wiesbaden Forschungsgesellschaft für Straßen- und Verkehrswesen (2008) Richtlinien für integrierte Netzgestaltung: RIN. FGSV-Verlag. Köln.



Specialization Environment

Module M0581: Water Pro	tection			
Courses				
Title		Тур	Hrs/wk	СР
	agement and Hydraulic Engineering (L0963)	Problem-based Learning	2	2
Water Protection and Wastewater Manag		Lecture	2	2
Water Protection and Wastewater Manag	gement (L0227)	Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous				
Knowledge	 Basic knowledge in water management; 			
	Good knowledge in urban drainage;			
	Good knowledge of wastewater treatment techniques;			
	 Good knowledge of pollutants (e.g. COD, BOD, TS, N, P) a 	nd their properties;		
-	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students can describe the basic principles of the regulator			
	explain limnological processes, substance cycles and water m			
	problems. Finally, the students can demonstrate to achieve signif			
	able to judge environmental and wastewater related issues an	nd to widely consider innovative so	olutions, remediation	measures and further
	interventions as well as conceptual problem solving approaches.			
			_	
Skills	Students can accurately assess current problems and situation			
	contribute to the planning of tomorrow's urban water cycle. Furt	nermore, they can suggest appropri	ate technical, admin	istrative and legislative
	solutions to solve these problems.			
Personal Competence				
	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare the	mselves before presentations and	discussion. They ca	an acquire appropriate
	knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
	Written exam			
Examination duration and scale	60 min Civil Engineering: Specialisation Structural Engineering: Elective	Compulson		
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Civil Engineering: Specialisation Geotechnical Engineering: Elective			
Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective C			
	Environmental Engineering: Specialisation Water: Elective Comp			
	International Management and Engineering: Specialisation II. Civ			
	Joint European Master in Environmental Studies - Cities and Sust		tive Compulsory	
			uve Compulsory	
	Water and Environmental Engineering: Specialisation Water: Con			
	Water and Environmental Engineering: Specialisation Environme			
	Water and Environmental Engineering: Specialisation Cities: Elec			



ourse L0963: Geo-Information-Systems in Water Management and Hydraulic Engineering		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE/EN	
Cycle	WiSe	
Content	Theoretical basics of Geo-Information-Systems	
	 Data models, geographical coordinates, geo-referencing, map-views Data mining and – analyses of geo-data Analysis techniques 	
Literature	None	

Course L0226: Water Protection a	Course L0226: Water Protection and Wastewater Management			
Тур	cture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	NN			
Language	EN			
Cycle	WiSe			
	 The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips 			
Literature	 The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. 			

Course L0227: Water Protection a	Course L0227: Water Protection and Wastewater Management		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Stephan Köster		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0830: Environmental Protection and Management				
Courses				
Title		Тур	Hrs/wk	CP
Integrated Pollution Control (L0502)		Lecture	2	2
Health, Safety and Environmental Manag	gement (L0387)	Lecture	2	3
Health, Safety and Environmental Manag	gement (L0388)	Recitation Section (small)	1	1
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous				
Knowledge	Environmental Technologies			
	Environmental Legislation			
	Environmental Assessment			
Educational Objectives	After taking part arrange fills, at sharts barra year bod the falls.			
Educational Objectives Professional Competence	After taking part successfully, students have reached the follow	wing iedining iesuits		
Knowledge	The students are able to describe the basics of regulations	s economic instruments voluntary initia	tives fundamentals	of HSE legislation ISC
Nilowiedge	14001, EMAS and Responsible Care ISO 14001 require			-
	and approaches from end-of-pipe technology to eco-efficienc			
	problems. They are able to judge environmental issues and		-	
	measures and further interventions as well as conceptual prol			
Skills	Students are able to assess current problems and situatio	ns in the field of environmental protect	tion They can cons	ider the best available
chine -	techniques and to plan and suggest concrete actions in a			
	technical, administrative and legislative level.	sompany of station opcome context. By	and mound andy de	
Personal Competence				
Social Competence	The students can work together in international groups.			
eesial eempeteriee				
Autonomy	Students are able to organize their work flow to prepare the	emselves for presentations and contribu	itions to the discuss	ions They can acquire
Autonomy	appropriate knowledge by making enquiries independently.			ions. mey oan acquire
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Energy and Environmental Engineering: Specialisation Enviro	onmental Engineering: Elective Compute	ory	
Assignment for the Following Curricula	Environmental Engineering: Core qualification: Compulsory	annentai Engineening. Elective Compuis	ory	
Gurricula	International Production Management: Specialisation Manage	ament: Elective Compulsory		
	Joint European Master in Environmental Studies - Cities and		tive Compulsory	
	Joint European Master in Environmental Studies - Cities and			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	Product Development, Materials and Production: Specialisation			
	· ····································			
	Water and Environmental Engineering: Specialisation Enviror			



Course L0502: Integrated Pollution	n Control
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stephan Köster
Language	EN
Cycle	WiSe
Content	The lecture focusses on:
	 The Regulatory Framework Pollution & Impacts, Characteristics of Pollutants Approaches of Integrated Pollution Control Sevilla Process, Best Available Technologies & BREF Documents Case Studies: paper industry, cement industry, automotive industry Field Trip
Literature	

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

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



Module M0902: Wasterwa	er Treatment and Air Pollution Abatement			
Courses				
Title		Tue	Hrs/wk	CP
Biological Wastewater Treatment (L0517		Typ Lecture	НГS/WK 2	3
Air Pollution Abatement (L0203)	}	Lecture	2	3
Module Responsible	Dr. Ernst-Ulrich Hartge		_	-
Admission Requirements				
Recommended Previous	Basic knowledge of biology and chemistry			
Knowledge	basic knowledge of solids process engineering and separati	on technology		
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	After successful completion of the module students are able	0		
	 name and explain biological processes for waste wa 	ter treatment.		
	 characterize waste water and sewage sludge 	name and explain biological processes for waste water treatment, characterize waste water and sewage sludge		
	 discuss legal regulations in the area of emissions and 	d air quality		
	 classify off gas tretament processes and to define their area of application 			
Chille				
SKIIIS	Students are able to			
	choose and design processs steps for the biological waste water treatment			
	combine processes for cleaning of off-gases dependence	ng on the pollutants contained in th	e gases	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioproce	ess Engineering: Elective Compulse	ory	
Curricula	Chemical and Bioprocess Engineering: Specialisation Gene	ral Process Engineering: Elective C	ompulsory	
	Energy and Environmental Engineering: Specialisation Envi	ronmental Engineering: Elective Co	ompulsory	
	Environmental Engineering: Specialisation Waste and Energy	y: Elective Compulsory		
	International Management and Engineering: Specialisation I	I. Energy and Environmental Engin	eering: Elective Compulsor	/
	Joint European Master in Environmental Studies - Cities and	Sustainability: Specialisation Wate	r: Elective Compulsory	
	Process Engineering: Specialisation Environmental Process	Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineering : I	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water			
	Water and Environmental Engineering: Specialisation Enviro			
	Water and Environmental Engineering: Specialisation Cities	Compulsory		

Course L0517: Biological Wastewater Treatment			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Joachim Behrendt		
Language	DE/EN		
Cycle	WiSe		
Content	Charaterisation of Wastewater		
	Metobolism of Microorganisms		
	Kinetic of mirobiotic processes		
	Calculation of bioreactor for wastewater treatment		
	Concepts of Wastewater treatment		
	Design of WWTP		
	Excursion to a WWTP		
	Biofilms		
	Biofim Reactors		
	Anaerobic Wastewater and sldge treatment		
	resources oriented sanitation technology		
	Future challenges of wastewater treatment		
Literature	Gujer, Willi		
	Siedlungswasserwirtschaft : mit 84 Tabellen		
	ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv?		
	id=2842122&prov=M&dok_var=1&dok_ext=htm		



Berlin [u.a.] : Springer, 2007
TUB_HH_Katalog
Henze, Mogens
Wastewater treatment : biological and chemical processes
ISBN: 3540422285 (Pp.)
Berlin [u.a.] : Springer, 2002
TUB_HH_Katalog
Imhoff, Karl (Imhoff, Klaus R.;)
Taschenbuch der Stadtentwässerung : mit 10 Tafeln
ISBN: 3486263331 ((Gb.))
München [u.a.] : Oldenbourg, 1999
TUB_HH_Katalog
Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;)
Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft
ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334
Donaueschingen-Pfohren : Mall-Beton-Verl., 2000
TUB_HH_Katalog
Mudrack, Klaus (Kunst, Sabine;)
Biologie der Abwasserreinigung : 18 Tabellen
ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903
Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003
TUB_HH_Katalog
Tchobanoglous, George (Metcalf & Eddy, Inc., ;)
Wastewater engineering : treatment and reuse
ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk))
Boston [u.a.] : McGraw-Hill, 2003
TUB_HH_Katalog
Henze, Mogens
Activated sludge models ASM1, ASM2, ASM2d and ASM3
ISBN: 1900222248
London : IWA Publ., 2002
TUB_HH_Katalog
Kunz, Peter
Umwelt-Bioverfahrenstechnik
Vieweg, 1992
Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für Wasserwirtschaft, Abwas
und Abfall, ;)
Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe aus
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
10514.0527012100 (00.) 0112.110 / 1000000 (00.000000000000000000000000000
Wainhaim WILEY VCH 2007
Weinheim : WILEY-VCH, 2007 TUB_HH_Katalog



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



Courses				
Title		Тур	Hrs/wk	СР
Renewable Energy Projects in Emerged	Markets (L0014)	Project Seminar	1	1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use – Focus Offshore (L0		Lecture	1	1
Module Responsible				
Admission Requirements	none			
Recommended Previous	Thermodynamics, Fluid Mechanics, Fundame	ntals of Fluid Flow Engines		
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	By ending this module students can explain i	n detail knowledge of wind turbines with a particular	focus of wind energy u	se in offshore condition
	and can critical comment these aspects in con	nsideration of current developments. Furthermore, the	ey are able to describe	fundamentally the use
	water power to generate electricity. The stude	ents reproduce and explain the basic procedure in th	e implementation of re-	newable energy proje
	in countries outside Europe.			
Skille	Students are able to apply the acquired the	retical foundations on exemplary water or wind power	or systems and ovaluat	o and accoss toobnic
Skiils		dimensioning and operation of these energy syste		
	•	le energy projects in countries outside Europe with t		
			ne in principle applied	
	can apply this procedure on exemplary theore	aicai piojecis.		
Personal Competence				
Social Competence	Studente con dicques scientific tasks subjet s	pecificly and multidisciplinary within a seminar.		
Social Competence	Sudents can discuss scientific tasks subjet-s	pechiciy and multidisciplinary within a seminar.		
Autonomy	Students can independently exploit sources in	n the context of the emphasis of the lecture material to	a clear the contents of t	he lecture and to acqu
Autonomy				ne lecture and to acqu
	the particular knowledge about the subject and	ea.		
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	Civil Engineering: Specialisation Structural En	ngineering: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnica	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	ineering: Elective Compulsory		
	Energy and Environmental Engineering: Spec	cialisation Energy Engineering: Elective Compulsory		
	International Management and Engineering:	Specialisation II. Renewable Energy: Elective Compu	Isory	
	International Management and Engineering:	Specialisation II. Energy and Environmental Engineer	ing: Elective Compulso	ry
	• • •	on: Specialisation Product Development: Elective Co	•	
		on: Specialisation Production: Elective Compulsory		
		on: Specialisation Materials: Elective Compulsory		
	Renewable Energies: Core qualification: Con			
	Water and Environmental Engineering: Speci			
	Water and Environmental Engineering: Speci			



Course L0014: Renewable Energy	Projects in Emerged Markets	
Тур	Project Seminar	
Hrs/wk	1	
CP		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Andreas Wiese	
Language	DE	
Cycle	SoSe	
Content		
	1. Introduction	
	 Development of renewable energies worldwide 	
	History	
	Future markets	
	 Special challenges in new markets - Overview 	
	2. Sample project wind farm Korea	
	• Survey	
	Technical Description	
	 Project phases and characteristics 	
	3. Funding and financing instruments for EE projects in new markets	
	Overview funding opportunitie	
	Overview countries with feed-in laws	
	Major funding programs	
	4. CDM projects - why, how , examples	
	Overview CDM process	
	◦ Examples	
	• Exercise CDM	
	5. Rural electrification and hybrid systems - an important future market for EE	
	Rural Electrification - Introduction	
	 Types of Elektrizifierungsprojekten 	
	The role of the EEInterpretation of hybrid systems	
	 Project example: hybrid system Galapagos Islands 	
	6. Tendering process for EE projects - examples	
	South Africa	
	• Brazil	
	 Selected projects from the perspective of a development bank - Wesley Urena Vargas, KfW Development Bank 	
	• Geothermal	
	Wind or CSP	
Literature	Folien der Vorlesung	

Тур	Lecture	
Hrs/wk		
CP		
-		
	Independent Study Time 16, Study Time in Lecture 14	
	Dr. Stephan Heimerl	
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 Plant	ourse L0011: Wind Turbine Plants	
Тур	ecture	
Hrs/wk	2	
CP	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		
CP	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 M0513: System As	pects of Renewable Energies			
Courses				
Title		Тур	Hrs/wk	СР
	ew Materials for Energy Production and Storage (L0021)	Lecture	2	2
Energy Trading (L0019)		Lecture	1	1
Energy Trading (L0020)		Recitation Section (small)	1	1
Deep Geothermal Energy (L0025)		Lecture	2	2
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following the students have reached the following the students have reached the students h	owing learning results		
Professional Competence				
Knowledge	Students are able to describe the processes in energy trac	ling and the design of energy markets an	d can critically eval	luate them in relation
	current subject specific problems. Furthermore, they are able			
	cells and can establish and explain the relationship to di			
	technology with other energy storage options. In addition, s			
	geothermal energy.	adents can give an overview of the procee	the and the energy	suc involvement of dec
	geotromatenergy.			
Chille	Otudente con annu the loowned knowledge of store or ousto	no for every incompany to everlain for veri		different enpression
Skills	Students can apply the learned knowledge of storage syste			
	ensure a secure energy supply. In particular, they can plar			
	storage systems in an energy-efficient way and can assess		ns. In this context, s	students can assess ti
	potential and limits of geothermal power plants and explain	their operating mode.		
	Furthermore, the students are able to explain the procedure	s and strategies for marketing of energy an	d apply it in the con	text of other modules of
	renewable energy projects. In this context they can unassiste			
Personal Competence				
Social Competence				
Autonomy	Students can independently exploit sources , acquire the pa	rticular knowledge about the subject area a	and transform it to ne	ew questions.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioproc	ess Engineering: Elective Compulsory		
Curricula	Energy and Environmental Engineering: Specialisation Ene	rgy and Environmental Engineering: Electiv	e Compulsory	
	International Management and Engineering: Specialisation	II. Renewable Energy: Elective Compulsory	1	
	International Management and Engineering: Specialisation	II. Energy and Environmental Engineering:	Elective Compulsor	гy
	International Management and Engineering: Specialisation	II. Process Engineering and Biotechnology	Elective Compulso	ory
	Renewable Energies: Core qualification: Compulsory			
	Process Engineering: Specialisation Environmental Process	Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineering :	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	r: Elective Compulsory		



Course L0021: Fuel Cells, Batterie	s, and Gas Storage: New Materials for Energy Production and Storage
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Fröba
Language	DE
Cycle	SoSe
Content	 Introduction to electrochemical energy conversion Function and structure of electrolyte Low-temperature fuel cell Types Thermodynamics of the PEM fuel cell Cooling and humidification strategy High-temperature fuel cell The MCFC The SOFC Integration Strategies and partial reforming Fuels Supply of fuel Reforming of natural gas and biogas Reforming of liquid hydrocarbons Energetic Integration and control of fuel cell systems
Literature	• Hamann, C.; Vielstich, W.: Elektrochemie 3. Aufl.; Weinheim: Wiley – VCH, 2003

Course L0019: Energy Trading	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Michael Sagorje, Jörg Seidel
Language	DE
Cycle	SoSe
Content	 Basic concepts and tradable products in energy markets Primary energy markets Electricity Markets European Emissions Trading Scheme Influence of renewable energy Real options Risk management
Literature	

Course L0020: Energy Trading	ourse L0020: Energy Trading	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Michael Sagorje, Jörg Seidel	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0025: Deep Geothermal I	Energy
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Ben Norden
Language	DE
Cycle	SoSe
Content	 Introduction to the deep geothermal use Geological Basics I Geological Basics II Geology and thermal aspects Rock Physical Aspects Geochemical aspects Geochemical aspects Exploration of deep geothermal reservoirs Drilling technologies, piping and expansion Borehole Geophysics Underground system characterization and reservoir engineering Microbiology and Upper-day system components Adapted investment concepts, cost and environmental aspect
Literature	 Dipippo, R.: Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact. Butterworth Heinemann; 3rd revised edition. (29. Mai 2012) www.geo-energy.org Edenhofer et al. (eds): Renewable Energy Sources and Climate Change Mitigation; Special Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 2012. Kaltschmitt et al. (eds): Erneuerbare Energien: Systemtechnik, Wirtschaftlichkeit, Umweltaspekte. Springer, 5. Aufl. 2013. Kaltschmitt et al. (eds): Energie aus Erdwärme. Spektrum Akademischer Verlag; Auflage: 1999 (3. September 2001) Huenges, E. (ed.): Geothermal Energy Systems: Exploration, Development, and Utilization. Wiley-VCH Verlag GmbH & Co. KGaA; Auflage: 1. Auflage (19. April 2010)



Module M0703: Soil and G	aroundwater Contamination			
Courses				
Title		Тур	Hrs/wk	CP
Contamination and Remediation (L0547)		Project Seminar	3	3
NAPL in Soil and Groundwater (L0545)		Lecture	1	1
NAPL in Soil and Groundwater (L0546)		Recitation Section (small)	2	2
Module Responsible	Prof. Wilfried Schneider			
Admission Requirements	None			
Recommended Previous	Groundwater hydrology, Hydromechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students are able to analyse contamination in soils and groundwater. They are able to create remediation concepts as monitored attenuatior			
	and pump and treat.			
Skills	The students are able to analyse contaminations in soils and groundwater using special engineering methods. They can do transport modelling			
	the unsaturated zone, estimations of groundwater poll	ution and analyse the impacts of remediation	measures. They can	forecast die distributi
	mobility and remediation of non aquaous phase liquids	in soil and groundwater.		
Personal Competence				
Social Competence	The students are able to prepare complex contamination	on issues in teamwork and are able to find rem	ediation measures.	
Autonomy	none			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	Klausur 60 min; Referat 15 min;			
Assignment for the Following	Energy and Environmental Engineering: Specialisation	Environmental Engineering: Elective Compul	sory	
Curricula	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

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

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

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



Module M0749: Waste Tre	atment and Solid Matter Process Technol	ogy		
•				
Courses				
Title		Тур	Hrs/wk	CP
Solid Matter Process Technology for Bio Thermal Waste Treatment (L0320)	mass (L0052)	Lecture	2	2
Thermal Waste Treatment (L0320)		Recitation Section (large)	2	2
	Prof. Kerstin Kuchta			_
Admission Requirements	none			
Recommended Previous	Basics of			
Knowledge				
	thermo dynamics			
	fluid dynamics			
	chemistry			
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge	The students can describe current issue and problems in	the field of thermal waste treatment and pa	article process enginee	ering.
	The industrial application of unit operations as part of pro	cess engineering is explained by actual ex	amples of waste incin	eration technologies and
	solid biomass processes. Compostion, particle sizes, tran			-
	described as important unit operations when producing s			
	recyclables.			
Skills	The students are able to select suitable processes for the	treatment of wastes or raw material with	respect to their charac	teristics and the proces
	aims. They can evaluate the efforts and costs for processe	es and select economically feasible treatm	ent concepts.	
Personal Competence				
Social Competence	Students can			
,				
	 respectfully work together as a team and discuss to a second secon			
	 participate in subject-specific and interdisciplinary 	discussions,		
	develop cooperated solutions			
	 promote the scientific development and accept pro- 	ofessional constructive criticism.		
Autonomy	Students can independently tap knowledge of the sub	ject area and transform it to new ques	tions. They are capal	ole, in consultation with
	supervisors, to assess their learning level and define fi	urther steps on this basis. Furthermore, t	hey can define target	s for new application-o
	research-oriented duties in accordance with the potential	social, economic and cultural impact.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
	Bioprocess Engineering: Specialisation A - General Biopr		ative Compulsor:	
Curricula	Energy and Environmental Engineering: Specialisation E			
	International Management and Engineering: Specialisatio	• •	bgy: Elective Compulso	лу
	Renewable Energies: Specialisation Bio energies: Electiv			
	Process Engineering: Specialisation Chemical Process E			
	Process Engineering: Specialisation Process Engineering			
	Water and Environmental Engineering: Specialisation En-			
	Water and Environmental Engineering: Specialisation Cit			



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

Course L0320: Thermal Waste Tre	atment
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta, Dr. Joachim Gerth, Dr. Ernst-Ulrich Hartge
Language	EN
Cycle	SoSe
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 L1177: Thermal Waste Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Ernst-Ulrich Hartge, Dr. Joachim Gerth
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Courses				
Title		Тур	Hrs/wk	CP
Applied Groundwater Modeling (L0543) Applied Groundwater Modeling (L0544)		Lecture	1	1
Modeling of Water Supply and Sewer Ne	twork (1.0875)	Recitation Section (small) Problem-based Learning	2	3
Module Responsible	Prof. Wilfried Schneider	Frobletti-based Learning	2	5
Admission Requirements	none			
Recommended Previous	Groundwater			
Knowledge	Gioundwater			
Kilowiedge	 groundwater hydraulics and transport of substant 	inces		
	Din e Sueteme			
	Pipe Systems			
	 Knowledge on urban water infrastructures, in p 	articular drinking water systemsand urban dr	ainage systems includ	ng special structures
	 Hydraulics of drinking water supply systems an 	d sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached the	a following loarning results		
Professional Competence	Alter laking part successionly, students have reached in	le lonowing learning lesuits		
•	The students are able to describe the modelling of	reundwater flow and transport on well on a	rhan watar infrastruct	Iron Thou can carry
Knowledge	The students are able to describe the modelling of g			
	systems analyses and can detect technical and cond		ase studies. Besides i	ney are able to analy
	interdependencies of hydraulic and toxic phenomena	in son and water.		
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare			
	or assess different solutions for existing problems by	application of selected software products.	The students are able	to use different softwa
	solutions (e.g. EPANET, EPA-SWMM).			
Dava anal Commetanae				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	J		
Credit points Examination	6 Written exam			
Examination duration and scale	שוונכון באמווו			
	Civil Engineering: Specialization Structural Engineering	a: Elective Compulsor		
Assignment for the Following	Civil Engineering: Specialisation Structural Engineerin			
Curricula	Civil Engineering: Specialisation Geotechnical Engineering			
	Civil Engineering: Specialisation Coastal Engineering			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

Course L0543: Applied Groundwat	ter Modeling
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wilfried Schneider
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

Content Literature



Course L0544: Applied Groundwater Modeling			
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Wilfried Schneider		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		
Course L0875: Modeling of Water	Supply and Sewer Network		
Тур	Problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Klaus Johannsen, NN		
Language	DE		
Cycle	SoSe		



Module M0828: Urban En	rironmental Management			
Courses				
Title		Тур	Hrs/wk	CP
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Problem-based Learning	2	4
Module Responsible	NN			
Admission Requirements	none			
Recommended Previous				
Knowledge	 Urban planning Measures for climate protection and climate change adaptation 			
	 Basics of urban drainage 	adaptation		
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: E	lective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Ele	ctive Compulsory		
	Joint European Master in Environmental Studies - Cities ar	nd Sustainability: Core qualification: Compul	sory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastr	ucture and Mobility: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Env			
	Water and Environmental Engineering: Specialisation Citie	es: Compulsory		

Course L1109: Noise Protection	ourse L1109: Noise Protection		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Bitte auswählen		
Language	EN		
Cycle	SoSe		
Content			
Literature			

Course L0874: Urban Infrastructures			
Тур	Problem-based Learning		
Hrs/wk	2		
CP	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	SoSe		
Content	 Problem/Project Based Learning Main topics are: Design of future cities, concepts and technical approaches for future-proof drinking water supply and wastewater disposal Climate Change Impacts, Adaptation and Mitigation Rainwater Management & urban flash floods New water sources: rainwater harvesting and wastewater reuse Urban greening & urban agriculture Water sensitive urban design How to better link urban planning and urban water issues 		
Literature			



Module M0857: Geochem	ical Engineering			
0				
Courses				
Title		Тур	Hrs/wk	CP
Contaminated Sites and Landfilling (L090		Lecture	2	2
Contaminated Sites and Landfilling (L090)/)	Recitation Section (large)	1	2
Geochemical Engineering (L0904) Module Responsible	Dr. Joachim Gerth	Lecture	2	2
Admission Requirements				
	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	With the completion of this module students acquire pro	found knowledge of biogeochemical pro	ocesses, the fate of	pollutants in soil and
Skills	groundwater, and techniques to deposit contaminated waste material. They are able to describe in principle the behaviour of chemicals in the environment. Students can explain and report the approach to remediate contaminated sites. With the completion of this module students can apply the acquired theoretical knowledge to model cases of site pollution and critically assess the situation technically and conceptually. They are able to draw comparisons on different remediation strategies and techniques. Model projects can be devised and treated.			
Personal Competence Social Competence Autonomy	Students can discuss technical and scientific tasks within a s Students can independently exploit sources , acquire the pa			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 hours			
Assignment for the Following	Energy and Environmental Engineering: Specialisation Envi	ronmental Engineering: Elective Compulse	ory	
Curricula	Environmental Engineering: Core qualification: Elective Con	npulsory		
	Water and Environmental Engineering: Specialisation Water	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities	Elective Compulsory		

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



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

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



Module M0870: Managem	ent of Surface Water			
Courses				
Title		Тур	Hrs/wk	СР
Modelling of Flow in Rivers and Estuarie	s (L0810)	Lecture	3	4
Nature-Oriented Hydraulic Engineering	Integrated Flood Protection (L0961)	Problem-based Learning	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous				
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 processe	s that are related to the modelling of flow	s in hydraulic enginee	ring. Besides, they ca
	describe the basic aspects of numerical modelling and a	actual numerical models for the simulation	of flows and waves. T	hey can also depict t
	concepts of nature oriented hydraulic engineering.			
Skille	Students are able to apply hydrodynamic-numerical moc	late to practical bydraulic opgingoring tack	Eurthormoro the stu	dante ara abla ta satu
Skills	flood-risk management concepts and are able to apply ba			uents are able to set
	nood hak management concepts and are able to apply be		bienta.	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The examination	ation includes tasks with respect to the gen	eral understanding of t	he lecture contents a
	calculations tasks.			
Assignment for the Following	Environmental Engineering: Core qualification: Elective C	Compulsory		
Curricula	Joint European Master in Environmental Studies - Cities a	and Sustainability: Core qualification: Comp	oulsory	
	Water and Environmental Engineering: Specialisation Wa	ater: Compulsory		
	Water and Environmental Engineering: Specialisation En	vironment: Compulsory		
	Water and Environmental Engineering: Specialisation Cit	ies: Elective Compulsory		
Course L0810: Modelling of Flow in	n Rivers and Estuaries			
Тур	Lecture			
Hrs/wk	3			
CP	4			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Peter Fröhle			
Language	DE/EN			
Cycle	SoSe			
- ,				

Basics of numerial models / application of models

- classification of models
- model concept
- modelling

Content

1D Working Equation

Mathematical description of physical processes

- Equation of motions
 - conservation of mass
- conservation of momentum
- Initial conditions and boundary conditions

Numerical Methods

.

- Time step procedure
- Finite differences
- Finite volumes

Literature Vorlesungsskript



Course L0961: Nature-Oriented Hy	ydraulic Engineering / Integrated Flood Protection
Тур	Problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 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 M0871: Hydrologi	cal Systems			
Courses				
Title		Тур	Hrs/wk	CP
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Problem-based Learning	1	2
Interaction Water - Environment in Fluvia	al Areas (L0295)	Problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	learning results		
Professional Competence				
Knowledge	The students are able to define the basic concepts of hydrology and water management. They are able to describe and quantify the relevant			
	processes of the hydrological water cycle. Besides, the students know the main aspects of rainfall-run-off-models and are able to theoretically			
	derive established reservoir / storage models and a unit-hydrograph.			
01:11-	The students are able to use the basis budgets is a second as		4 11	
Skiiis	The students are able to use the basic hydrological concepts and			•
	models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the basic concepts of measurements of			
	hydrological and hydrodynamic values in nature and are able to perform, analyze and statistically assess these measurements. Furthermore, they are able to apply a hydrological model to basic hydrological problems.			
	are able to apply a hydrological model to basic hydrological probl	2015.		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 90 min. The examination inclu	des tasks with respect to the genera	al understanding of t	he lecture contents and
	calculations tasks.			
Assignment for the Following	Environmental Engineering: Core qualification: Elective Compulse	ory		
Curricula	Water and Environmental Engineering: Specialisation Water: Elec	tive Compulsory		
	Water and Environmental Engineering: Specialisation Environment	nt: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Elec	tive Compulsory		

Course L0289: Applied Surface Hy	ydrology
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle, Sandra Hellmers
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://kalypso.bjoernsen.de/ http://sourceforge.net/projects/kalypso/



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

Course L0295: Interaction Water -	Environment in Fluvial Areas
Тур	Problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle, Sandra Hellmers
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 M0874: Wastewate	or Sustame				
Would Woor4. Wastewald	er Systems				
Courses					
Title		Тур	Hrs/wk	CP	
Wastewater Systems - Collection, Treat	ment and Reuse (L0934)	Lecture	2	2	
Wastewater Systems - Collection, Treat	ment and Reuse (L0943)	Recitation Section (large)	1	1	
Advanced Wastewater Treatment (L035	7)	Lecture	2	2	
Advanced Wastewater Treatment (L035	8)	Recitation Section (large)	1	1	
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
Recommended Previous	Knowledge of wastewater management and the keep	ey processes involved in wastewater treatment.			
Knowledge					
Educational Objectives	After taking part successfully, students have reach	ed the following learning results			
Professional Competence					
Knowledge	Students are able to outline key areas of the full r	ange of treatment systems in waste water managem	ent, as well as their	mutual dependence fo	
	sustainable water protection. They can describe relevant economic, environmental and social factors.				
01:11-					
Skills	Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application in municipal and fo				
	some industrial treatment plants.				
Personal Competence					
Social Competence					
Autonomy	Students are in a position to work on a subject and	d to organize their work flow independently. They car	also present on this	subject.	
Workload in Hours	Independent Study Time 96, Study Time in Lecture	ə 84			
Credit points	6				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory			
Curricula	Civil Engineering: Specialisation Geotechnical En	gineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory			
	Bioprocess Engineering: Specialisation A - Gener	al Bioprocess Engineering: Elective Compulsory			
	Energy and Environmental Engineering: Specialis	ation Environmental Engineering: Elective Compuls	ory		
	International Management and Engineering: Spec	ialisation II. Energy and Environmental Engineering:	Elective Compulsor	у	
	International Management and Engineering: Spec	ialisation II. Process Engineering and Biotechnology	: Elective Compulso	ry	
	Process Engineering: Specialisation Environment	al Process Engineering: Elective Compulsory			
	Process Engineering: Specialisation Process Eng	ineering : Elective Compulsory			
	Water and Environmental Engineering: Specialisa	tion Water: Compulsory			
	Water and Environmental Engineering: Specialisa	tion Environment: Elective Compulsory			

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



Course L0943: Wastewater System	ourse L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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



Course L0358: Advanced Wastew	ater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	DE
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

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Module M0875: Water & V	Vastewater Systems			
Courses				
Title		Тур	Hrs/wk	СР
Ecological Town Design - Water, Energ	y, Soil and Food Nexus (L1229)	Lecture	2	2
Water & Wastewater Systems in a Glob	al Context (L0939)	Lecture	2	4
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with	n rising poverty, soil degradation, migration to cities, la	ack of water resources and	sanitation
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students can describe the facets of the global water situation. Students can judge the enormous potential of the implementation of syn			
	systems in Water, Soil, Food and Energy su	pply.		
Skills	Students are able to design ecological settle	ements for different geographic and socio-economic o	conditions for the main clin	nates around the wo
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subje	ect and to organize their work flow independently. The	ey can also present on this	s subject.
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Bioprocess Engineering: Specialisation A -	General Bioprocess Engineering: Elective Compulso	ry	
Curricula	Chemical and Bioprocess Engineering: Spe	ecialisation General Process Engineering: Elective Co	ompulsory	
	Environmental Engineering: Core qualificati	ion: Elective Compulsory		
	Joint European Master in Environmental Stu	udies - Cities and Sustainability: Core qualification: Co	ompulsory	
		nmental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Proces			
	Water and Environmental Engineering: Spe	ecialisation Water: Elective Compulsory		

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Course L1229: Ecological Town De	esign - Water, Energy, Soil and Food Nexus
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
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 TUHH Rural Development Toolbox (cont.) 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 Exam with color pencils: Design of a New Town
Literature	 Ralf Otterpohl 2013: Gründer-Gruppen als Lebensentwurf: "Synergistische Wertschöpfung in erweiterten Kleinstadt- und Dorfstrukturen", ir "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

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



Course L0939: Water & Wastewate	er Systems in a Global Context
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	 Participants Workshop: Awareness of global water problems; role play's, theatre, pantomime, developing a song and else 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 Video contest: Participants groups search, introduce, show and discuss excellent short water videos Why are there excreta in water? Public Health, Awareness Campaigns Seminar: Participants prepare and give 5 min presentations Rehearsal session, Q&A Exam
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)



Module M0922: City Plann				
Courses				
Title		Тур	Hrs/wk	CP
Prinicples of City Planning (L1066)		Problem-based Learning	2	3
Street Design (L1067)		Problem-based Learning	2	3
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	for "Principles of Urban Planning": none			
Knowledge	for "Designing Urban Streetscapes": some knowledge of trans Traffic Engineering"	port planning, e.g. through taking the un	dergraduate class "	Transport Planning
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
	Students are able to:			
Ũ				
	 use technical terms of urban planning. 			
	describe the main determinants of urban development.			
	explain and compare different possibilities of how urba	n development can be influenced.		
	discuss requirements for public streetscapes.			
	explain the importance of street design.			
Chille	Chudente ere ekle ter			
SKIIIS	Students are able to:			
	 read and analyze urban development concepts and de 	signs for streetscapes		
	appraise such concepts in the context of competing rec	uirements.		
	design, justify and reflect their own solutions for concre	e 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 on their own work. 			
Autonomy	Students are able to:			
, atonomy				
	 independently complete a written report including draw 	ings following a broadly pre-defined pro	cess.	
	assess the consequences of their proposed solutions.			
	 independently acquire knowledge and apply this to ne 	issues or problem areas.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Project			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Elect	ve Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E	ective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure	re and Mobility: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water: B	lective Compulsory		
	Water and Environmental Engineering: Specialisation Environ	nent: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: C	ompulsory		



Course L1066: Prinicples of City Planning				
Тур	Problem-based Learning			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
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 project work deals with a real life scenario and includes drawing up			
	development plan, an urban design concept as well as a building masterplan.			
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt.			
	Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen			
	Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen			
	Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.			

Course L1067: Street Design	
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	 "Designing Urban Streetscapes" covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The class deals with: technical and design requirements, the effects of streetscapes on the behaviour of their users, possible measures relating to changes in traffic development. For their applied project, students will be required to redesign the streetscape of an actual case study.
Literature	Forschungsgesellschaft für Straßen- und Verkehrswesen (2011) Empfehlungen zur Straßenraumgestaltung innerhalb bebauter Gebiete - ESG. FGSV-Verlag. Köln (FGSV, 230). Forschungsgesellschaft für Straßen- und Verkehrswesen (2007) Richtlinien für die Anlage von Stadtstraßen – RASt 06. FGSV-Verlag. Köln (FGSV, 200).



Module M0968: Subsoil er	ngineering and Numerics			
Courses				
Title		Тур	Hrs/wk	CP
Numerical Methods in Geotechnics (L03	175)	Lecture	3	3
Underground Constructions (L0707)		Problem-based Learning	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Basics in construction and design of reinforced concrete st	tructures, Soil Mechanics and Foundation En	gineering	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	ollowing 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			
Examination	Oral exam			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: E	Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineerin	g: Compulsory		
	Water and Environmental Engineering: Specialisation Wat	ter: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Env	ironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Citie	es: Elective Compulsory		

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



Course L0707: Underground Cons	tructions
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
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



Module M0619: Waste Tre	atment Technologies			
Courses				
Title Waste and Environmental Chemistry (LC Biological Waste Treatment (L0318)	1328)	Typ Laboratory Course Problem-based Learning	Hrs/wk 2 3	CP 2 4
Module Responsible	Prof. Kerstin Kuchta			•
Admission Requirements	none			
Recommended Previous	chemical and biological basics			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge				
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional test. They are capable of reflecting and evaluating findings in the group.			
Personal Competence Social Competence				
Autonomy	Students can independently tap knowledge from consultation with supervisors as well as in the Furthermore, they can define targets for new applicing impact.		evel and define furth	er steps on this basi
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Examination	Project			
Examination duration and scale	Elaboration and presentation (15-25 minutes in gro	oups), successful participation at Praktikum		
Assignment for the Following	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	•		
	Energy and Environmental Engineering: Specialis		sory	
	Environmental Engineering: Core qualification: Co			
	International Management and Engineering: Speci		-	У
		Cities and Sustainability: Specialisation Energy: El	ective Compulsory	
	Water and Environmental Engineering: Specialisat	tion Environment: Elective Compulsory		



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

Course L0318: Biological Waste T	reatment
Тур	Problem-based Learning
Hrs/wk	3
CP	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 M0620: Special As	spects of Waste Resource Managemen	t		
Courses				
Title		Тур	Hrs/wk	CP
Advanced Topics in Waste Resource M	anagement (L1055)	Problem-based Learning	3	3
International Waste Management (L0317)	Problem-based Learning	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	none			
Recommended Previous	basics in waste treatment technologies			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe waste as a resour detail. This covers collection, transport, treatment and	аў. ў	ing and recovery of	resources from waste in
Skills	Students are able to select suitable processes for the treatment with respect to the national or cultural and developmental context. They can evaluate the ecological impact and the technical effort of different technologies and management systems.			
Personal Competence				
Social Competence	Students can work together as a team of 2-5 persons, participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development of colleagues. Furthermore, they can give and accept professional constructive criticisms.			
Autonomy	Students can independently gain additional knowledge	ge of the subject area and apply it in solving the g	given course tasks a	nd projects.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70		
Credit points	6			
Examination	Project			
Examination duration and scale	PowerPoint presentation (10-15 minutes)			
Assignment for the Following	Environmental Engineering: Specialisation Waste and	d Energy: Elective Compulsory		
Curricula	Joint European Master in Environmental Studies - Cit	ies and Sustainability: Specialisation Energy: Ele	ective Compulsory	
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	n Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	n Cities: Elective Compulsory		

Course L1055: Advanced Topics in	n Waste Resource Management
Тур	Problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Rüdiger Siechau
Language	EN
Cycle	WiSe
Content	 Focus of the course "Advanced topics of waste resource management" lies on the organisational structures in waste management – such as planning, financing and logistics. One excursion will be offered to take part in (incineration plant, vehicle fleet and waste collection systems). The course is split into two parts: part: "Conventional" lecture (development of waste management, legislation, collection, transportation and organisation of waste management, costs, fees and revenues). 2. part: Project base learning: You will get a project to work out in groups of 4 to 6 students; all tools and data you need to work out the project were given before during the conventional lecture. Course documents are published in StudIP and communication during project work takes place via StudIP. The results of the project work are presented at the end of the semester. The final mark for the course consists of the grade for the presentation.
Literature	Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 PowerPoint slides in Stud IP



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



Module M0705: Groundwa	iter			
Courses				
Title		Тур	Hrs/wk	CP
Geohydraulic and Solute Transport (L05	539)	Lecture	2	2
Geohydraulic and Solute Transport (L05	540)	Recitation Section (small)	1	1
Simulation in Groundwater Hydrology (L		Lecture	1	1
Simulation in Groundwater Hydrology (L	,	Recitation Section (small)	2	2
Module Responsible	Prof. Wilfried Schneider			
Admission Requirements	None			
Recommended Previous Knowledge	Ground water hydrologyHydromechanics			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	The students are able to describe the fate of solutes in t	The students are able to describe the fate of solutes in the subsurface along the path between soil and water body quantitatively and qualitatively		
	They are able to do this with simulation models.			
Skills	The students are able to describe conceptually movem	ent and storage of water in the unsaturated z	one. They are able	to analyse pF- function
	and Ku functions. They can model transport of solutes	in the unsaturated and saturated zoned. They	are able to determin	ne dispersiities, sorption
	coefficients, decay rates and dissolution rates for organi	c and inorganic substances.		
Personal Competence				
Social Competence	The students can help to each other.			
Autonomy	none			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min written exam and written papers			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering	: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: I	Elective Compulsory		
	Process Engineering: Specialisation Environmental Pro	cess Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineeri	ng: Elective Compulsory		
	Water and Environmental Engineering: Specialisation V	later: Compulsory		
	Water and Environmental Engineering: Specialisation E	nvironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation C	ities: Elective Compulsory		

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

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



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

Course L0542: Simulation in Groundwater Hydrology	
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wilfried Schneider
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0801: Water Res	ources and -Supply			
Courses				
Title		Тур	Hrs/wk	CP
Chemistry of Drinking Water Treatment	(L0311)	Lecture	2	1
Chemistry of Drinking Water Treatment		Recitation Section (large)	1	2
Water Resource Management (L0402)		Lecture	2	2
Water Resource Management (L0403)		Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Knowledge of water management and the key processes in	volved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	lowing learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in wate	r management, as well as their mutual depe	endence for sustain	able water supply. They
	will understand relevant economic, environmental and soci	ial factors. Students will be able to explain	and outline the orga	anisational 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 drinkir	ng water production and establish solutions	involving water mar	nagement and technical
	measures. They will be able to assess the evaluation metho	•	Ū.	•
	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 prof			
	joint solutions in teams of diverse experts and present these			
Autonomy	Students will be in a position to work on a subject independ	ently and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (chemistry) + presentation			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Energy and Environmental Engineering: Specialisation Energy and Environmental Engineering: Elective Compulsory			
	International Management and Engineering: Specialisation	II. Energy and Environmental Engineering:	Elective Compulsor	у
	Water and Environmental Engineering: Specialisation Wate	r: Compulsory		
	Water and Environmental Engineering: Specialisation Envir	ronment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities	s: Elective Compulsory		

Course L0311: Chemistry of Drink	ing Water Treatment
Тур	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 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 Drink	Course L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Klaus Johannsen	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0402: Water Resource M	anagement
Тур	Lecture
Hrs/wk	2
CP	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 M	Course L0403: Water Resource Management	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	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 M0802: Membrane	e Technology			
Courses				
Title		Тур	Hrs/wk	CP
Membrane Technology (L0399)		Lecture	2	3
Membrane Technology (L0400)		Recitation Section (small)	1	2
Membrane Technology (L0401)		Laboratory Course	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Basic knowledge of water chemistry. Knowledge of the core pro	cesses involved in water, gas and ste	am treatment	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students will be able to rank the technical applications of ind	ustrially important membrane process	ses. They will be able	to explain the different
	driving forces behind existing membrane separation processe	es. Students will be able to name ma	aterials used in memb	orane filtration and their
	advantages and disadvantages. Students will be able to expla	in the key differences in the use of me	embranes in water, ot	her liquid media, gases
	and in liquid/gas mixtures.			
Skille	Students will be able to prepare mathematical equations for	material transport in persus and solu	ition diffusion mombr	anos and calculate key
SKIIIS	parameters in the membrane separation process. They will be			
	provide recommendations for the sequence of different treatment		, in the second s	
	separation efficiency, filtration characteristics and application of			
	of the fouling layer in different waters and apply technical meas			
Personal Competence				
Social Competence	Students will be able to work in diverse teams on tasks in the field of membrane technology. They will be able to make decisions within their group			
	on laboratory experiments to be undertaken jointly and present	these to others.		
Autonomy	Students will be in a position to solve homework on the topic	of membrane technology independe	ntly. They will be cap	able of finding creative
	solutions to technical questions.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess			
Curricula	Bioprocess Engineering: Specialisation B - Industrial Bioproces	• • • •		
	Chemical and Bioprocess Engineering: Specialisation Chemica	• • •		
	Chemical and Bioprocess Engineering: Specialisation General			
	Energy and Environmental Engineering: Specialisation Energy		tive Compulsory	
	Environmental Engineering: Specialisation Water: Elective Con			
	Joint European Master in Environmental Studies - Cities and Su		ctive Compulsory	
	Process Engineering: Specialisation Environmental Process Er			
	Process Engineering: Specialisation Process Engineering: Elec			
	Water and Environmental Engineering: Specialisation Water: E			
	Water and Environmental Engineering: Specialisation Environm			
	Water and Environmental Engineering: Specialisation Cities: El	ective Compulsory		



Course L0399: Membrane Techno	loav
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
	The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane 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 Techno	logy
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Course work	Students can voluntarily hand in solutions to exercises. They can gather extra points with the handed-in solutions. The students are given more
	detailed information at the beginning of the course.
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0401: Membrane Techno	Course L0401: Membrane Technology	
Тур	Laboratory Course	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Course work	Compulsory report: Students hand in a report about the carried out experiments.	
Lecturer	Prof. Mathias Ernst	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0822: Process N	Iodeling in Water Technology				
Courses					
Title			Тур	Hrs/wk	CP
Process Modelling of Wastewater Treat	ment (L0522)		Problem-based Learning	2	3
Process Modeling in Drinking Water Tre	atment (L0314)		Problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen				
Admission Requirements	none				
Recommended Previous	Knowledge of the most important processes in drinking	g water and waste	water treatment.		
Knowledge					
Educational Objectives	After taking part successfully, students have reached the	he following learnii	ng results		
Professional Competence					
Knowledge	Students are able to explain selected processes of drinking water and waste water treatment in detail. They are able to explain basics as well as possibilities and limitations of dynamic 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 s	solutions in a grou	p with members of different	technical background	I. They are able to give
	appropriate feedback and can work constructively with	n feedback concern	ning their work.		
Autonomy	Students are able to define a problem, gain the require	ed knowledge and	set up a model.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6			
Credit points	6				
Examination	Written exam				
Examination duration and scale	1,5 hours				
Assignment for the Following	Environmental Engineering: Specialisation Water: Ele	ctive Compulsory			
Curricula			ity: Specialisation Water: Ele	ctive Compulsory	
	Water and Environmental Engineering: Specialisation				
	Water and Environmental Engineering: Specialisation	Environment: Elec	tive Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Co	mpulsory		



Course L0522: Process Modelling	of Wastewater Treatment
Тур	Problem-based Learning
Hrs/wk	2
CP	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
	Traces modelling
	Tracer modelling
	Activated Sludge Model
	Wastewater Treatment Plant Modelling (continously and SBR)
	Sludge Treatment (ADM, aerobic autothermal)
	Biofilm Modelling
Literature	Henze, Mogens (Seminar on Activated Sludge Modelling, ; Kollekolle Seminar on Activated Sludge Modelling, ;)
	Activated sludge modelling : processes in theory and practice ; selected proceedings of the 5th Kollekolle Seminar on Activated Sludge Modelling,
	held in Kollekolle, Denmark, 10 - 12 September 2001
	ISBN: 1843394146
	[London] : IWA Publ., 2002
	TUB_HH_Katalog
	Henze, Mogens
	Activated sludge models ASM1, ASM2, ASM2d and ASM3
	ISBN: 1900222248
	London : IWA Publ., 2002
	TUB_HH_Katalog
	Henze, Mogens
	Wastewater treatment : biological and chemical processes
	ISBN: 3540422285 (Pp.)
	Berlin [u.a.] : Springer, 2002
	TUB_HH_Katalog
	Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;)
	Fundamentals of biological wastewater treatment
	ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm
	Weinheim : WILEY-VCH, 2007
	TUB_HH_Katalog



Course L0314: Process Modeling i	n Drinking Water Treatment
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE/EN
Cycle	WiSe
Content	In this course selected drinking water treatment processes (e.g. aeration or activated carbon adsorption) are modeled dynamically using the programming language Modelica, that is increasingly used in industry. In this course OpenModelica is used, an free access frontend of the programming language Modelica. In the beginning of the course the use of OpenModelica is explainded by means of simple examples. Together required elements and structure of the model are developed. The implementation in OpenModelica and the application of the model is done individually or in groups respectively. Students get feedback and can gain extra points for the exam.
Literature	 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.

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Module M0847: Analytical	Methods and Treatment Technologies	for Wastewaters		
Courses				
Title		Тур	Hrs/wk	CP
Low-Cost Procedures for Water and Wa	stewater Analysis (L0505)	Lecture	2	3
Physico-Chemical Water Treatment (L0	482)	Lecture	2	3
Module Responsible	Dr. Holger Gulyas			
Admission Requirements	none			
Recommended Previous	Fundamental knowledge in chemistry and physics (k	nowledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students know some non-biological processes for the treatment of water and wastewater as well as the fundamentals of mass transfer which is essential for many treatment processes. They have knowledge about analytical procedures which can be applied even without the availability of a laboratory and which are useful for evaluating the performance of (waste)water treatment processes and the assessment of surface water quality in an economically feasible way.			
Skills	The students are able to select suitable processes for the treatment of wastewaters with respect to their characteristics. They can evaluate the efforts and costs for analytical procedures for the characterization of waters/wastewaters and select economically feasible analytical procedures.			
Personal Competence				
Social Competence	The students have the competence to plan and to perform wastewater analyses together with colleagues in small groups and to efficientl distribute the respective tasks within the group.			
Autonomy	The students are capable to make their own decision economically feasible analytical procedures for wate		water/wastewater treatmen	nt processes as well a
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General	Bioprocess Engineering: Elective Compulso	ry	
Curricula	Energy and Environmental Engineering: Specialisati		Elective Compulsory	
	Environmental Engineering: Specialisation Water: El			
	Joint European Master in Environmental Studies - Ci		Elective Compulsory	
	Process Engineering: Specialisation Environmental			
	Process Engineering: Specialisation Process Engine	• • •		
	Water and Environmental Engineering: Specialisatio			
	Water and Environmental Engineering: Specialisatio			
	Water and Environmental Engineering: Specialisatio	in Onlies. Elective Compulsory		



Course L0505: Low-Cost Procedu	res for Water and Wastewater Analysis
Тур	Lecture
Hrs/wk	
CP Workload in Hours	
Workload in Hours Lecturer	Independent Study Time 62, Study Time in Lecture 28 NN
Language	EN
Cycle	
Content	1 Introduction
	2 Costing of wastewater and water analyses
	3 Parameters routinely measured in municipal wastewater effluents
	4 Surrogate parameters
	5 Field methods
	6 Basic laboratory instruments and equipment
	6.1 Balances
	6.2 Volumetric dosing instruments
	6.3 Photometer
	6.3.1 General
	6.3.2 Principle of photometry
	6.3.3 Elements of a photometer
	6.4 Deionised water supply
	6.5 Safety equipment
	7 Inorganic parameters
	7.1 Inorganic parameters by probes/electrodes
	7.1.1 Dissolved oxygen
	7.1.1.1 Polarographic measurement of dissolved oxygen
	7.1.1.2 Optical probe for measuring dissolved oxygen utilising luminescence quenching of oxygen
	7.1.1.3 Titrimetric determination of dissolved oxygen
	7.1.2 pH
	7.1.3 Alkalinity
	7.1.4 Electric conductivity/salinity
	7.2 Nitrogen and phosphorus compounds (nutrients)
	7.2.1 Colorimetric methods without expensive instruments
	7.2.2 Reflectometric methods
	7.2.3 Photometric methods
	8 Particles in water and wastewater
	9 Organic sum parameters
	9.1 Overview
	9.2 Chemical Oxygen Demand: Why to avoid COD analyses by the dichromate method?
	9.3 TOC cuvette tests
	9.4 Absorption of UV light (254 nm) as a surrogate parameter for COD
	9.5 Volatile Solids as surrogate for COD
	9.6 Biological oxygen demand
	10 Microbiological parameters determined in a low-cost way
	11 Toxicity toward activated sludge
Literature	Skript auf StudIP



Course L0482: Physico-Chemical	Water Treatment
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	EN
Cycle	WiSe
Content	- Stripping
	- Evaporation
	- Wastewater Incineration
	- Wet Air Oxidation
	- Ozonation
	- Advanced Oxidation Processes
Literature	Physical-Chemical Treatment of Water and Wastewater, A.P. Sincero, G.A. Sincero, CRC Press, Boca Raton 2003;
	Handbook of Separation Techniques for Chemical Engineers, P.A. Schweitzer, ed., McGraw-Hill, New York 1988
	Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney, eds., McGraw-Hill, New York 1984
	Chemical Engineering, Vol. 2, J.M. Coulson, J.F. Richardson, Pergamon Press, Oxford 1991
	Ozone in Water Treatment, B. Langlais, D.A. Reckhow, D.R. Brink, eds., Lewis Publishers, Chelsea 1991



Courses				
Title		Тур	Hrs/wk	CP
Practical Course in Water and Wastewa		Laboratory Course	2	3
Practicle Course of Wastewater Techno	5, (),	Laboratory Course	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	none			
Recommended Previous	Basic knowledge in chemistry and physics (kn	owledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students know basic analytical procedures for evaluating the quality of water and wastewater. They have knowledge about fundamenta			
	process engineering features of important water and wastewater treatment technologies.			
Skills	Is The students are able to understand and to practically apply methodologies for wastewater analysis as well as descriptions of experiments		ions of experiments a	
	experimental setups in wastewater technology	у.		
Personal Competence				
Social Competence				
Autonomy	The students are able to conduct experiments	following written procedures without external assistant	ice.	
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	ca. 5 Stunden			
Assignment for the Following	Water and Environmental Engineering: Specia	alisation Water: Elective Compulsory		
Curricula	Water and Environmental Engineering: Specia	alisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia	aliantian Citian Elective Compulson		

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

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



Courses				
litle		Тур	Hrs/wk	СР
ntegrated Transportation Planning (L10	68)	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 under	graduate class "Transport Plannin	g and Traffic Engine	erin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	Students are able to:			
	 describe interdescribe between land use/leastics above 			
	 describe interdependencies between land-use/location choic explain and evaluate the social, ecological and economic effective 			
	 relate current issues in the area of integrated transport planni 			
Skills	Students are able to:			
<i>chino</i>				
	 quantify important parameters, which influence travel demand 			
	 comprehensively examine a pre-defined or self-selected to 	ppic from a transportation studies	s perspective and d	ocument the results
	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:			
		ti viti a a		
	 assess potential consequences of their future professional ac independently plan working on a pre-defined project topic, ac 		nd una appropriato m	anna far ita ayaautian
	• Independently plan working on a pre-defined project topic, ac	quire the necessary knowledge a	no use appropriate n	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written elaboration			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Elective Co	moulcon		
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Co Civil Engineering: Specialisation Geotechnical Engineering: Elective			
Gurricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Civil Engineering: Specialisation Coastal Engineering: Elective Com			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	, ,		
	Water and Environmental Engineering: Specialisation Water: Elective			
	Water and Environmental Engineering: Specialisation Environmental			



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



Module M0949: Rural Dev	elopment and Sanitation for differe	nt Climate Zones		
Courses				
Title		Тур	Hrs/wk	CP
Rural Development in Different Climates	(L0941)	Lecture	2	2
Resources Oriented Sanitation: High and	d Low-Tech Options (L0942)	Lecture	2	3
Resources Oriented Sanitation: High - a	nd Low - Tech Options (L0504)	Laboratory Course	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with risi	ng poverty, soil degradation, lack of water resourc	es and sanitation	
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students can describe resources oriented wa	stewater systems mainly based on source cont	trol in detail. They can c	comment on techniqu
·	designed for reuse of water, nutrients and soil c	onditioners.		
	Students are able to discuss a wide range of pro	oven approaches in Rural Development from and	for many regions of the w	orld.
Skillo	Students are able to design law tech/law cost	sanitation, rural water supply, rainwater harvestir	na ovotomo, monouros for	the rehabilitation of t
- China		curity. Students can consult on the basics of soi		
	developed by Allan Savory.	unty. Students can consult on the basics of sol	r building through Thonsi	to Trainieu Grazing
	developed by Alian Savory.			
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject a	nd to organize their work flow independently. The	ey can also present on this	s subject.
Workload in Hours	Independent Study Time 110, Study Time in Lea	cture 70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	During the course of the semester, the students	work towards five mile stones. The work include	s presentations and pape	ers. Detailed informati
	can be found at the beginning of the smester in			
Assignment for the Following		eral Bioprocess Engineering: Elective Compulsor	v	
Curricula		isation General Process Engineering: Elective Co		
0.1.100.00		lisation Energy and Environmental Engineering:		
	Environmental Engineering: Specialisation Wat			
	• • •	ecialisation II. Energy and Environmental Engine	ering: Elective Compulsor	- V
		s - Cities and Sustainability: Specialisation Water:	•	у
	Process Engineering: Specialisation Environme			
	Process Engineering: Specialisation Process En			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali	sation Cities: Elective Compulsory		



Course L0941: Rural Development	t in Different Climates
Тур	Lecture
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Literature	 Small Breakout Groups on "Rural Development" and presentation of results Living Soil – THE key element of Rural Development Permaculture Principles of Rural Development Case Studies: Global Ecovillage Network, Complementary Currencies Going Further: The TUHH Toolbox for Rural Development Rainwater Harvesting, Participatory planning principles Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos EMAS Technologies, Hand-Pump and wells Practical Pump/Well-Building Seminar: Participants prepare and give short 5 min presentations "Best Practice cases in Rural Development" In Depth: Rural Drinking Water Supply (Dr. Bendinger) cont. Rural Drinking Water Supply (Dr. Bendinger) cont. Rural Drinking Water Supply (Dr. Bendinger) Exam
Literature	 Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation: http://youtu.be/9hmkgn0nBgk Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press

Course L0942: Resources Oriente	d Sanitation: High and Low-Tech Options	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	 Small Breakout Groups on "The horrific global situation in Sanitation " and presentation of results Keynote lecture: Resources Oriented Sanitation around the World Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos In Depth: Terra Preta Sanitation, an emerging concept based on historic global best practice in the Amazon Region Seminar: All participants prepare and give 10 min presentations (choice of topics) cont. cont. cont. Rehearsal and final panel discussion Exam 	
Literature	 J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek) Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download) Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys 	



Course L0504: Resources Oriente	ed Sanitation: High - and Low - Tech Options
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	Practical course: Preparation and execution of four experiments and written report about the experiments.
Lecturer	Dr. Holger Gulyas
Language	EN
Cycle	WiSe
Content	- Construction of urine-diverting toilets
	- Comparison of stored and fresh urine: ammonia concentration
	- Comparison of stored and fresh urine: alkalinity
Literature	Skript
	Steven A. Esrey, Jean Gough, Dave Rapaport, Ron Sawyer, Mayling Simpson-Hébert, Jorge Vargas and Uno Winblad: Ecological Sanitation, SIDA, Stockholm 1998, http://www.ecosanres.org/pdf_files/Ecological_Sanitation.pdf



Courses	
itle	Typ Hrs/wk CP
Module Responsible	Dozenten des SD B
Admission Requirements	None
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	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 and Environment Engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science ar 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 expla how these methods or approaches relate to solutions in the field of work and how the context of application has to be adjusted. General finding 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. The 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
Examination	
Examination duration and scale	
Assignment for the Following	Water and Environmental Engineering: Specialisation Environment: Compulsory
Curricula	

Ξ



Specialization Water

Module M0581: Water Pro	tection			
Courses				
Title		Тур	Hrs/wk	CP
	agement and Hydraulic Engineering (L0963)	Problem-based Learning	2	2
Water Protection and Wastewater Mana		Lecture	2	2
Water Protection and Wastewater Mana		Recitation Section (large)	1	2
Module Responsible				
Admission Requirements	none			
Recommended Previous	 Basic knowledge in water management; 			
Knowledge	 Good knowledge in urban drainage; 			
	 Good knowledge of wastewater treatment techniques; 			
	 Good knowledge of pollutants (e.g. COD, BOD, TS, N, P) 	and their properties;		
Educational Objectives	After taking part augeografully, atudente have reached the followi	a loorning rooulto		
Educational Objectives	After taking part successfully, students have reached the following	ig learning results		
Professional Competence Knowledge	The students can describe the basic principles of the regulat	nry framework related to the internet	tional and Europoon	water sector Thou con
Kilowieuge	explain limnological processes, substance cycles and water			
	problems. Finally, the students can demonstrate to achieve sign			
	able to judge environmental and wastewater related issues		• •	
	interventions as well as conceptual problem solving approaches		,	
Skills	Students can accurately assess current problems and situation	ons in a country-specific or local co	ntext. They can sugg	est concrete actions to
	contribute to the planning of tomorrow's urban water cycle. Fu			
	solutions to solve these problems.			
Personal Competence				
	The students can work to other in international groups			
Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves before presentations and discussion. They can acquire appropriate			
	knowledge by making enquiries independently.			
147 · · · · · ·				
Workload in Hours				
Credit points				
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Electiv			
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Ele Civil Engineering: Specialisation Coastal Engineering: Elective	1 3		
	Environmental Engineering: Specialisation Coastal Engineering: Elective Environmental Engineering: Specialisation Water: Elective Com			
	International Management and Engineering: Specialisation II. C			
	Joint European Master in Environmental Studies - Cities and Su			
	Water and Environmental Engineering: Specialisation Water: Co			
	Water and Environmental Engineering: Specialisation Environm			
	Water and Environmental Engineering: Specialisation Cities: Ele			
	5 -			



Course L0963: Geo-Information-Systems in Water Management and Hydraulic Engineering		
Тур	Problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE/EN	
Cycle	WiSe	
Content	Theoretical basics of Geo-Information-Systems	
	 Data models, geographical coordinates, geo-referencing, map-views Data mining and – analyses of geo-data Analysis techniques 	
Literature	None	

Course L0226: Water Protection and Wastewater Management		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	EN	
Cycle	WiSe	
	 The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips 	
Literature	 The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. 	

Course L0227: Water Protection and Wastewater Management	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Stephan Köster
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Module M0705: Groundwa	iter			
Courses				
Title		Тур	Hrs/wk	CP
Geohydraulic and Solute Transport (L05	39)	Lecture	2	2
Geohydraulic and Solute Transport (L05	40)	Recitation Section (small)	1	1
Simulation in Groundwater Hydrology (L		Lecture	1	1
Simulation in Groundwater Hydrology (L		Recitation Section (small)	2	2
Module Responsible	Prof. Wilfried Schneider			
Admission Requirements	None			
Recommended Previous	Groundwater hydrology, Hydromechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the fate of solutes	in the subsurface along the path between soil and	l water body quantit	atively and qualitativel
	They are able to do this with simulation models.			
Skills	The students are able to describe conceptually mov	rement and storage of water in the unsaturated zo	one. They are able	to analyse pF- functior
	and Ku functions. They can model transport of solut	es in the unsaturated and saturated zoned. They	are able to determin	ne dispersiities, sorptio
	coefficients, decay rates and dissolution rates for organic and inorganic substances.			
Personal Competence				
Social Competence	The students can help to each other.			
Autonomy	none			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min written exam and written papers			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineer	ring: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engin	neering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
	Process Engineering: Specialisation Environmental	Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engine	eering : 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 L0539: Geohydraulic and Solute Transport		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	Pump test analysis, water content-water suction functions, unsaturated hydraulic conductivity function, Brooks-Corey relation, van Genuchten	
	relation, solute transport in unsaturated zone, solute transport and reactions in groundwater	
Literature	Todd; K. (2005): Groundwater Hydrology	
	Fetter, C.W. (2001): Applied Hydrogeology	
	Hölting & Coldewey (2005): Hydrogeologie	
	Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport	

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



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

Course L0542: Simulation in Group	Course L0542: Simulation in Groundwater Hydrology	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0801: Water Res	ources and -Supply			
Courses				
Title		Тур	Hrs/wk	CP
Chemistry of Drinking Water Treatment (L0311)	Lecture	2	1
Chemistry of Drinking Water Treatment (Recitation Section (large)	1	2
Water Resource Management (L0402)		Lecture	2	2
Water Resource Management (L0403)		Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Knowledge of water management and the key processes in	volved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in wate	r management, as well as their mutual dep	endence for sustain	able water supply. They
	will understand relevant economic, environmental and soc	ial factors. Students will be able to explain	and outline the org	anisational structures of
	water companies. They will be able to explain the available	water treatment processes and the scope of	f their application.	
Skills	Students will be able to assess complex problems in drinkir	ng water production and establish solutions	involving water ma	nagement and technical
	measures. They will be able to assess the evaluation metho	•	•	•
	selected treatment processes and apply generally accepted			
Personal Competence				
	Working in a diverse group of specialists, students will be a	able to develop and document complex solu	utions for the manag	mement and treatment of
,	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			
Autonomy	Students will be in a position to work on a subject independ	ently and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (chemistry) + presentation			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering	: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elec	ctive Compulsory		
	Energy and Environmental Engineering: Specialisation Ene	ergy and Environmental Engineering: Electiv	e Compulsory	
	International Management and Engineering: Specialisation	II. Energy and Environmental Engineering:	Elective Compulsor	у
	Water and Environmental Engineering: Specialisation Water	er: Compulsory		
	Water and Environmental Engineering: Specialisation Envir			
	Water and Environmental Engineering: Specialisation Cities			

Course L0311: Chemistry of Drink	ing Water Treatment
Тур	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 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 Drink	ourse L0312: Chemistry of Drinking Water Treatment		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Dr. Klaus Johannsen		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0402: Water Resource M	lanagament
	Lecture
Hrs/wk	2
CP	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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Mathias Ernst	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title		Тур	Hrs/wk	CP
Fuel Cells, Batteries, and Gas Storage: I	New Materials for Energy Production and Storage (L0021)	Lecture	2	2
Energy Trading (L0019)		Lecture	1	1
Energy Trading (L0020)		Recitation Section (small)	1	1
Deep Geothermal Energy (L0025)		Lecture	2	2
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	none			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
	current subject specific problems. Furthermore, they are able to explain the basics of thermodynamics of electrochemical energy conversion in fu cells and can establish and explain the relationship to different types of fuel cells and their respective structure. Students can compare th technology with other energy storage options. In addition, students can give an overview of the procedure and the energetic involvement of dee geothermal energy.			
Skills	Students can apply the learned knowledge of storage systems for excessive energy to explain for various energy systems different approaches to ensure a secure energy supply. In particular, they can plan and calculate domestic, commercial and industrial heating equipment using energy storage systems in an energy-efficient way and can assess them in relation to complex power systems. In this context, students can assess the potential and limits of geothermal power plants and explain their operating mode. Furthermore, the students are able to explain the procedures and strategies for marketing of energy and apply it in the context of other modules on renewable energy projects. In this context they can unassistedly carry out analysis and evaluations of energie markets and energy trades.			
Personal Competence				
Social Competence				
Autonomy	Students can independently exploit sources , acquire the par	icular knowledge about the subject area a	and transform it to ne	ew questions.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours written exam			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioproce	ss Engineering: Elective Compulsory		
Curricula	Energy and Environmental Engineering: Specialisation Energy	gy and Environmental Engineering: Electiv	e Compulsory	
	International Management and Engineering: Specialisation II	. Renewable Energy: Elective Compulsory	/	
	International Management and Engineering: Specialisation II	. Energy and Environmental Engineering:	Elective Compulsor	ry
	International Management and Engineering: Specialisation II	Process Engineering and Biotechnology	: Elective Compulso	ory
	Renewable Energies: Core qualification: Compulsory			
	Process Engineering: Specialisation Environmental Process	Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineering : E	• • • • •		
	Water and Environmental Engineering: Specialisation Water	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro			



Тур	Lecture
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Fröba
Language	DE
Cycle	SoSe
Content	 Introduction to electrochemical energy conversion Function and structure of electrolyte Low-temperature fuel cell Types Thermodynamics of the PEM fuel cell Cooling and humidification strategy High-temperature fuel cell The MCFC The SOFC Integration Strategies and partial reforming Fuels Supply of fuel Reforming of natural gas and biogas Reforming of liquid hydrocarbons Energetic Integration and control of fuel cell systems
Literature	• Hamann, C.; Vielstich, W.: Elektrochemie 3. Aufl.; Weinheim: Wiley – VCH, 2003

Course L0019: Energy Trading	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Michael Sagorje, Jörg Seidel
Language	DE
Cycle	SoSe
Content	 Basic concepts and tradable products in energy markets Primary energy markets Electricity Markets European Emissions Trading Scheme Influence of renewable energy Real options Risk management
Literature	

Course L0020: Energy Trading	ourse L0020: Energy Trading		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Michael Sagorje, Jörg Seidel		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Course L0025: Deep Geothermal E	Energy
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Ben Norden
Language	DE
Cycle	SoSe
Content	 Introduction to the deep geothermal use Geological Basics I Geological Basics II Geology and thermal aspects Rock Physical Aspects Geochemical aspects Geochemical aspects Exploration of deep geothermal reservoirs Drilling technologies, piping and expansion Borehole Geophysics Underground system characterization and reservoir engineering Microbiology and Upper-day system components Adapted investment concepts, cost and environmental aspect
Literature	 Dipippo, R.: Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact. Butterworth Heinemann; 3rd revised edition. (29. Mai 2012) www.geo-energy.org Edenhofer et al. (eds): Renewable Energy Sources and Climate Change Mitigation; Special Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 2012. Kaltschmitt et al. (eds): Erneuerbare Energien: Systemtechnik, Wirtschaftlichkeit, Umweltaspekte. Springer, 5. Aufl. 2013. Kaltschmitt et al. (eds): Energie aus Erdwärme. Spektrum Akademischer Verlag; Auflage: 1999 (3. September 2001) Huenges, E. (ed.): Geothermal Energy Systems: Exploration, Development, and Utilization. Wiley-VCH Verlag GmbH & Co. KGaA; Auflage: 1. Auflage (19. April 2010)



Module M0703: Soil and G	aroundwater Contamination			
Courses				
Title		Тур	Hrs/wk	CP
Contamination and Remediation (L0547)		Project Seminar	3	3
NAPL in Soil and Groundwater (L0545)		Lecture	1	1
NAPL in Soil and Groundwater (L0546)		Recitation Section (small)	2	2
Module Responsible	Prof. Wilfried Schneider			
Admission Requirements	None			
Recommended Previous	Groundwater hydrology, Hydromechanics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to analyse contamination in soils and groundwater. They are able to create remediation concepts as monitored attenuation			
	and pump and treat.			
Skills	The students are able to analyse contaminations in soils and groundwater using special engineering methods. They can do transport modelling in			
	the unsaturated zone, estimations of groundwater pollution and analyse the impacts of remediation measures. They can forecast die distribution			
	mobility and remediation of non aquaous phase liqui	ds in soil and groundwater.		
Personal Competence				
Social Competence	The students are able to prepare complex contamina	tion issues in teamwork and are able to find rem	ediation measures.	
Autonomy	none			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Examination	Written exam			
Examination duration and scale	Klausur 60 min; Referat 15 min;			
Assignment for the Following	Energy and Environmental Engineering: Specialisati	on Environmental Engineering: Elective Compu	lsory	
Curricula	Water and Environmental Engineering: Specialisatio	n Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisatio	n Cities: Elective Compulsory		

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

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

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



Courses				
Title		Тур	Hrs/wk	CP
Applied Groundwater Modeling (L0543) Applied Groundwater Modeling (L0544)		Lecture Recitation Section (small)	1	1 2
Modeling of Water Supply and Sewer Ne	twork (10875)	Problem-based Learning	2	3
Module Responsible	Prof. Wilfried Schneider		L	0
Admission Requirements	none			
Recommended Previous	Groundwater			
Knowledge	Cioundwater			
Kilowiedge	 groundwater hydraulics and transport of substant 	inces		
	Pipe Systems			
	Tipe Systems			
	 Knowledge on urban water infrastructures, in p 	articular drinking water systemsand urban dr	ainage systems includ	ng special structures
	 Hydraulics of drinking water supply systems ar 	d sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached t	ne following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling of	roundwater flow and transport as well as u	rhan water infrastruct	ires. They can carry o
Thomeage	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They can carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides they are able to analyse			
	interdependencies of hydraulic and toxic phenomena		ase stadies. Desides i	iney are able to analy
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare			
	or assess different solutions for existing problems by application of selected software products. The students are able to use different software			
	solutions (e.g. EPANET, EPA-SWMM).			
Dava anal Competence				
Personal Competence				
Social Competence				
Autonomy				
		-		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	J		
Credit points Examination	6 Written exam			
Examination duration and scale	Whiteh exam			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineerin	a: Elective Compulson		
Curricula	Civil Engineering: Specialisation Studiulal Engineering			
Curricula				
	Civil Engineering: Specialisation Coastal Engineering			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

Course L0543: Applied Groundwat	ter Modeling
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wilfried Schneider
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

Language

Cycle

Content Literature DE

SoSe



Course L0544: Applied Groundwat	ter Modeling
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wilfried Schneider
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course
Course L0875: Modeling of Water	Supply and Sewer Network
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen, NN



Module M0857: Geochem	cal Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Contaminated Sites and Landfilling (L090)6)	Lecture	2	2
Contaminated Sites and Landfilling (L090	17)	Recitation Section (large)	1	2
Geochemical Engineering (L0904)		Lecture	2	2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	none			
Recommended Previous	Fundamentals of inorganic/organic chemistry and bio	ogy		
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	With the completion of this module students acquire profound knowledge of biogeochemical processes, the fate of pollutants in soil and			
	groundwater, and techniques to deposit contaminated waste material. They are able to describe in principle the behaviour of chemicals in the			
	environment. Students can explain and report the approach to remediate contaminated sites.			
Skills	With the completion of this module students can apply the acquired theoretical knowledge to model cases of site pollution and critically assess t			
	situation technically and conceptually. They are able to draw comparisons on different remediation strategies and techniques. Model projects ca			
	be devised and treated.			
Personal Competence				
Social Competence	Students can discuss technical and scientific tasks wi	thin a seminar subject specific and interdisciplina	ary.	
Autonomy	Students can independently exploit sources , acquire	the particular knowledge of the subject and apply	it to new problems.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 hours			
Assignment for the Following	Energy and Environmental Engineering: Specialisation	n Environmental Engineering: Elective Compulse	ory	
Curricula	Environmental Engineering: Core qualification: Electiv	ve Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

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



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

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

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Courses				
Title		Тур	Hrs/wk	CP
Modelling of Flow in Rivers and Estuarie	s (L0810)	Lecture	3	4
Nature-Oriented Hydraulic Engineering	Integrated Flood Protection (L0961)	Problem-based Learning	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reac	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 ca			
	describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows and waves. They can also depict			
	concepts of nature oriented hydraulic engineering	g.		
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. Furthermore, the students are able to set			
O.M.IO	flood-risk management concepts and are able to apply basic concepts of renaturation to practical problems.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lect	ture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The	examination includes tasks with respect to the ge	neral understanding of	the lecture contents a
	calculations tasks.			
Assignment for the Following	Environmental Engineering: Core qualification: E	Elective Compulsory		
Curricula	Joint European Master in Environmental Studies	- Cities and Sustainability: Core qualification: Con	npulsory	
	Water and Environmental Engineering: Specialis	ation Water: Compulsory		
	Water and Environmental Engineering: Specialis	sation Environment: Compulsory		

Course L0810: Modelling of Flow in	n Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of numerial models / application of models
	 classification of models model concept modelling 1D Working Equation Mathematical description of physical processes Equation of motions conservation of mass conservation of momentum Initial conditions and boundary conditions Numerical Methods Time step procedure Finite differences Finite volumes
1 ta	Verlegungeolizint
Literature	Vorlesungsskript



Typ Problem-based Learning Hrs/wk 2 CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecture Prof. Peter Fröhle DE/EN DE/EN 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	ourse L0961: Nature-Oriented Hy	ydraulic Engineering / Integrated Flood Protection
CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Peter Fröhle Language DE/EN 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 	Тур	Problem-based Learning
Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Peter Fröhle Language DE/EN 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 • Design techniques in technical flood protection	Hrs/wk	2
Lecturer 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 	CP	2
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 Engineering - biological measures for the stabilization of rivers Risk management in flood protection Design techniques in technical flood protection	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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 	Lecturer	Prof. Peter Fröhle
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	Language	DE/EN
 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 	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
Literature Vorlesungsumdruck	Literature	Vorlesungsumdruck



Module M0871: Hydrologi	cal Systems			
Courses				
Title		Тур	Hrs/wk	CP
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Problem-based Learning	1	2
Interaction Water - Environment in Fluvia	al Areas (L0295)	Problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	none			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge	The students are able to define the basic concepts of hydrolog	y and water management. They are	able to describe ar	nd quantify the relevant
	processes of the hydrological water cycle. Besides, the student	s know the main aspects of rainfall-	run-off-models and a	are able to theoretically
	derive established reservoir / storage models and a unit-hydrograph.			
	The students are able to use the basic hydrological concepts an	d approaches and are able to theory	المعقوم ويشروه بالمعان	abad vacanceir (atoreas
Skills	models or a unit-hydrograph as the basis for rainfall-run-off-me			•
	hydrological and hydrodynamic values in nature and are able to			
	are able to apply a hydrological model to basic hydrological prob			ients. i untilennore, tiley
	are able to apply a figurological model to basic figurological prob	101113.		
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 90 min. The examination incl	udes tasks with respect to the genera	al understanding of t	he lecture contents and
	calculations tasks.			
Assignment for the Following	Environmental Engineering: Core qualification: Elective Compute	ory		
Curricula	Water and Environmental Engineering: Specialisation Water: Ele	ctive Compulsory		
	Water and Environmental Engineering: Specialisation Environme	ent: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Ele	ctive Compulsory		

Course L0289: Applied Surface Hy	ydrology
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle, Sandra Hellmers
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	Problem-based Learning	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0295: Interaction Water - Environment in Fluvial Areas			
Тур	Problem-based Learning		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Peter Fröhle, Sandra Hellmers		
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 M0874: Wastewate	er Sveteme			
module moor 4. Wastewatt	or oystems			
Courses				
Title		Тур	Hrs/wk	CP
Wastewater Systems - Collection, Treatment and Reuse (L0934)		Lecture	2	2
Wastewater Systems - Collection, Treatment and Reuse (L0943)		Recitation Section (large)	1	1
Advanced Wastewater Treatment (L035	7)	Lecture	2	2
Advanced Wastewater Treatment (L035	8)	Recitation Section (large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management and the key processes involved in wastewater treatment.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	ne following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of the full range of treatment systems in waste water management, as well as their mutual dependence for			
	sustainable water protection. They can describe relevant economic, environmental and social factors.			
Skills	Students are able to pre-design and explain the availa	able wastewater treatment processes and the sc	ope of their applicat	tion in municipal and fo
	some industrial treatment plants.			
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Bioprocess Engineering: Specialisation A - General Bio	oprocess Engineering: Elective Compulsory		
	Energy and Environmental Engineering: Specialisation	n Environmental Engineering: Elective Compulso	ory	
	International Management and Engineering: Specialis	ation II. Energy and Environmental Engineering:	Elective Compulsor	у
	International Management and Engineering: Specialis	ation II. Process Engineering and Biotechnology	Elective Compulso	ry
	Process Engineering: Specialisation Environmental Pr	ocess Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineer	ring : Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Compulsory		

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



Course L0943: Wastewater System	Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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



Course L0358: Advanced Wastewater Treatment		
Тур	Recitation Section (large)	
Hrs/wk		
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Joachim Behrendt	
Language	DE	
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 M0875: Water & W	astewater Systems			
Courses				
Title		Тур	Hrs/wk	CP
Ecological Town Design - Water, Energy	v, Soil and Food Nexus (L1229)	Lecture	2	2
Water & Wastewater Systems in a Glob	al Context (L0939)	Lecture	2	4
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with rising pov	erty, soil degradation, migration to cities, la	ack of water resources and	sanitation
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	Students can describe the facets of the global water	situation. Students can judge the enorm	ous potential of the impler	nentation of synergist
	systems in Water, Soil, Food and Energy supply.			
01:11-		-1:00		
Skills	Students are able to design ecological settlements for	different geographic and socio-economic	conditions for the main cliff	lates around the world
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject and to o	organize their work flow independently. Th	ey can also present on this	subject.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bi	oprocess Engineering: Elective Compulso	iry	
Curricula	Chemical and Bioprocess Engineering: Specialisation	General Process Engineering: Elective C	ompulsory	
	Environmental Engineering: Core qualification: Electiv	e Compulsory		
	Joint European Master in Environmental Studies - Citi	es and Sustainability: Core qualification: C	ompulsory	
	Process Engineering: Specialisation Environmental P	rocess Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineer	ring : Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

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Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
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 TUHH Rural Development Toolbox (cont.) 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 Exam with color pencils: Design of a New Town
Literature	 Ralf Otterpohl 2013: Gründer-Gruppen als Lebensentwurf: "Synergistische Wertschöpfung in erweiterten Kleinstadt- und Dorfstrukturen", i "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 an Sanitation) TEDx New Town Ralf Otterpohl: http://youtu.be/ M0J2u9BrbU



Course L0939: Water & Wastewate	er Systems in a Global Context
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	 Participants Workshop: Awareness of global water problems; role play's, theatre, pantomime, developing a song and else 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 Video contest: Participants groups search, introduce, show and discuss excellent short water videos Why are there excreta in water? Public Health, Awareness Campaigns Seminar: Participants prepare and give 5 min presentations Rehearsal session, Q&A Exam
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 an Rwanda) http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation an Sanitation)



Module M0922: City Plann				
Courses				
Title		Тур	Hrs/wk	CP
Prinicples of City Planning (L1066)		Problem-based Learning	2	3
Street Design (L1067)		Problem-based Learning	2	3
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	for "Principles of Urban Planning": none			
Knowledge	for "Designing Urban Streetscapes": some knowledge of transpo Traffic Engineering"	ort planning, e.g. through taking the ur	idergraduate class "	Transport Planning
Educational Objectives	After taking part successfully, students have reached the followir	g learning results		
Professional Competence		· ·		
	Students are able to:			
Ū				
	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.			
Personal Competence	 Students are able to: read and analyze urban development concepts and desi appraise such concepts in the context of competing requi design, justify and reflect their own solutions for concrete Students are able to: discuss intermediate results with each other. 	rements.		
	 constructively accept feedback on their own work. 			
	 provide constructive feedback to others. 			
Autonomy	Students are able to:			
	independently complete a written report including drawin	gs following a broadly pre-defined pro	cess.	
	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			
Examination	Project			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Ele			
	Civil Engineering: Specialisation Coastal Engineering: Elective			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure			
	Water and Environmental Engineering: Specialisation Water: Ele	ective Compulsory		
	Water and Environmental Engineering: Specialisation Environm	ent: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Co	mpulsory		



Course L1066: Prinicples of City P	•	
Тур	Problem-based Learning	
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
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 project work deals with a real life scenario and includes drawing up a	
	development plan, an urban design concept as well as a building masterplan.	
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt.	
	Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen	
	Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen	
	Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.	

Course L1067: Street Design	
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Designing Urban Streetscapes" covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The class deals with: • technical and design requirements,
	 the effects of streetscapes on the behaviour of their users, possible measures relating to changes in traffic development. For their applied project, students will be required to redesign the streetscape of an actual case study.
Literature	Forschungsgesellschaft für Straßen- und Verkehrswesen (2011) Empfehlungen zur Straßenraumgestaltung innerhalb bebauter Gebiete - ESG. FGSV-Verlag. Köln (FGSV, 230). Forschungsgesellschaft für Straßen- und Verkehrswesen (2007) Richtlinien für die Anlage von Stadtstraßen – RASt 06. FGSV-Verlag. Köln (FGSV, 200).



Module M0968: Subsoil ei	ngineering and Numerics			
Courses				
Title		Тур	Hrs/wk	CP
Numerical Methods in Geotechnics (L03	375)	Lecture	3	3
Underground Constructions (L0707)		Problem-based Learning	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous	Basics in construction and design of reinforced co	oncrete structures, Soil Mechanics and Foundation Er	igineering	
Knowledge				
Educational Objectives	After taking part successfully, students have reach	hed the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Examination	Oral exam			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engin	neering: Elective Compulsory		
Curricula	Civil Engineering: Specialisation Geotechnical En	ngineering: Compulsory		
	Water and Environmental Engineering: Specialise	ation Water: Elective Compulsory		
	Water and Environmental Engineering: Specialise	ation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialise	ation Cities: Elective Compulsory		

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



Course L0707: Underground Cons	tructions
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
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 in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources
Literature	 Vorlesung/Übung s. www.tu-harburg.de/gbt



Module M0620: Special As	spects of Waste Resource Management			
Courses				
Title		Тур	Hrs/wk	CP
Advanced Topics in Waste Resource M	anagement (L1055)	Problem-based Learning	3	3
International Waste Management (L0317	7)	Problem-based Learning	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	none			
Recommended Previous	basics in waste treatment technologies			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	The students are able to describe waste as a resource as	well as advanced technologies for recyclin	ng and recovery of	resources from waste in
	detail. This covers collection, transport, treatment and dispo	sal in national and international contexts.		
0.111				
Skills	Students are able to select suitable processes for the tre			ental context. They can
	evaluate the ecological impact and the technical effort of dif	terent technologies and management syste	ms.	
Personal Competence				
Social Competence	Students can work together as a team of 2-5 persons,	participate in subject-specific and interdis	ciplinary discussion	ns, develop cooperated
	solutions and defend their own work results in front of oth	ers and promote the scientific developmen	t of colleagues. Fur	thermore, they can give
	and accept professional constructive criticisms.			
A				
Autonomy	Students can independently gain additional knowledge of t	ne subject area and apply it in solving the g	iven course lasks ar	ia projecis.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Project			
Examination duration and scale	PowerPoint presentation (10-15 minutes)			
Assignment for the Following	Environmental Engineering: Specialisation Waste and Ene	rgy: Elective Compulsory		
Curricula	Joint European Master in Environmental Studies - Cities an	d Sustainability: Specialisation Energy: Elec	ctive Compulsory	
	Water and Environmental Engineering: Specialisation Water	er: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Envi	ronment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Citie	s: Elective Compulsory		

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



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



Module M0822: Process M	Nodeling in Water Technology				
Courses					
Title			Тур	Hrs/wk	СР
Process Modelling of Wastewater Treat	ment (L0522)		Problem-based Learning	2	3
Process Modeling in Drinking Water Tre	atment (L0314)		Problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen				
Admission Requirements	none				
Recommended Previous	Knowledge of the most important processes in dri	inking water and waste	water treatment.		
Knowledge					
Educational Objectives	After taking part successfully, students have reach	hed the following learni	ng results		
Professional Competence					
Knowledge	Students are able to explain selected processes possibilities and limitations of dynamic modeling.	-	vaste water treatment in deta	ail. They are able to e>	plain basics as well as
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 docum	nent solutions in a grou	p with members of different	technical background	. They are able to give
	appropriate feedback and can work constructively	y with feedback concerr	ning their work.		
Autonomy	Students are able to define a problem, gain the re	equired knowledge and	set up a model.		
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56			
Credit points	6				
Examination	Written exam				
Examination duration and scale	1,5 hours				
Assignment for the Following	Environmental Engineering: Specialisation Water	r: Elective Compulsory			
Curricula	Joint European Master in Environmental Studies	- Cities and Sustainabil	ity: Specialisation Water: Ele	ective Compulsory	
	Water and Environmental Engineering: Specialisa	ation Water: Elective Co	ompulsory		
	Water and Environmental Engineering: Specialisa	ation Environment: Elec	ctive Compulsory		
	Water and Environmental Engineering: Specialis	ation Cities: Elective Co	ompulsory		



Typ Problem-based Learning Hravkt 2 (P) 3 Workload in Hours Independent Study Time 82, Study Time in Lecture 28 Lecturer pr. Joachim Behrendt Qycle WS6 Content Mass and energy balances Tacer modelling Activated Studge Model Wastewater Treatment Plant Modelling (continously and SBR) Studge Treatment (ADM, aerobic autothermal) Biolin Modelling Biolin Modelling: processes in theory and practice ;selected proceedings of the 5th Kollekolle Seminar on Activated Studge Modelling, held in kollekolle, Denmark, 10 - 12 September 2001 Lisen: Iterature Herze, Mogens Activated aludge modelling: processes in theory and practice ;selected proceedings of the 5th Kollekolle Seminar on Activated Studge Modelling, held in kollekolle, Denmark, 10 - 12 September 2001 Lisen: Iterature Herze, Mogens Activated aludge models ASM1, ASM2, ASM2d and ASM3 ISBN: 1900222248 Londorn : WA Publ, 2002 TUB, H-I, Katalog Herze, Mogens Wastewater treatment Elological and chemical processes ISBN: 360422285 (Pp.) Berlin (Lua); Springer, 2002 TUB, H-I, Katalog Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria.) Funchamentalis obiological wastewater treatment <th>Course L0522: Process Modelling</th> <th>of Wastewater Treatment</th>	Course L0522: Process Modelling	of Wastewater Treatment
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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		
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Course L0314: Process Modeling	in Drinking Water Treatment
Тур	Problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE/EN
Cycle	WiSe
Content	In this course selected drinking water treatment processes (e.g. aeration or activated carbon adsorption) are modeled dynamically using the programming language Modelica, that is increasingly used in industry. In this course OpenModelica is used, an free access frontend of the programming language Modelica. In the beginning of the course the use of OpenModelica is explainded by means of simple examples. Together required elements and structure of the model are developed. The implementation in OpenModelica and the application of the model is done individually or in groups respectively. Students get feedback and can gain extra points for the exam.
Literature	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 M0802: Membrane	e Technology			
Courses				
Title		Тур	Hrs/wk	CP
Membrane Technology (L0399)		Lecture	2	3
Membrane Technology (L0400)		Recitation Section (small)	1	2
Membrane Technology (L0401)		Laboratory Course	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Basic knowledge of water chemistry. Knowledge of the core pro	cesses involved in water, gas and ste	am treatment	
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students will be able to rank the technical applications of inde	ustrially important membrane process	ses. They will be able	to explain the different
	driving forces behind existing membrane separation processe	es. Students will be able to name ma	aterials used in memb	orane filtration and their
	advantages and disadvantages. Students will be able to expla	in the key differences in the use of m	embranes in water, of	her liquid media, gases
	and in liquid/gas mixtures.			
Skills	Students will be able to prepare mathematical equations for	material transport in porous and solu	ution-diffusion membr	anes and calculate key
	parameters in the membrane separation process. They will be			
	provide recommendations for the sequence of different treatme		-	
	separation efficiency, filtration characteristics and application of	f different membrane materials. Stude	ents will be able to ch	aracterise the formation
	of the fouling layer in different waters and apply technical meas	ures to control this.		
Personal Competence				
Social Competence				
eesiar eempeteriee	on laboratory experiments to be undertaken jointly and present			
Autonomy	Students will be in a position to solve homework on the topic of membrane technology independently. They will be capable of finding creative			
	solutions to technical questions.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bioprocess	Engineering: Elective Compulsory		
Curricula	Bioprocess Engineering: Specialisation B - Industrial Bioproces			
	Chemical and Bioprocess Engineering: Specialisation Chemica			
	Chemical and Bioprocess Engineering: Specialisation General			
	Energy and Environmental Engineering: Specialisation Energy	• •	tive Compulsory	
	Environmental Engineering: Specialisation Water: Elective Con Joint European Master in Environmental Studies - Cities and Su		ctivo Compulsory	
	Process Engineering: Specialisation Environmental Process Er			
	Process Engineering: Specialisation Process Engineering: Elect	• • • •		
	Water and Environmental Engineering: Specialisation Water: E			
	Water and Environmental Engineering: Specialisation Environm			
	Water and Environmental Engineering: Specialisation Cities: El			



Course L0399: Membrane Techno	logy
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
	The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane 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 Techno	logy
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Course work	Students can voluntarily hand in solutions to exercises. They can gather extra points with the handed-in solutions. The students are given more
	detailed information at the beginning of the course.
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0401: Membrane Techno	Course L0401: Membrane Technology	
Тур	Laboratory Course	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Course work	Compulsory report: Students hand in a report about the carried out experiments.	
Lecturer	Prof. Mathias Ernst	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Module M0847: Analytical	Methods and Treatment Technologies f	or Wastewaters		
Courses				
Title		Тур	Hrs/wk	CP
Low-Cost Procedures for Water and Wa	stewater Analysis (L0505)	Lecture	2	3
Physico-Chemical Water Treatment (L0-	482)	Lecture	2	3
Module Responsible	Dr. Holger Gulyas			
Admission Requirements	none			
Recommended Previous	Fundamental knowledge in chemistry and physics (kno	wledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students know some non-biological processes for the treatment of water and wastewater as well as the fundamentals of mass transfer which is essential for many treatment processes. They have knowledge about analytical procedures which can be applied even without the availability of a laboratory and which are useful for evaluating the performance of (waste)water treatment processes and the assessment of surface water quality in an economically feasible way.			
Skills	The students are able to select suitable processes for the treatment of wastewaters with respect to their characteristics. They can evaluate the efforts and costs for analytical procedures for the characterization of waters/wastewaters and select economically feasible analytical procedures.			
Personal Competence				
Social Competence	The students have the competence to plan and to perform wastewater analyses together with colleagues in small groups and to efficiently distribute the respective tasks within the group.			
Autonomy	The students are capable to make their own decisions economically feasible analytical procedures for water/w	•	water/wastewater treatmen	nt processes as well a
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	;		
Credit points	6			
Examination	Oral exam			
Examination duration and scale	30 min			
Assignment for the Following	Bioprocess Engineering: Specialisation A - General Bio	oprocess Engineering: Elective Compulsor	ry	
Curricula	Energy and Environmental Engineering: Specialisation	Energy and Environmental Engineering:	Elective Compulsory	
	Environmental Engineering: Specialisation Water: Elec	tive Compulsory		
	Joint European Master in Environmental Studies - Citie	s and Sustainability: Specialisation Water:	Elective Compulsory	
	Process Engineering: Specialisation Environmental Pro	ocess Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineer	ing: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation I	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		



Course L0505: Low-Cost Procedur	res for Water and Wastewater Analysis
Тур	Lecture
Hrs/wk	
CP Workload in Hours	
	Independent Study Time 62, Study Time in Lecture 28 NN
Language	EN
Cycle	
	1 Introduction
	2 Costing of wastewater and water analyses
	3 Parameters routinely measured in municipal wastewater effluents
	4 Surrogate parameters
	5 Field methods
	6 Basic laboratory instruments and equipment
	6.1 Balances
	6.2 Volumetric dosing instruments
	6.3 Photometer
	6.3.1 General
	6.3.2 Principle of photometry
	6.3.3 Elements of a photometer
	6.4 Deionised water supply
	6.5 Safety equipment
	7 Inorganic parameters
	7.1 Inorganic parameters by probes/electrodes
	7.1.1 Dissolved oxygen
	7.1.1.1 Polarographic measurement of dissolved oxygen
	7.1.1.2 Optical probe for measuring dissolved oxygen utilising luminescence quenching of oxygen
	7.1.1.3 Titrimetric determination of dissolved oxygen
	7.1.2 pH
	7.1.3 Alkalinity
	7.1.4 Electric conductivity/salinity
	7.2 Nitrogen and phosphorus compounds (nutrients)
	7.2.1 Colorimetric methods without expensive instruments
	7.2.2 Reflectometric methods
	7.2.3 Photometric methods
	8 Particles in water and wastewater
	9 Organic sum parameters
	9.1 Overview
	9.2 Chemical Oxygen Demand: Why to avoid COD analyses by the dichromate method?
	9.3 TOC cuvette tests
	9.4 Absorption of UV light (254 nm) as a surrogate parameter for COD
	9.5 Volatile Solids as surrogate for COD
	9.6 Biological oxygen demand
	10 Microbiological parameters determined in a low-cost way
	11 Toxicity toward activated sludge
Literature	Skript auf StudIP



Course L0482: Physico-Chemical	Water Treatment
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	EN
Cycle	WiSe
Content	- Stripping
	- Evaporation
	- Wastewater Incineration
	- Wet Air Oxidation
	- Ozonation
	- Advanced Oxidation Processes
Literature	Physical-Chemical Treatment of Water and Wastewater, A.P. Sincero, G.A. Sincero, CRC Press, Boca Raton 2003;
	Handbook of Separation Techniques for Chemical Engineers, P.A. Schweitzer, ed., McGraw-Hill, New York 1988
	Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney, eds., McGraw-Hill, New York 1984
	Chemical Engineering, Vol. 2, J.M. Coulson, J.F. Richardson, Pergamon Press, Oxford 1991
	Ozone in Water Treatment, B. Langlais, D.A. Reckhow, D.R. Brink, eds., Lewis Publishers, Chelsea 1991



Courses				
Title		Тур	Hrs/wk	CP
Practical Course in Water and Wastewa	6 , ()	Laboratory Course	2	3
Practicle Course of Wastewater Techno		Laboratory Course	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	none			
Recommended Previous	Basic knowledge in chemistry and physics (kr	nowledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	The students know basic analytical procedu	ires for evaluating the quality of water and wastewa	ter. They have knowle	dge about fundamen
	process engineering features of important water and wastewater treatment technologies.			
Skills	The students are able to understand and to	practically apply methodologies for wastewater analy	sis as well as descript	ons of experiments a
	experimental setups in wastewater technology.			
Personal Competence				
Social Competence				
Autonomy	The students are able to conduct experiments	following written procedures without external assistant	nce.	
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	ca. 5 Stunden			
Assignment for the Following	Water and Environmental Engineering: Speci	alisation Water: Elective Compulsory		
Curricula	Water and Environmental Engineering: Speci	alisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Speci			

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

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



Module M0902: Wastewate	er Treatment and Air Pollution Abaten	nent			
•					
Courses					
Title	A.	Тур	Hrs/wk	CP	
Biological Wastewater Treatment (L0517 Air Pollution Abatement (L0203))	Lecture	2	3 3	
Module Responsible	Dr. Ernst-Ulrich Hartge	Lecture	2	5	
	*				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge of biology and chemistry				
Kilowieuge	basic knowledge of solids process engineering and	I separation technology			
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence					
Knowledge	After successful completion of the module students	are able to			
	name and explain biological processes for	waste water treatment.			
	 characterize waste water and sewage sludg 				
	 discuss legal regulations in the area of emis 				
	 classify off gas tretament processes and to define their area of application 				
Skills	Students are able to				
	choose and design processs steps for the bit	iological waste water treatment			
	combine processes for cleaning of off-gases	depending on the pollutants contained in the	gases		
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in Lecture	9 56			
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following	Bioprocess Engineering: Specialisation A - Genera	Bioprocess Engineering: Elective Compulsor	у		
Curricula	Chemical and Bioprocess Engineering: Specialisat	ion General Process Engineering: Elective Co	mpulsory		
	Energy and Environmental Engineering: Specialisa	tion Environmental Engineering: Elective Com	pulsory		
	Environmental Engineering: Specialisation Waste a	and Energy: Elective Compulsory			
	International Management and Engineering: Specia	alisation II. Energy and Environmental Enginee	ering: Elective Compulsory	/	
	Joint European Master in Environmental Studies - C	Cities and Sustainability: Specialisation Water:	Elective Compulsory		
	Renewable Energies: Specialisation Bio energies:	Elective Compulsory			
	Process Engineering: Specialisation Environmenta	Process Engineering: Elective Compulsory			
	Process Engineering: Specialisation Process Engin	eering: Elective Compulsory			
	Water and Environmental Engineering: Specialisati				
	Water and Environmental Engineering: Specialisati				
	Water and Environmental Engineering: Specialisati	on Cities: Compulsory			

Course L0517: Biological Wastewa	ater Treatment		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Joachim Behrendt		
Language	DE/EN		
Cycle	WiSe		
Content	Charaterisation of Wastewater		
	Metobolism of Microorganisms		
	inetic of mirobiotic processes		
	alculation of bioreactor for wastewater treatment		
	oncepts of Wastewater treatment		
	esign of WWTP		
	xcursion to a WWTP		
	Biofilms		
	Biofim Reactors		
	Anaerobic Wastewater and sldge treatment		
	resources oriented sanitation technology		
	Future challenges of wastewater treatment		
Literature	Gujer, Willi		
Ellerature	Siedlungswasserwirtschaft : mit 84 Tabellen		
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URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334	
: Mall-Beton-Verl., 2000	
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Metcalf & Eddy, Inc., ;)	
treatment and reuse	
aper) ISBN: 0071122508 (ISE (*pbk))	
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ISM1, ASM2, ASM2d and ASM3	
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Course L0203: Air Pollution Abate	ment
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Ernst-Ulrich Hartge
Language	EN
Cycle	WiSe
Content	In the lecture methods for the reduction of emissions from industrial plants are treated. At the beginning a short survey of the different forms of air pollutants is given. In the second part physical principals for the removal of particulate and gaseous pollutants form flue gases are treated. Industrial applications of these principles are demonstrated with examples showing the removal of specific compounds, e.g. sulfur or mercury from flue gases of incinerators.
Literature	Handbook of air pollution prevention and control, Nicholas P. Cheremisinoff Amsterdam [u.a.] : Butterworth-Heinemann, 2002 Atmospheric pollution : history, science, and regulation, Mark Zachary Jacobson Cambridge [u.a.] : Cambridge Univ. Press, 2002 Air pollution control technology handbook, Karl B. Schnelle Boca Raton [u.a.] : CRC Press, c 2002 Air pollution, Jeremy Colls 2. ed London [u.a.] : Spon, 2002



Courses				
Title		Тур	Hrs/wk	CP
ntegrated Transportation Planning (L10	68)	Problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Recommended Previous	some knowledge of transport planning, e.g. through	n taking the undergraduate class "Transport Plannin	g and Traffic Engine	erin
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	Students are able to:			
		use/location choice and transportation/mobility beha		
		and economic effects of transport and land-use polic		
	 relate current issues in the area of integrate 	d transport planning and formulate an opinion on the	em.	
Skillo	Students are able to:			
Skills				
	 quantify important parameters, which influer 	nce travel demand or are influenced by it.		
	 comprehensively examine a pre-defined of 	or self-selected topic from a transportation studies	perspective and d	locument the results
	accordance with scientific conventions.			
Personal Competence				
Social Competence	Students are able to:			
	 provide feedback on topical contents and th 	eir teaching.		
	 constructively handle feedback on their own 			
	 produce results in group work and documer 			
	, , , , , , , , , , , , , , , , , , , ,			
Autonomy	Students are able to:			
	 assess potential consequences of their future 			
	 Independently plan working on a pre-define 	ed project topic, acquire the necessary knowledge an	nd use appropriate n	neans for its execution
	Independent Study Time 124, Study Time in Lecture	d 90		
Credit points				
Examination	Written elaboration			
Examination duration and scale				
Assignment for the Following	Civil Engineering: Specialisation Structural Engine			
Curricula	Civil Engineering: Specialisation Geotechnical Eng	0 1 3		
	Civil Engineering: Specialisation Coastal Engineer	•		
	Logistics, Infrastructure and Mobility: Specialisation			
	Water and Environmental Engineering: Specialisati	ion water: Elective Compulsory		
	Water and Environmental Engineering: Specialisati			



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



Courses	
Title	Typ Hrs/wk CP
Module Responsible	
Admission Requirements	None
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of Water and Environmental 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 the field of Water and Environment Engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science ar 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 expla how these methods or approaches relate to solutions in the field of work and how the context of application has to be adjusted. General finding 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. Th 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
Examination	Project (accord. to Subject Specific Regulations)
Examination duration and scale	
Assignment for the Following	Water and Environmental Engineering: Specialisation Water: Compulsory
Curricula	



Module M0949: Rural Dev	elopment and Sanitation for differe	nt Climate Zones		
Courses				
Title		Тур	Hrs/wk	CP
Rural Development in Different Climates	(L0941)	Lecture	2	2
Resources Oriented Sanitation: High and	d Low-Tech Options (L0942)	Lecture	2	3
Resources Oriented Sanitation: High - a	nd Low - Tech Options (L0504)	Laboratory Course	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge of the global situation with risi	ng poverty, soil degradation, lack of water resourc	es and sanitation	
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students can describe resources oriented wa	stewater systems mainly based on source cont	trol in detail. They can c	comment on techniqu
·	designed for reuse of water, nutrients and soil c	onditioners.		
	Students are able to discuss a wide range of pro	oven approaches in Rural Development from and	for many regions of the w	orld.
Skillo	Students are able to design law tech/law cost	sanitation, rural water supply, rainwater harvestir	na ovotomo, monouros for	the rehabilitation of t
- China				
	soil quality combined with food and water security. Students can consult on the basics of soil building through "Holisite Planne			
	developed by Allan Savory.			
Personal Competence				
Social Competence				
Autonomy	Students are in a position to work on a subject a	nd to organize their work flow independently. The	ey can also present on this	s subject.
Workload in Hours	Independent Study Time 110, Study Time in Lea	cture 70		
Credit points	6			
Examination	Written elaboration			
Examination duration and scale	During the course of the semester, the students	work towards five mile stones. The work include	s presentations and pape	ers. Detailed informati
	can be found at the beginning of the smester in			
Assignment for the Following		eral Bioprocess Engineering: Elective Compulsor	v	
Curricula				
0.1.100.00				
	Energy and Environmental Engineering: Specialisation Energy and Environmental Engineering: Elective Compulsory Environmental Engineering: Specialisation Water: Elective Compulsory			
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory			
		s - Cities and Sustainability: Specialisation Water:	•	у
	Process Engineering: Specialisation Environme			
	Process Engineering: Specialisation Process En			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali			
	Water and Environmental Engineering: Speciali	sation Cities: Elective Compulsory		



Course L0941: Rural Development	t in Different Climates
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	 Small Breakout Groups on "Rural Development" and presentation of results Living Soil – THE key element of Rural Development Permaculture Principles of Rural Development Case Studies: Global Ecovillage Network, Complementary Currencies Going Further: The TUHH Toolbox for Rural Development Rainwater Harvesting, Participatory planning principles Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos EMAS Technologies, Hand-Pump and wells Practical Pump/Well-Building Seminar: Participants prepare and give short 5 min presentations "Best Practice cases in Rural Development" In Depth: Rural Drinking Water Supply (Dr. Bendinger) cont. Rural Drinking Water Supply (Dr. Bendinger) Exam
Literature	 Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation: http://youtu.be/9hmkgn0nBgk Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press

Course L0942: Resources Oriented Sanitation: High and Low-Tech Options		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Literature	 Small Breakout Groups on "The horrific global situation in Sanitation " and presentation of results Keynote lecture: Resources Oriented Sanitation around the World Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos In Depth: Terra Preta Sanitation, an emerging concept based on historic global best practice in the Amazon Region Seminar: All participants prepare and give 10 min presentations (choice of topics) cont. cont. cont. Rehearsal and final panel discussion Exam 	
Literature	 J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek) Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download) Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys 	



Course L0504: Resources Oriente	ed Sanitation: High - and Low - Tech Options
Тур	Laboratory Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Course work	Practical course: Preparation and execution of four experiments and written report about the experiments.
Lecturer	Dr. Holger Gulyas
Language	EN
Cycle	WiSe
Content	- Construction of urine-diverting toilets
	- Comparison of stored and fresh urine: ammonia concentration
	- Comparison of stored and fresh urine: alkalinity
Literature	Skript
	Steven A. Esrey, Jean Gough, Dave Rapaport, Ron Sawyer, Mayling Simpson-Hébert, Jorge Vargas and Uno Winblad: Ecological Sanitation, SIDA, Stockholm 1998, http://www.ecosanres.org/pdf_files/Ecological_Sanitation.pdf



Thesis

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Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	 According to General Regulations §24 (1):
	At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	 The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues.
	 The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject, describing curre
	developments and taking up a critical position on them.
	• The students can place a research task in their subject area in its context and describe and critically assess the state of research.
Skills	The students are able:
	 To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.
	 To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incomplete
	defined problems in a solution-oriented way.
	To develop new scientific findings in their subject area and subject them to a critical assessment.
Deve and Commetance	
Personal Competence	Studente con
Social Competence	Students can
	Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.
	Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholdin
	their own assessments and viewpoints convincingly.
Autonomy	Students are able:
	 To structure a project of their own in work packages and to work them off accordingly.
	To work their way in depth into a largely unknown subject and to access the information required for them to do so.
	 To apply the techniques of scientific work comprehensively in research of their own.
Workload in Hours	Independent Study Time 900, Study Time in Lecture 0
Credit points	30
Examination	according to Subject Specific Regulations
Examination duration and scale	see FSPO
Assignment for the Following	Civil Engineering: Thesis: Compulsory
Curricula	Bioprocess Engineering: Thesis: Compulsory
	Chemical and Bioprocess Engineering: Thesis: Compulsory
	Computer Science: Thesis: Compulsory
	Electrical Engineering: Thesis: Compulsory
	Energy and Environmental Engineering: Thesis: Compulsory
	Energy Systems: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory
	Global Innovation Management: Thesis: Compulsory
	Computational Science and Engineering: Thesis: Compulsory
	Information and Communication Systems: Thesis: Compulsory
	International Production Management: Thesis: Compulsory
	International Management and Engineering: Thesis: Compulsory
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory
	Logistics, Infrastructure and Mobility: Thesis: Compulsory
	Materials Science: Thesis: Compulsory
	Mechanical Engineering and Management: Thesis: Compulsory
	Mechatronics: Thesis: Compulsory
	Biomedical Engineering: Thesis: Compulsory Microelectronics and Microsystems: Thesis: Compulsory
	Product Development, Materials and Production: Thesis: Compulsory
	Renewable Energies: Thesis: Compulsory
	Naval Architecture and Ocean Engineering: Thesis: Compulsory



Ship and Offshore Technology: Thesis: Compulsory	
Theoretical Mechanical Engineering: Thesis: Compulsory	
Process Engineering: Thesis: Compulsory	
Water and Environmental Engineering: Thesis: Compulsory	