HOCHSCHULE MAGDEBURG-STENDAL

Fachbereich Wasser- und Kreislaufwirtschaft

Modulhandbuch des internationalen Masterstudiengangs

Water Engineering (M. Eng.)

Regelstudienzeit: **3 Semester Vollzeit**

Anzahl der Credits: **90**

Magdeburg, April 2014

Inhaltsverzeichnis

Modulbezeichnung/ module notation	**1. Hydrological Plannings and Projects I**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	HPPI
Lehrveranstaltungen/ courses	1.1 Analysis of water resource systems
	1.2 Design of water resources systems
	1.3 Water management plans
	1.4 Water economy and legislation
Modulverantwortlicher/ module responsible	Prof. Dr. Sc Francisco Padilla Benitez
Dozent(in)/ lecturer	Prof. Dr. Sc Francisco Padilla Benitez, Prof. Dr. Meng. Ricardo Juncosa Rivera, Prof. Dr. MEng. Juan Acinas, Ass. Prof. Gustavo Vazquez
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Compulsory module
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Hydrology, Environmental Engineering
Form der Prüfung/ form of exam	homework or project
Angestrebte Lernergebnisse/ target educational objective	Students are able to analyse and design water management systems
1.1 Analysis of water resource systems	Assessment and analysis of water resource systems. Water withdrawals and uses.
1.2 Design of water resources systems	Methods of analysis: identification, optimization, uncertainties, objectives and control of water management plans. Introduction to data management systems by GIS. Design of water resources systems and planning. Water economy and legislation.
1.3 Water management plans	Groundwater management. Surface water management.
1.4 Water economy and legislation	
Medienformen/ used media	Powerpoint presentation, White board
Literatur/ literature	Script

Modulbezeichnung/ module notation	**2. Water supply and drainage systems**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	WSDS
Lehrveranstaltungen/ courses	2.1 Supply systems design
	2.2 Urban drainage
Modulverantwortlicher/ module responsible	Prof. Dr Meng Pablo Rodriguez-Vellando
Dozent(in)/ lecturer	Prof. Dr Meng Pablo Rodriguez-Vellando, Ass. Prof. Gustavo Vazquez, Prof. Dr. Javier Sanz, Prof. Alberte Martinez, Meng Hector Garcia Rabade, Prof. Dr. Meng. Cristina Vazquez
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Compulsory module
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Hydrology, Environmental Engineering
Form der Prüfung/ form of exam	practica
Angestrebte Lernergebnisse/ target educational objective	Students are able to
2.1 Supply systems design	Construction planning, Introduction to SUDS, Pre-treatment systems, green roofs, rainwater, filter strips, trenches, swales, bioretention,
2.2 Urban drainage	How SUDS differ from conventional drainage, Erision, Sediment control, Pollution control, inspections, Method statement, Sand filters, infiltration basins, wetlands
Medienformen/ used media	Script, Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**3. Physico-Chemistry and Quality of Water**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	PCQW
Lehrveranstaltungen/ courses	3.1 Principles of water chemistry
	3.2 Water quality
	3.3 Analytical technics
Modulverantwortlicher/ module responsible	Prof.Dr. MSc Jordi Delgado Martinez
Dozent(in)/ lecturer	Prof.Dr. MSc Jordi Delgado Martinez, Dr. Sc. Ana Vazquez
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Compulsory module
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Chemistry and Physics
Form der Prüfung/ form of exam	Experimental work and homework
Angestrebte Lernergebnisse/ target educational objective	Learning the basic principles of water chemistry.Learning the basic principles of the analytical techniques aimed at quantifying the concentrations of water contaminants and their constituents.bility to establish relationships between physico-chemical data and the chemical state of a water body or the prescribed legal environmental quality objectives. Concentration units Colligative properties Mass action law and the equilibrium constant Sampling and monitroing Routine parameters Special determinations In situ vs. laboratory determinations Sampling surveys for ground, precipitation, stream and lake/reservoir waters Sampling frequency Analitical techniques and quality assessment Accuracy, precission, bias Detection and quatification limits Titrations Analytical techniques (spectrophtometry, ICP, ...) Data analysis and interpretation Fundamentals of descriptive statistics Graphic analysis of water chemistry data Time series representation and analysis Hydrochemical processes and modelling

	Chemical reactions and temperature dependence Equilibrium vs. kinetic processes Ion speciation Acidity and alkalinity Solid dissolution/precipitation processes Ion exchange and sorption Redox processes Aqueous modelling with PHREEQC
3.1 Principles of water chemistry	Basics of water chemistry ,Mol and stoichiometry Aqueous interactions and chemical bonding, Structure and properties of water, Aqueous interactions and chemical bonding, Routine parameters, In situ vs. laboratory determinations, Sampling frequency, Accuracy, precission, bias
3.2 Water quality	Concentration units, Mass action law and the equilibrium constant, Sampling surveys for ground, precipitation, stream and lake/reservoir waters , Detection and qualification limits, Graphic analysis of water chemistry data, Acidity and alkalinity, Chemical reactions and temperature dependence, Equilibrium vs. kinetic processes
3.3 Analytical technics	Analytical techniques (spectrophtometry, ICP, ...), Redox processes, Aqueous modelling with PHREEQC, Ion exchange and sorption
Medienformen/ used media	Script, Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**4. Experimental Hydraulics I**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	EH I
Lehrveranstaltungen/ courses	4.1 Scale models I
	4.2 Experimental field techniques
Modulverantwortlicher/ module responsible	Prof. Meng Juan Ramon Rabunal
Dozent(in)/ lecturer	Prof. Meng Juan Ramon Rabunal, Dr, Sc Ana Vazquez
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Fluid Mechanics and Physics
Form der Prüfung/ form of exam	Experimental work
Angestrebte Lernergebnisse/ target educational objective	Students are able to use investigations and tests in experimental in hydraulics for the prediction of hydraulic processes
4.1 Scale models I	Froude-models, use of physical models, control sections, apllied physical models, hydraulic flumes, wave basin
4.2 Experimental field techniques	Experimental field technics, Instrumentation systems i.e. sensors, actuators, Control modules, data aquisition
Medienformen/ used media	Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**5. Computational Fluid Dynamics I**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	CFD I
Lehrveranstaltungen/ courses	5.1 Mathematics I
	5.2 Finite element programming
	5.3 Porous media and geochemical models
Modulverantwortlicher/ module responsible	Prof. Dr.-Ing. Pablo Vellando
Dozent(in)/ lecturer	Prof. Dr.-Ing. Pablo Vellando, Prof. Dr Meng Jaime Fe Marques, Res Hector Garcia Rabade
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture and exercises
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Fluid Mechanics and Physics, Mathematics for Engineers
Form der Prüfung/ form of exam	homework or written examination
Angestrebte Lernergebnisse/ target educational objective	The students are able to use computational models as an instrument for the prediction of hydraulic processes.
5.1 Mathematics I	Fundamentals of Open Channel flow,Computational Fluid Dynamics,Saint-Venant-Equation, Navier-Stokes-Equation, Shallow-Water-Convection-Diffusion
5.2 Finite element programming	Finite Elements programming, Fundamentals of Finite Volume programming, Matlab programming, Hydrodynamic models
5.3 Porous media and geochemical models	Darcy equation, Porous media models,Governing equations, Geochemical models, commercial programms
Medienformen/ used media	Powerpoint presentation, Computer
Literatur/ literature	J. Puertas Agudo (2000). Apuntes de Hidráulica de Canales. Nino,J. Donea (2003). Finite Element Methods for Flow Problems. Wiley, O. Pironneau (1989). Finite Element Methods for Fluids. Wiley, G. Carey, J. Oden (1984). Finite Elements. Prentice-Hall, A. Chadwick (1986). Hydraulics in Civil Engineering. Allen&Unwin, P. Gresho, R Sani (2000). Incompressible flow and the finite element method. Wiley, Singiresu Rao (2005). The Finite Element Method in

	Engineering. Elsevier, O. C. Zienkiewicz, R.L. Taylor (1982). The Finite Element Method. Vol 3, Fluid dynamics. Mc Graw Hill

Modulbezeichnung/ module notation	**6. Water Treatment and Energy Efficency**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	WT Codenumber 632844206
Lehrveranstaltungen/ courses	6.1 Water treatment processes
	6.2 Power consumption
	6.3 Environmental implications
Modulverantwortlicher/ module responsible	Dr Sc Maria Jose Servia
Dozent(in)/ lecturer	Dr Sc Maria Jose Servia,, Meng Margarita Martinez, Dr. Sc Ana Vazquez
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Chemistry, hydraulic engineering, Fluid dynamics
Form der Prüfung/ form of exam	homework
Angestrebte Lernergebnisse/ target educational objective	Students are able to
6.1 Water treatment processes	Effects of pollutants on aquatic ecosystems, The use of bioindicators to assess freshwater quality, The functioning of freshwater ecosystems, Lentic systems, Lotic Systems, Microbes and plants, animals suborganisam effects, supraorganism effects,
6.2 Power consumption	Chemical contaminants of water, Bioindicators recommende by the Water Framework Directive, Types, Standards, Problems,Health Effects and Impact on the environment, Coagulation precipitation, Oxidation reduction, ion exchange, Desinfection, High service pumping, water plant residuals management,
6.3 Environmental implications	Freshwater biodiversity. Types of aquatic organisms, Types of water contamination, Analytical methods for the determination of physicochemical parameters, Domestic waste water, livestock wastewater, industrial wastewater, Municipal waste water
Medienformen/ used media	Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**7. Groundwater Engineering I**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	GE I
Lehrveranstaltungen/ courses	7.1 Physical Hydrogeology
	7.2 Hydrogeochemical principles
	7.3 Hydrodynamic in aquifers
Modulverantwortlicher/ module responsible	Prof. Dr. Sc Francisco Padilla Benitez
Dozent(in)/ lecturer	Prof. Dr. Sc Francisco Padilla Benitez, Prof. Dr. Meng. Ricardo Juncosa Rivera, Prof. Dr. MEng. Juan Acinas, Ass. Prof. Gemma Soriano Hoyuelos
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Physics, Fluid dynamics
Form der Prüfung/ form of exam	Practica
Angestrebte Lernergebnisse/ target educational objective	Overwiew of basic and applied aspects of hydrogeology from needs of civil engineering. Ability to design and interpret the hydraulics tests and hydrodynamic characterization of medium, interpreting hydrogeological maps ans constructive ways of sources
7.1 Physical Hydrogeology	Introduction to the Hydrologic Cycle, Baseflow, Evapotranspiration and potencial Evapotranspiration, Infiltration and recharge, Continental environments, erosion, transportation and deposition,fluvial, eolian, lacustrine, glacial deposits, uplift, diagenesis and erosion
7.2 Hydrogeochemical principles	Basic concepts, Tectonism and the formation of fractures, Darcy´s experimental law and field extensions, porosity and hydraulic conductivity, Field mapping,
7.3 Hydrodynamic in aquifers	Flow in fractured rocks, conservation of fluid mass, storage properties of porous media, boundary conditions and flow nets, Unsaturated flow in fractured rocks, Richard´s equation, Soute and particle transport
Medienformen/ used media	Powerpoint presentation, White board
Literatur/ literature	Script

Modulbezeichnung/ module notation	**8. Hydraulic Plannings and Projects II**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	HPP II
Lehrveranstaltungen/ courses	8.1 Global Water resource management and strategies
	8.2 Design of dams, water treatment and waste waterplants
	8.3 Plannings and project
Modulverantwortlicher/ module responsible	Prof. Dr.-Ing. Bernd Ettmer
Dozent(in)/ lecturer	Prof. Dr.-Ing. Gilian Gerke Dr. Thilo Weichel Prof. Dr.-Ing. Bernd Ettmer Prof. Dr.-Ing. Uwe Brettschneider Prof. Dr.-Ing. Torsten Schmidt
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Compulsory module
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture and excursion
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Hydrology, Environmental Engineering
Form der Prüfung/ form of exam	Homework or written examination
Angestrebte Lernergebnisse/ target educational objective	Planning strategies and design of water management systems, Rehabilitation of water management systems
8.1: Global Water resource management and strategies (Gerke, Weichel)	Global water resources management and strategies, Project management software, Flood-control and flood protection, hydraulic design of dikes
8.2: Design of dams, water treatment and waste waterplants (Schmidt, Brettschneider, Ettmer)	Design of dams in international consulting projects, Rehabilitation of dam structures, Design of spillways, Design of Waste water plants construction details, Water supply and water treatment
8.3: Plannings and project (Schmidt)	Design of sewage systems and potable system, rehabilitation of pipline systems
Medienformen/ used media	Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**9. GIS and Hydrology**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	GH
Lehrveranstaltungen/ courses	9.1 GIS and Hydrology
	9.2 Advanced Hydrology
	9.3 Geohydraulic design criterias
Modulverantwortlicher/ module responsible	Prof. Dr. rer. nat. habil. Frido Reinstorf
Dozent(in)/ lecturer	Prof. Dr. rer. nat. habil. Frido Reinstorf Dr.-Ing. Peter Grubert
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Compulsory module
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydrology, Environmental Engineering, Mathematics for Engineers
Form der Prüfung/ form of exam	homework
Angestrebte Lernergebnisse/ target educational objective	Data processing and analysis; mapping and data visualization, Autonomous work with GIS-tools, Hydrological modeling
9.1: GIS and Hydrology (Reinstorf)	GIS is used as vehicle to deliver environmental knowledge and spatial information. The series of courses emphasize students to investigate the environment, use GPS marking geographic locations, and further collect environmental information. The students learn to work with GIS incl. georeferencing, data processing and analysis as well as mapping. All students create in a scientific project their own maps with individual hydrological subjects, integrate environmental information, and adopt the spatial analyses with ArcGIS 10 software. The objective of this courses is to cultivate students' capabilities of collecting, displaying and analyzing spatial information.
9.2: Advanced Hydrology (Reinstorf)	The students learn the basics of high flood prevention and flood protection measures, including the typical buildings and facilities. They learn to create a data base and base maps for determination of hydrological flooding events like flooding maps and damage risk maps.

9.3: Geohydraulic design criterias (Grubert)	Application of an geohydraulic model under seepage aspects of dikes and dam structures. Calculation of dambreak situation.
Medienformen/ used media	Powerpoint presentation, White board
Literatur/ literature	Script

Modulbezeichnung/ module notation	**10. Restoration Ecology**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	RE
Lehrveranstaltungen/ courses	10.1. Ecology and restoration of rivers
	10.2. Ecology and restoration of lakes
	10.3. Project in river restoration
Modulverantwortlicher/ module responsible	Prof. Dr. rer. nat. habil. Volker Lüderitz
Dozent(in)/ lecturer	Prof. Dr. rer. nat. habil. Volker Lüderitz Prof. Dr. Richard Gersberg Dr. rer. nat. Karsten Rinke Prof. Dr. José Ramón Arévalo
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Compulsory module
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture and excursion
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Hydrology, Environmental Engineering
Form der Prüfung/ form of exam	homework
Angestrebte Lernergebnisse/ target educational objective	Students are able to identify main processes in ecological and restauration projects of rivers and lakes. They learn the practice of ecological analysis and basics in ecological planning
10.1: Ecology and restoration of rivers (Lüderitz)	Ecology and restauration of rivers. Using makrozoobenthos as indicator.
10.2: Ecology and restoration of lakes (Rinke, Arevalo)	Basics in lake ecology and lake restauration. Ecology and restauration aspects in international projects. Projectmanagement and strategies.
10.3: Project in river restoration (Lüderitz)	River restauration project with application of theretical methods in practice. Identification of macrozoobenthos as idicator for restauration quality
Medienformen/ used media	Script, Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**11. Experimental Hydraulics II**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	EH II
Lehrveranstaltungen/ courses	11. 1 Scale models II
	11.2 Morphological flume experiments
	11.3 Scouring at hydraulic structures
Modulverantwortlicher/ module responsible	Prof. Dr.-Ing. Bernd Ettmer
Dozent(in)/ lecturer	Prof. Dr.-Ing. Bernd Ettmer Stefan Orlik, M.Eng. Franciska Orth, M.Eng.
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture, laboratory work and excursion
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Fluid Mechanics and Physics
Form der Prüfung/ form of exam	homework
Angestrebte Lernergebnisse/ target educational objective	The students are able to use and interpretate experimental tests as an instrument for the prediction of hydraulic and morphological processes.
11.1: Scale models II (Ettmer)	Review to Froude and Reynolds similarity laws and basics in model scaling. Morphological similarity laws and application on physical models. Physical models as an instrument of prediction for hydraulic and morphological processes. Basic research and applied research experments.
11.2: Morphological flume experiments (Orlik)	Morphological flume experiments with experimental tests. Autonomous measurement of settling velocity and critical velocity for the initiation of motion of sediment particles as most important parameters for morphological processes. Flume experiments in a sediment recirculating flume with a high resolution detection of sediment transport.
11:3: Scouring at hydraulic structures (Orth)	Erosion processes and scouring at hydraulic structures like piers, abutments, wiers etc. . Experimental tests aunder clear water, bed-load and suspension load conditions. Prediction of morphological processes.
Medienformen/ used media	Script, Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**12. Computational Fluid Dynamics II**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	CFD II
Lehrveranstaltungen/ courses	12.1. Mathematics II
	12.2. 1 D-Models
	12.3. 2 D-Models
Modulverantwortlicher/ module responsible	12.4. 3 D-Models
Dozent(in)/ lecturer	Prof. Dr.-Ing. Gehard Böttge
	Prof. Dr.-Ing. Gehard Böttge Dr. math. Falk Heße Daniel Hesse, M.Eng. Dipl.-Ing. Michael Marek
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture and exercises
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Fluid Mechanics and Physics, Mathematics for Engineers
Form der Prüfung/ form of exam	homework
Angestrebte Lernergebnisse/ target educational objective	The students are able to use computational models as an instrument for the prediction of hydraulic processes.
12.1: Mathematics II (Heße)	Within the scope of this module the students engage a range of advanced topics from CFD. This comprises solution techniquies for unsteady flow problems, i.e. different Euler and Runge-Kutta methods as well as classification schemes for Partial Differential Equations, i.e. elliptic, parabolic and hyperbolic PDE's. The latter issue will be connected to different flow regimes and the numerical solution techniques applicable for each type (Finite-Difference, Finite-Volume, Finite-Elements). The course itself contains both lectures and exercises, which are fully integrated into each other. The exercises themselves are both analytical and numerical, with the latter using the technical language Matlab.
12.2: 1 D-Models (Hesse)	Theoretical background of 1D- models using Bernoulli-Equation. Using of 1D- HEC-Ras software in a pratical application.

12.3: 2 D-Models (Böttge)	Theoretical background of Double-Averaged-Reynolds-Equation, Differentiation of 1D- and 2D-numerical model, Grid construction using SMS and RMA, Practical application.
12.4: 3 D-Models (Marek)	Theoretical Background: 3D-Navier-Stokes-Equations; Differentiation of 1D-, 2D-, and 3D-Numerical Models; Methods for Domain Discretization; Methods for Equation Discretization; Turbulence Modelling (RANS), Practical Application: Exercises using the Software SSIIM
Medienformen/ used media	Powerpoint presentation, White board, Computer
Literatur/ literature	

Modulbezeichnung/ module notation	**13. River Morphology**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	RM
Lehrveranstaltungen/ courses	13.1 River Morphology
	13.2 Sediment transport
	13.3 Planning and Projects
	13.4 Sedimentation and Erosion
Modulverantwortlicher/ module responsible	Prof. Dr.-Ing. Bernd Ettmer
Dozent(in)/ lecturer	Dr.-Ing. Francisco Nuñez-Gonzalez Prof. Dr.-Ing. Juan P. M. Vide Prof. Dr.-Ing. Oscar Link Prof. Dr.-Ing. Jochen Aberle, Prof. Dr.-Ing. Bernd Ettmer
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	Hydraulics, Hydrology, Fluid Mechanics and Physics
Form der Prüfung/ form of exam	Homework or written examination
Angestrebte Lernergebnisse/ target educational objective	Students are able to describe and analyse morphological processes in rivers and reservoirs. They are able to calculate and predict morphological processes.
13.1: River Morphology (Nuñez, Vide)	Basics in river morphology. Definition of sediment particles, Calculation of initiation of motion of sediment particles, calculation of settling velocities, Erosion and sedimentation basics, sharp bents, scouring and deposition.
13.2: Sediment transport (Link)	Sediment transport processes in rivers and reservoirs, Calculation and prediction of sediment transport by using typical approaches and eqautions. Diferentiation between bed load and suspension load calculations.

13.3: Planning and Projects (Ettmer)	Application of sedimetation and erosion processes to an international hydraulic engineering project. Calulation, interpretation and prediction of morphological processes. Using a 1D-model for morphological calulation.
13.4: Sedimentation and Erosion (Aberle)	Understanding of sediment transport mechanisms and basic concepts for gravel bed rivers, Classification of sediment transport processes, Critical shear stress concept and incipient motion for granular material, Armour layer development, Examples of Bed load and Suspended sediment transport and Reservoir sedimentation.
Medienformen/ used media	Script, Powerpoint presentation, White board
Literatur/ literature	

Modulbezeichnung/ module notation	**14. Environmental biotechnology and hydrochemistry**
Modulniveau/ module level	Master
Studiensemester/ semester	2
Kürzel/ abbreviation	EBH
Lehrveranstaltungen/ courses	14.1 Environmental biotechnology and hydrochemistry
	14.2 Water Chemistry
Modulverantwortlicher/ module responsible	Dr. Uta Langheinrich
Dozent(in)/ lecturer	Dr. Uta Langheinrich Prof. Dr. Carmen Rubio Armendáriz Dr.-Ing. Anne Becker Dr.-rer.nat. Bernd Feuerstein
Sprache/ language	english
Zuordnung zum Curriculum/ correlation to curriculum	Optional course
Lehrform/SWS/ teaching form/contact hours	6 SWS lecture, practical training and fieldwork
Arbeitsaufwand/ amount of work	180 h
Kreditpunkte/ credit points	6
Voraussetzungen nach Prüfungsordnung/ requirements	Bachelor degree
Empfohlene Voraussetzungen/ recommended requirements	high school graduation in biology, knowledge in microbiology
Form der Prüfung/ form of exam	homework
Angestrebte Lernergebnisse/ target educational objective	Students are able to use biological and hydrochemical methods for the assessment of water bodies
14.1: Environmental biotechnology and hydrochemistry (Langheinrich, Rubio, Becker)	Planing and management of constructed wetlands, Knowledge about various biological processes and methods for treatment of water-, air- and soil-pollutions, toxicological effects oft different loads
14.2: Water Chemistry (Feuerstein)	Methods and processes for detection and assessment of different environmental pollutants
Medienformen/ used media	Script, Powerpoint presentation, White board
Literatur/ literature	G. Biiton: Wastewater microbiology. WILEY 2005