Hochschule Bremen
City University of Applied Sciences
Faculty 2: Architecture, Civil and Environmental Engineering

Civil and Environmental Engineering (Infrastructure) M.Sc.

Bremen 09.01.2017

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Module Manual for the Master Courses B&U Infrastructure

Courses and Examinations

Excerpt from the subject-specific part of the master's examination regulations for civil and environmental engineering (infrastructure)

1. Semester

No.	Exam. No.	Abbr.	Course Title	SWS[1)]	ECTS[2)]	EX[3)4)]
1.1	**1110**	GRIS	**Principles of Infrastructural Systems**	**4**	**6**	R
1.1.1			Principles of Regional Development	2		
1.1.2			Infrastructures of Civil Engineering Hydraulic Systems	2		
1.2	**1111**	EMSI	**Experiment, Model and Simulation**	**4**	**6**	HA
1.2.1			Mathematical Modeling and Simulation	2		
1.2.2			Experimentelle Mechanics	2		
1.3	**111x**	WPF1	**Elective Module 1**	**4**	**6**	
1.4	**111x**	WPF2	**Elective Module 2**	**4**	**6**	
1.5	**111x**	WPF3	**Elective Module 3**	**4**	**6**	
				20	**30**	

Elective Modules

for professional differentiation **Civil Engineering**

No.	Exam. No.	Abbr.	Course Title	SWS[1)]	ECTS[2)]	PL[3)4)]
1.6	**1112**	WAGE	**Hydraulic and Geotechnical Engineering**	**4**	**6**	ENT+R, KOL
1.6.1			Hydraulic Engineering	2		
1.6.2			Geotechnical Engineering	2		
1.7	**1113**	TRIB	**Load-bearing structures for infrastructure buildings**	**4**	**6**	ENT+KOL
1.7.1			Structural Design of Reinforced Concrete Construction	2		
1.7.2			Structural Design of Steel Construction	2		
1.8	**1114**	VEGE	**Traffic Infrastructure and Geotechnical Engineering**	**4**	**6**	ENT+R, KOL
1.8.1			Traffic Route Engineering	2		
1.8.2			Soil Engineering	2		

for professional differentiation **Environmental Engineering**

No.	Exam. No.	Abbr.	Course Title	SWS[1)]	ECTS[2)]	PL[3)4)]
1.9	**1115**	WAWI	**Water and Wastewater Management**	**4**	**6**	HA+KOL
1.9.1			Water and Wastewater Management	4		
1.10	**1116**	BMAW	**Circular Bioeconomy**	**4**	**6**	R, EX
1.10.1			Circular Bioeconomy	4		
1.11	**1117**	ENTS	**Disposal Technology**	**4**	**6**	R, PF
1.11.1			Disposal Technology	4		

In the case of elective modules, a module from other subject differentiation can be selected with regard to the professional specialization.

2. Semester

No.	Exam. No.	Abbr.	Course Titel	SWS[1)]	ECTS[2)]	PL[3)4)]
2.1	**1210**	RBIS	**Framework conditions of infrastructural systems**	**4**	**6**	PF
2.1.1			Basic Principles	3		
2.1.2			Management Games	1		
2.2	**1220**	PPLA	**Project Planning**	**4**	**6**	PF
2.2.1			Scientific Project Planning	2		
2.2.2			Individual Project Planning	2		
2.3	**1230**	PBAU	**Project „Civil and Environmental Engineering - Infrastructure“**	**12**	**18**	
2.3.1			Material and Methods	4		PA+PR
2.3.2			Project Implementation	4		PA+PR
2.3.3			Project Evaluation	4		PA+PR
				20	**30**	

3. Semester

No.	Exam. No.	Abbr.	Course Title	Weeks	SWS[1)]	ECTS[2)]	PL[3)4)]
3.1	**1310**	THES	**Master Thesis and Thesis Seminar**	22	4	**30**	Thesis + KOL
					4	**30**	

[1)] Workload in SWS; SWS: Semester –Week-Hours = Semester Hours per Week
[2)] ECTS (European Credit Transfer System) or Credit Points (CP)
[3)] Individual Examination for each Course
[4)] EX = Types of Examination, see Examination Regulations AT-MPO and FT-MPO

Module Name: Principles of Infrastructural Systems

Module Code	M1.1 GRIS

Semester	1th Semester
Person in Charge	Prof. Dr.-Ing. Carsten Müller
Competence Goals	By successfully passing this module, students can • name, apply and evaluate framework conditions of infrastructural networking through the specifications of regional planning • recognize the sectoral structures of the energy system and their transitions, and develop and evaluate solutions for the integration / coupling of renewable energies into them • independently carry out, present and defend the content of methodically well-founded analyses of infrastructures.
Course Content	The following topics will be covered: • Regional planning and their legal and planning principles • Planning hierarchies and responsibilities of federal, state and local authorities • Status quo and development of the various energy systems (sectoral structures and interfaces between heating, electricity and gas networks, e.g. power-to-gas) • Network development, electric supply network (On- und Offshore) • Basics principles of using renewable energies with special infrastructural requirements, such as offshore wind energy / ocean energy
Course Type	compulsory module
Lecture Type	seminar
Exam Typ /Exam Duration (expected for awarding credit points)	report (R)
Requirements for participation	none
Add. Useability	
Course Workload	60 h Lectures + 120 h. Self-Study = 180 h.
Lectures	60 h

Self-Study	120 h,
Credit Points (ECTS)	6
Duration and Frequency	15 events per academic year only in the Fall Semester
Language of Instruction	German
Literature	A list of current specialist literature is made available to the students at the beginning of the course.

Teaching Courses		
Instructors	Titel of Course	SWS
Prof. Dr.-Ing. Müller	Principles of Regional Development	2,0
Prof. Dr.-Ing. von Horn	Infrastructures of Civil Engineering Hydraulic Systems	2,0

Module Name: Experiment, Model und Simulation

Module Code	M1.2 EMSI

Semester	1th Semester
Person in Charge	Prof. Dr.-Ing. Marc Gutermann
Competence Goals	By successfully passing this module, students can: • Understand and apply mathematical modeling of technical or natural systems and processes of technical infrastructure, civil and environmental engineering • select and apply suitable numerical methods and solution methods • Conduct parametric studies to test and verify the models • Develop test strategies, derive analytical solutions for sub-models and draw up balance sheets • Name and apply statistical experimental designs to optimize the models, • Plan and use model-based measurements to monitor and control processes and procedures in technical infrastructure and construction
Course Content	The following topics will be covered: • Mathematical forecasts, process and procedure visualizations as well as parameter studies and data interpretation are carried out on selected models from the construction industry, from the environmental or the energy technology: • Models of mechanical systems from civil engineering, energy and process engineering • Numerical Methods for Solving Differential Equations, Data Interpolation, Regression Analysis und Optimization • Analytical Methods for Solving simple Differential Equation • procedural and object-oriented programming languages, Algorithmen und Numeric (C++/Fortran/Matlab) • Parameter estimation method for adaptive control • Measurement-based structural analysis
Course Type	compulsory module
Lecture Type	seminar with laboratory internships
Exam Typ /Exam Duration (expected for awarding credit points)	term paper
Requirements for participation	none

Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	A list of current specialist literature is made available to the students at the beginning of the course

Teaching Courses		
Instructors	Titel of Course	SWS
Prof. Dr. Thomas Rauscher (main focus Civil Engineering) Dr. Florian Kuhnen (main focus Environmental Engineering)	Mathematical Modeling and Numerical Simulation	2,0
Prof. Dr. Marc Gutermann	Experimental Mechanics	2,0

Module Name: Hydraulic and geotechnical engineering

Module Code	M1.6 WAGE

Semester	1st Semester
Person in Charge	Prof. Dr.-Ing. Spekker
Competence Goals	The aim of the module is to provide in-depth knowledge of infrastructural hydraulic structures with selected areas of geotechnical engineering. Upon completion of the module, students should gain knowledge of the calculation, design and construction of hydraulic engineering structures in the system network with special civil engineering. Different geotechnical aspects and boundary conditions, verifications of ultimate limit states and serviceability under special hydraulic engineering boundary conditions/structures
Course Content	In the module, the theoretical fundamentals of the following topics are developed, explained using practical construction examples and deepened using calculation examples. • Design and calculation of hydraulic structures such as dykes, • dams, • docks and weir structures as well as • port and quay facilities with special requirements for subsoil and stability, taking into account • Structural systems with columns and geogrid reinforcement • Soil-structure interaction (bedding models) • Shear laws • Material laws of soil mechanics • Subsurface hydraulics • Fluid forces in soil • Earth pressure and earth resistance in flowing groundwater • hydraulic ground failure and hydraulic bottom failure • buoyancy problems
Course Type	Elective module in the specialization civil engineering
Lecture Type	Seminar
Exam Typ /Exam Duration (expected for awarding credit points)	Draft incl. presentation, Colloquium 30 min
Requirements for participation	none

Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	A list of current specialist literature is made available to the students at the beginning of the course

Teaching Courses		
Instructors	Titel of Course	SWS
Dr.-Ing. Heiko Spekker	Hydraulic Engineering	2,0
Prof. Dr.-Ing. Scholz	Geotechnical Engineering	2,0

Module Name: Load-bearing structures for infrastructure buildings

Module Code	M1.7 TRIB

Semester	1th Semester
Person in Charge	Prof. Dr.-Ing. Rolf Sommer
Competence Goals	By passing the module, students will be able to, • understand and apply realistic engineering models for infrastructure structures. • understand the service and load-bearing behavior of special infrastructural solid structures by means of calculation, design and verification. • perform special verifications for infrastructural steel structures (steel plates at risk of buckling; shells at risk of stability; antennas and masts subjected to dynamic loads; fatigue problems; composite components). • use the finite element method to calculate the structural systems of infrastructure buildings. The following key skills have been developed after completing this module: • Competences for information acquisition, planning management, ability to work in a team, self-management, professional flexibility, creativity. • Process-oriented thinking and acting; understanding of interrelationships with regard to structural analysis; acquisition of the associated methodological competence
Course Content	The module serves the in-depth teaching of selected topics, in particular scientifically oriented special procedures, which are also to be related to structural design or structural analysis of infrastructure structures: **Reinforced Concrete Design:** Special requirements according to Eurocode 2; application of the finite element method in reinforced concrete construction, if necessary also non-linear methods; internal beam models for discontinuity areas; design for fire ("hot design" e.g. for tunnel structures); special structures in prestressed concrete construction, e.g. for bridges and liquid containers (e.g. for water supply and disposal) as well as for towers of wind energy plants; optional in addition: Calculation and design of shallow foundations of infrastructure buildings; structural design in existing structures. **Steel Design:** Calculation methods of braced and unbraced buckling fields incl. application of numerical program systems; shell stability with examples from wind energy; dynamically loaded chimneys and

	masts based on the single-mass oscillator with verifications of the load-bearing capacity and fatigue strength; composite structures for infrastructure buildings incl. structural fire protection. The specific interrelationships as well as the presentation of methods are on the one hand fundamentally theoretical and on the other hand accompanied by numerous application-oriented examples from solid construction and steel construction.
Course Type	Elective module in the specialization civil engineering
Lecture Type	Seminar
Exam Typ /Exam Duration (expected for awarding credit points)	Design and Colloquium
Requirements for participation	Knowledge of building material behavior and structural design; good knowledge of engineering mechanics, structural analysis and engineering mathematics (e.g. linear elasto statics, plane stress state, beam and plate theory, internal force calculation, solving linear equations, graphical representation and evaluation of functions, mechanical fundamentals of cracked and plasticized media, fundamentals of data processing; Reinforced concrete construction as well as steel construction basics
Add. Useability	
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	A list of current specialist literature is made available to the students at the beginning of the course

Teaching Courses		
Instructors	Title of Course	SWS

Prof. Dr.-Ing. Rolf Sommer	Reinforced Concrete Construction	2,0
Prof. Dr.-Ing. Stephan Lochte-Holtgreven	Steel Construction	2,0

Module Name: Traffic Infrastructure and Geotechnical Engineering

Module Code	M1.8 VEGE

Semester	1. Semester
Person in Charge	Prof. Dr.-Ing. Carsten-W. Müller
Competence Goals	The aim of the module is to provide in-depth knowledge of land transport road structures with selected areas of geotechnical engineering. Upon completion of the module, students should gain knowledge of the construction and design of traffic structures in a system network with special civil engineering. Different geotechnical aspects and boundary conditions of load-bearing capacity and serviceability under special boundary conditions of traffic route construction, such as road construction or railroad construction on subsoils with low load-bearing capacity, should also be taught.
Course Content	In the module, the theoretical fundamentals of the following topics are developed, explained using practical construction examples and deepened using calculation examples: • Calculation, design and construction of traffic infrastructure structures such as • access roads and connecting roads within and outside the city as well as • rail transport structures • with geotechnical consideration/measurement of foundation engineering specifications with regard to subsoil and stability, taking into account • subsoil expertise • Excavation pits as complex earth static systems • slope and terrain failure • Diaphragm walls and narrow walls • Construction on subsoil with low bearing capacity • Preloading and backfill methods
Course Type	Elective module in the specialization civil engineering
Lecture Type	Seminar
Exam Typ /Exam Duration (expected for awarding credit points)	Draft incl. presentation Colloquium 30 min
Requirements for participation	none
Add. Useability	for engineering or science degree programmes

Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	A list of current specialist literature is made available to the students at the beginning of the course

Teaching Courses		
Instructors	Title of Course	SWS
Prof. Dr.-Ing. Carsten-W. Müller	Surface Transportation	2,0
Prof. Dr.-Ing. Christian Scholz/ Dr. Alois Steiner or lecturers according to current conditions	Foundation Engineering	2,0

Module Name: Water and Wastewater Management

Module Code	M1.9 WAWI

Semester	1th Semester
Person in Charge	Prof. Dr.-Ing. Lars Jürgensen
Competence Goals	By successfully passing this module, students will be able to: • recognize essential issues of a complex water or wastewater engineering task and create solutions under economic aspects • Apply the basics of process and reaction engineering to find an economical solution to the problems • Select and optimize technically and economically suitable plant components for the required solution • Dimension and optimize the plant with all plant components, apparatus and piping required for the solution concept • Design and optimize the measurement and control technology required for economically optimal operation • Estimate the investment and operating costs of the selected solution concept • Carry out an economic comparison between several solutions for the problem at hand
Course Content	The module provides advanced knowledge from water and wastewater management in the context of infrastructure measures. The following aspects are dealt with in detail: • Basics and boundary conditions of a present complex water or wastewater technical project • Analysis of water or wastewater engineering issues with the aim of developing an economic solution concept • Modeling of treatment processes based on balance equations • Selection of technically and economically optimal processes by comparing the advantages and disadvantages for the concept at hand • Economically optimal choice of plant components to be considered for these processes • Dimensioning of these plant components by application of rules and/or balance equations • Presentation of the solution concept found in the form of complex basic and process flow diagrams • Selection of MSR technology required for technically and economically optimal operation

	• Dimensioning of piping and valves and their representation in the form of R+I flow diagrams • Estimation of the investment and operating costs of the solution concept found • Comparison of economic efficiency on the basis of annual costs
Course Type	Elective module in the specialization environmental engineering
Lecture Type	Gruppenunterricht, Exkursionen
Exam Typ /Exam Duration (expected for awarding credit points)	Homework with Colloquium (PL)
Requirements for participation	None
Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	Textbook and manual of wastewater engineering / published by the Abwassertechnische Vereinigung e. V. Industrial wastewater containing inorganic substances / edited by Abwassertechnische Vereinigung e. V. Biological-chemical and advanced wastewater treatment / edited by Abwassertechnische Vereinigung e. V. Wiesmann, Udo: Fundamentals of Biological Wastewater Treatment Regulations of the DWA

Lehrveranstaltungen		
Dozent(in)	Titel der Lehrveranstaltung	SWS
Prof. Dr.-Ing. Lars Jürgensen	Water- and Wastewater Management	4,0

Module Name: Circular Bioeconomy

Module Code	M1.10 BMAW

Semester	1th Semester
Person in Charge	Prof. Dr.-Ing. Anja Noke
Competence Goals	By successfully passing this module, students will be able to: • identify opportunities to use biomass for materials and energy and to integrate it into regional resource cycles. • identify the application and control options for pure and mixed culture systems by comparative consideration of biotechnical processes • select and evaluate biotechnical methods for the conversion of biomass and biogenic residues with enzymes and specialized production strains • independently develop proposals for biological optimization of process sequences (microbiological, process engineering) • recognize the social and ecological impacts of biomass utilization and develop sustainable proposals for solutions • find, understand, critically evaluate and compare English texts
Course Content	Specifically, the following topics will be addressed: • Identification and evaluation of usable biomass sources: Main characteristics, accumulation and processing. • Metabolism and growth of microorganisms as a basis for the conversion performance of microorganisms • Laboratory methods for testing the conversion potential of different substrates • Optimization of pure or mixed cultures and processing steps in biotechnical processes • Microorganisms and enzymes in environmental protection, e.g. in paper, textile and plastics production • Energy from biomass: biogas, hydrogen, ethanol • Biorefineries: Possibilities of an integrated material-energetic utilization of biomass
Course Type	Elective module in the specialization environmental engineering
Lecture Type	Seminar with Journal Club, lab work if applicable.

Exam Typ /Exam Duration (expected for awarding credit points)	Referat einschl. Vortrag (PL), experimentelle Arbeit (SL)
Requirements for participation	none
Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	Primarily current original publications from scientific journals Kamm, B. ed. (2010) Biorefineries - Industrial Processes and Products: Status Quo and Future Directions, Wiley-VCH Kaltschmitt, M. et al. (2009) Energy from biomass, Springer Verlag Madigan et al. (2015): Brock Biology of Microorganisms Addison-Wesley. Sadhukhan, J., Siew Ng, K., Martinez Hernandez, E. (2014) Biorefineries and Chemical Processes: Design, Integration and Sustainability Analysis, Wiley. Sahm, H. et al (2013) Industrial microbiology. Springer Spectrum.

Teaching Courses		
Instructors	Titel of Courses	SWS
Prof. Anja Noke	Circular Bioeconomy (Biomassewirtschaft)	4,0

Module Name: Disposal Technology

Module Code	M1.11 ENTS

Semester	1th Semester
Person in Charge	Prof. h.c. Dr.-Ing. Martin Wittmaier
Competence Goals	By successfully passing this module, students will be able to: • apply essential scientific methods relevant to the subject in a problem and project-related manner • analyze and evaluate material flow related processes in technical systems of the circular economy • develop strategies for optimization and implement them in selected examples (material flow management) • work out and present technically and ecologically reasonable, legally and organizationally feasible solutions.
Course Content	The module serves to teach selected topics on resource efficiency, especially in connection with infrastructure systems and energy systems. In detail, the following aspects are covered: • Material and energy flow analysis: procedures, qualitative and quantitative description, evaluation parameters, mathematical descriptions, analysis of process chains incl. use of data processing tools (e.g. UMBERTO®) • Collection, intermediate storage and transport of waste • Design and calculation of selected processes, such as recycling of household waste, urban mining, construction waste recycling, thermal waste treatment
Course Type	Elective module in the specialization environmental engineering
Lecture Type	Seminar
Exam Typ /Exam Duration (expected for awarding credit points)	Referat (SL), Portfolio (PL)
Requirements for participation	none
Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h

Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the spring term, 15 events
Language of Instruction	German / English
Literature	Heck/Bemmann (2002): Stoffstrommanagement Cologne; Deutscher Wirtschaftsdienst Scholz/Beckmann/Schulenburg (2001): Waste treatment in thermal plants Stuttgart; Teubner Kranert/Cord-Landwehr (2010): Introduction to Waste Management Wiesbaden; Vieweg+Teubner.

Teaching courses		
Instructors	Titel of Courses	SWS
Prof. h.c. Dr.-Ing. Martin Wittmaier	Disposal Technology	4,0

Module Name: Framework conditions of infrastructural systems

Module Code	M2.1 RBIS

Semester	2nd Semester
Person in Charge	Prof. Dr.-Ing. Jürgen Knies
Competence Goals	By successfully passing this module, students will be able to: • Analyze and assess legal framework conditions in a project-related manner • Analyze and evaluate the ecological framework in relation to the project • Analyze and evaluate economic framework conditions in relation to projects • establish links between the above-mentioned areas in projects and present them in a clear manner
Course Content	The module serves to teach selected topics for the preparation and support of the project modules in the areas of construction, environment and energy. In detail, the following aspects are covered: • Plant and construction-related building law, planning law, public procurement law, environmental law, plant law, energy law • Life cycle assessment, resource efficiency • management systems • Process and life-cycle related cost accounting, investment planning
Course Type	Compulsory module
Lecture Type	Seminar
Exam Typ /Exam Duration (expected for awarding credit points)	Portfolio (PL)
Requirements for participation	none
Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.

Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the autumn term, 15 events
Language of Instruction	German / English
Literature	A list of current literature will be provided to students at the beginning of the course.

Teaching courses		
Instructors	Titel of Courses	SWS
Prof. Dr.-Ing. Jürgen Knies	Fundamentals of spatial planning	3
Dipl.-Kfm. Thomas Kircher	Management game	1

Module Name: Project Planning

Module Code	M2.2 PPLA

Semester	2nd Semester
Person in Charge	Prof. Dr. Silke Eckardt
Competence Goals	By successfully passing this module, students will be able to: • determine and evaluate the state of the art in science and technology appropriate to the problem at hand • Based on this, specify and develop the project goals and tasks for a development or research project. • specifically select, validate and apply the engineering methods suitable for the project in question. • apply the methods of project management for planning based on the division of labor (project planning) and critically scrutinize, control and further develop them on the basis of the knowledge gained (project monitoring) • present and explain the methods and the developed concept in front of expert representatives and discuss them critically in the team deal constructively and critically with the methods of other projects. • experience, reflect and evaluate role and behavior patterns and derive options for action from them
Course Content	In detail, the following topics will be covered: • Scientific research based on original literature, databases, patents or market situation related to a call for proposals, which is carried out by the lecturers. • Formulation of a scientific hypothesis or a development goal and derivation of a technical-scientific objective. • Independent preparation of a technical-scientific project proposal (feasibility and preliminary studies) • Preparation of a development or research proposal incl. creation of a work, time and cost plan, selection of suitable methods for project processing • Methods for project monitoring, revision and concretization of a work, time and cost plan.
Course Type	Compulsory module

Lecture Type	Project study, scientifically guided self-study, possibly excursion
Exam Typ /Exam Duration (expected for awarding credit points)	Portfolio (PL)
Requirements for participation	
Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the autumn term, 15 events
Language of Instruction	German / English
Literature	

Teaching Courses		
Instructors	Titel of Courses	SWS
Prof. Dr. Eckhardt	Scientific project planning	2,0
All teachers in the program	Project plan for the respective project	2,0

Module Name: Project „Civil and Environmental Engineering - Infrastructure"

Module Code	M2.3 PBAU

Semester	2nd Semester
Person in Charge	Prof. Dr.-Ing. Carsten Müller
Competence Goals	In the chronological sequence, three sub-modules are distinguished, on which the qualification objectives build on each other. M2.3.1: Material and Methods M2.3.2: Implementation M2.3.3: Evaluation In the form of an interdisciplinary project team, tasks from the areas of infrastructure, object and specialist planning are processed in accordance with the service phases of the HOAI. After completion of the *Submodule 2.3.1 „Material and Methods"* • Establish methods for quantitative and qualitative data collection / documentation. • Identify and select criteria and parameters for evaluating the social, economic or scientific relevance of civil engineering or environmental engineering projects, reflect on their selection and, if necessary, specify them more precisely • Confidently apply techniques for coordination and agreement with other project participants (internal / external) • Determine, evaluate, if necessary adapt and validate suitable methods for calculations / experimental designs / setups etc. on the basis of independently formulated evaluation criteria, in order to thereby control and improve project implementation • Summarize and present work results in interim engineering reports. *Submodul 2.3.2 „Implementation"* • use selected and, if necessary, validated methods and tools to achieve development, study or measurement results and carry out the corresponding data collection. • Confirm or refute the formulated hypotheses experimentally or theoretically. • Evaluate the results obtained in relation to the developmental objectives or the objectives of a conceptual study,

	• critically evaluate the achieved objectives with reference to the designed work plan and time schedule on the basis of the achieved intermediate results • present and explain the results and the resulting further work plan in front of expert representatives and discuss them critically in the team as well as • to deal constructively and critically with the results of other scientific-technical projects. *Submoduls 2.3.3 „Evaluation"* • independently analyze the study, development or measurement results achieved in Module 2.3.2, • or measurement results achieved in the module 2.3.2 against the background of the formulated project objectives and in comparison to the state of the art and discuss and critically evaluate them in a scientific-technical context, • formulate in writing and orally present the chain of arguments developed to confirm / refute the formulated hypotheses, • write a structured project report according to technical and/or • or scientific standards, • present the project and its results in front of experts according to scientific and technical standards, explain them, defend them in a discussion • to deal constructively and critically with the results of other scientific-technical projects. *The project work organized and carried out in a team empowers the students beyond that,* • to recognize one's own strengths and weaknesses and to translate them into successful action (self-competence), • set work and behavioral goals for oneself and others, and take responsibility for achieving the project goal and one's own work package (social, self-competence) • be able to deal with conflicts (social competence).
Course Content	The starting point is a portfolio of tasks from the field of infrastructure planning. In supervised groups, infrastructure, object and specialist planning is carried out in the three sub-modules in accordance with the HOAI phases. Ideally, the working groups are made up of specialist civil engineers and environmental engineers to form an interdisciplinary team. • The teaching content is related to the specific project (to strengthen the technical competence) and methods (to strengthen the methodological competence). • In addition, techniques of division of labor are taught and support for coordination in the working group is provided.

Course Type	Compulsory module
Lecture Type	Scientifically guided project study
Exam Typ /Exam Duration (expected for awarding credit points)	Each sub-module concludes with a project work (written part and / or presentation). The work packages are structured according to three planning/service phases of the HOAI.
Requirements for participation	-
Add. Useability	for engineering or science degree programmes
Course Workload	180 h.
Lectures	60 h
Self-Study	120 h.
Credit Points (ECTS)	6
Duration and Frequency	once per academic year in the autumn term, 15 events
Language of Instruction	German / English
Literature	Independent literature research in the respective project

Teaching Courses		
Instructors	Titel of Courses	SWS
Teachers in the Master's program	Material and Methods	4,0
	Implementation	4,0
	Evaluation	4,0

Module Name: Master Thesis and Thesis Seminar

Module Code	M3.1 THES

Semester	3rd Semester
Person in Charge	All teachers in the program
Competence Goals	After completing the module, students will be able to: • independently work on relevant infrastructure topics while adhering to scientific principles and diligence and summarize them in a well-founded manner • evaluate scientific problems methodically and carefully • achieve and evaluate solutions to these problems • achieve a well-founded presentation of the solutions that appropriately emphasizes the significance of one's own approach • plan and produce investigation, solution and presentation of the problems with methods of time management
Course Content	The following topics will be dealt with in detail: • Relevant problems from the thematic field of sustainable construction, energy and environmental systems (topic assignment) • Design of the scientific work "Master thesis • Literature acquisition and evaluation • time management • Presentation and discussion of work results In the middle of the semester, each master student arranges a date by giving a presentation on his or her topic and represents his or her approaches, concepts, proposed solutions in the discussion with the other students and the university lecturers. For the master thesis itself applies: • Self-study with scientific literature work, writing up of the thesis.
Course Type	Compulsory module
Lecture Type	Seminar
Exam Type /Exam Duration (expected for awarding credit points)	Master Thesis and Colloquium

Requirements for participation	Proof of 48 ECTS
Add. Useability	
Course Workload	900 h
Lectures	60 h
Self-Study	840 h
Credit Points (ECTS)	30
Duration and Frequency	once per academic year in the spring term, 15 events
Unterrichtssprache	German
Literature	Independent literature research

Teaching Courses		
Instructors	Title of Course	SWS
All teachers in the program	Thesis Seminar	4,0