Karlsruher Institut für Technologie

Module Handbook

Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)

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KIT DEPARTMENT OF CIVIL ENGINEERING, GEO- AND ENVIRONMENTAL SCIENCES

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1 Curriculum

This module handbook is the relevant document describing the structure and the contents of the master's degree program Water Science & Engineering, and thus provides helpful information and guidance for planning the studies. The degree program and its subjects and modules are described in detail, thus providing the necessary information for planning an interdisciplinary course of studies tailored to each student's personal interests and needs.

Within the Curriculum (Chapt. 1) the organization of the degree program and further formalities in addition to the general examination regulations (ER/SPO) are specified. For example, the assignments of modules to the compulsory and compulsory elective subjects are listed. The current examination regulation (ER/SPO) and potential amendments of these regulations can be found on the web https://www.sle.kit.edu/english/vorstudium/master-water-science-engineering.php (in German).

Another key function of the module handbook is the collection of module descriptions (Chapt. 4), which provide information on the requirements and recommendations for the modules. Details about the learning controls are described at the so-called 'Teilleistungen' (Chapt. 5). There, also links are given to the respective courses in the online course catalog which shall be attended for taking the learning controls.

Hints concerning Corona pandemic:

The descriptions in this module handbook are not adapted to the rules concerning th Corona pandemic. Important information about the current rules are found on the webpage of the Corona Crisis Unit, http://www.kit.edu/kit/english/25911.php, in the section 'Studying and Teaching'. This will be updated regularly during the period of the pandemic.

Information about the offered mode of the single courses, in presence or online, are found in the online course catalog. Please note: Not all this information was up to date when the module handbook was published. In the linked ILIAS course further information about the procedure and content of the course is provided.

1.1 Objectives of the master degree program

The master's degree program **Water Science & Engineering** offers an interdisciplinary, research-oriented education at the interface of water-related engineering and natural sciences. Graduates are able to develop strategies and technical solutions for sustainable water resources management. This includes an efficient use of limited water resources, implementing increasing requirements for the protection of water bodies, handling of hydro-meteorological extreme events, and mitigating the impacts of global change on the water cycle and related material cycles. Graduates are qualified for a responsible position in planning offices and engineering companies, industrial enterprises, public authorities, international development cooperation, and research and development. They acquire qualifications that allow pursuing doctoral studies.

Graduates acquire broad and in-depth knowledge of water-related scientific and engineering fundamentals, extending their prior knowledge acquired during the bachelor degree program. The lectures and classes on 'Advanced Fundamentals' are complemented by lectures and classes on engineering and scientific methods as well as interdisciplinary competencies ('Cross Cutting Methods & Competencies'). Graduates are able to transform their theoretical knowledge into quantitative approaches for the balancing of systems and to solve them analytically and numerically. They can precisely describe relevant circumstances in the environment, and represent specialized solutions to both experts as well as laypersons in an understandable form. Through practical exercises in laboratories, in computer pools or field work, graduates acquire the ability to apply methods on their own in specific contexts. They have sound knowledge of the analysis of time- and space-related data, the design of experiments, and the assessment of uncertainties of measurement and model results. The methods and practices used can be reflected and adapted to changing conditions.

The specialization area is made up of the four profiles 'Water Technologies & Urban Water Cycle', 'Fluid Mechanics & Hydraulic Engineering', 'Environmental System Dynamics & Management', and 'Water Resources Engineering', which are oriented towards current job profiles. Within the 'Profile Studies', graduates acquire the competence to link the fundamental and advanced knowledge with engineering applications in their selected field. They are thus able to transfer their expertise into the development of innovative technologies and management concepts. Supplementary modules also offer the possibility to complement the specialization with skills from neighboring scientific and engineering disciplines.

The competence to work out structured solutions is further promoted by an interdisciplinary 'Study Project', in which the theoretical knowledge and skills are applied to deal with a specific problem.

Graduates in Water Science & Engineering have a broad knowledge and in-depth expertise in their subject, comprehensive methodological competences, and a sound understanding of complex interactions in environmental systems. They are able to apply a range of analytical, experimental, technical and planning methods to fulfill their tasks in solving water-related problems in consideration of social and economic criteria. They deal autonomously with the current state of research and are able to analyze complex problems and select adequate methods for target-oriented solutions. As teaching is predominantly in English and students collaborate in international teams, graduates are also able to communicate their research findings in an international framework.

1.2 Structure of the master degree program

The master degree program Water Science & Engineering comprises 120 credit points (CP) and is structured in the subjects

- Advanced Fundamentals, AF (27 CP), compulsory subject
- Cross-Cutting Methods & Competencies, CC (12 CP), compulsory subject
- Profile Studies, P (36 CP), compulsory elective subject
  - PA Water Technologies & Urban Water Cycle
  - PB Fluid Mechanics & Hydraulic Engineering
  - PC Environmental System Dynamics & Management
  - PD Water Resources Engineering
- Study Project, SP (15 CP), compulsory subject

as well as the preparation of the Master's Thesis in extent of 30 CP (Figure 1).

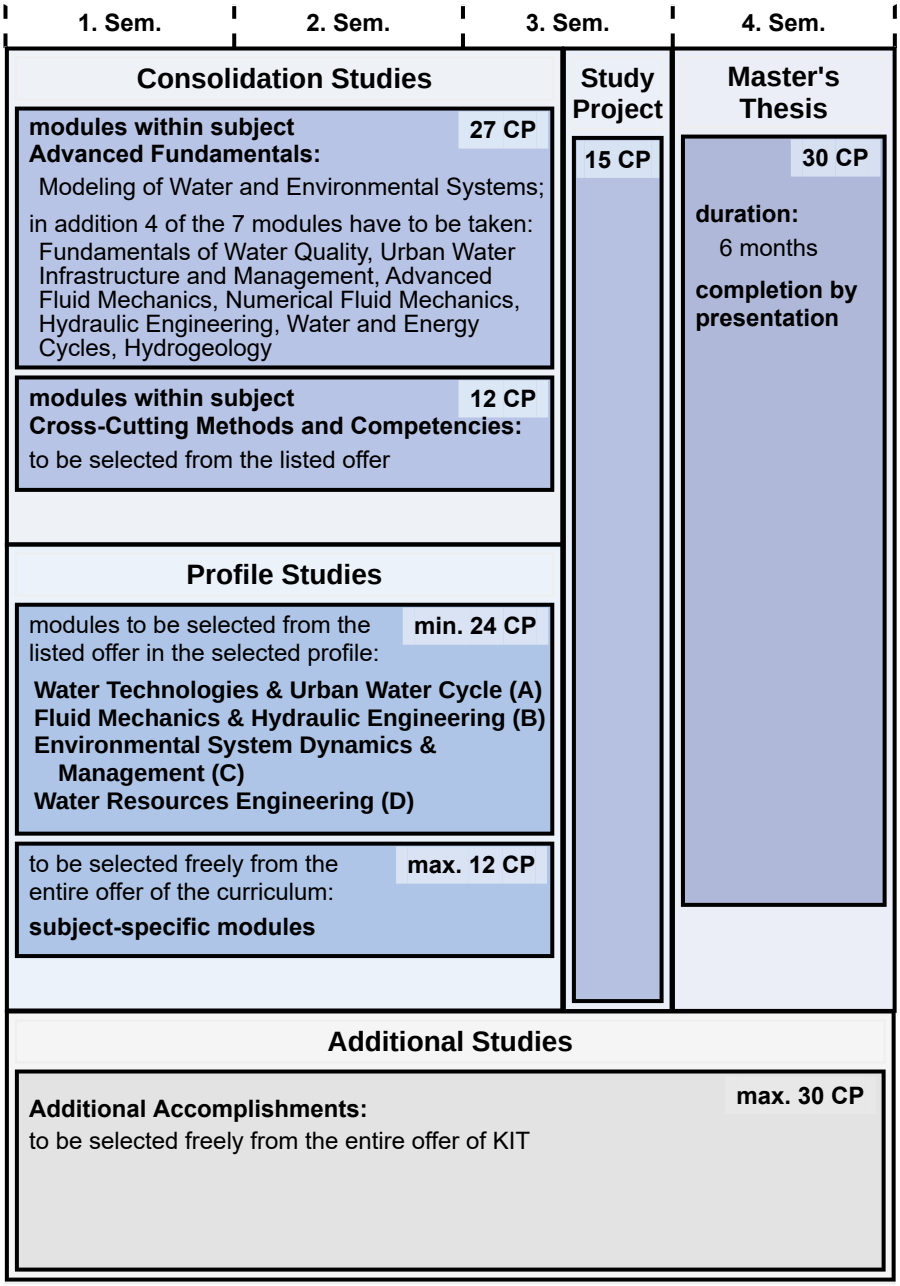

Figure 1: Structure of the master degree program Water Science & Engineering.

1.2.1 Advanced Fundamentals (AF), compulsory subject

In this subject, 'Advanced Fundamentals' of water-related engineering and natural sciences are taught in extent of 27 CP. The modules assigned to this subject are listed in Table 1. The module 'Modeling of Water and Environmental Systems (AF101)' is compulsory for all students. They further choose four out of seven subject-specific modules – according to their fields of interest and their selected specialization (cf. 'Profile Studies'). It is advisable to include the basic modules for the chosen profile; which are:

- for Profile A: AF201 and AF301
- for Profile B: AF401, AF501 and AF601
- for Profile C: AF701 and AF801

Table 1: Modules AF – Advanced Fundamentals

Module			Course				LC	
Code	Name	LP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
compulsory module:								
AF101:	Modeling of Water and Environmental Systems	3	Modeling of Water and Environmental Systems (E)	L	2		ngA	3
compulsory elective modules:								
AF201:	Fundamentals of Water Quality	6	Fundamentals of Water Quality (E)	L/E	2/1		wE	6
AF301:	Urban Water Infrastructure and Management	6	Urban Water Infrastructure and Management (E)	L/E	4		wE	6
AF401:	Advanced Fluid Mechanics	6	Advanced Fluid Mechanics (E)	L/E		4	wE	6
AF501:	Numerical Fluid Mechanics	6	Numerical Fluid Mechanics (E)	L/E	4		wE	6
AF601:	Hydraulic Engineering	6	River Engineering (E)	L/E		2	ngA [2)]	6
			Design of Hydraulic Structures (E)	L/E		2	ngA [2)] wE	
AF701:	Water and Energy Cycles	6	Water and Energy Cycles in Hydrological Systems: Processes, Predictions and Management (E)	L/E	4		EoT	6
AF801:	Hydrogeology [1)]	6	General and Applied Hydrogeology (E)	L/E		2	wE	6
			Field Methods in Hydrogeology (E)	L/E	1			

explanations to Table 1:

general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English
1)	Starting the module in summer term (S) is recommended.

type of course:

L	lecture
L/E	lecture and exercise, separate or integrated

type of learning control:

wE	written examination
oE	oral examination
ngA	not graded accomplishment
ngA 2)	not graded accomplishment as examination prerequisite

1.2.2 Cross-Cutting Methods & Competencies (CC), compulsory subject

The scientific education is complemented by a comprehensive education in interdisciplinary methods and technical skills. Students select modules of at least 12 CP in total from the options in Table 2. In line with the international orientation of the program, language courses of up to 6 CP can be taken in the module 'Language Skills'.

Table 2: Modules CC - Cross-Cutting Methods & Competencies (CC)

Module			Course				LC	
Code	Name	LP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
CC471:	Experiments in Fluid Mechanics	6	Experiments in Fluid Mechanics (E)	L/E		4	EoT	6
CC773:	Analysis of Spatial Data	6	Geostatistics (E)	L/E		4	oE	6
CC774:	Introduction to Environmental Data Analysis and Statistical Learning	6	Introduction to Environmental Data Analysis and Statistical Learning (E)	L/E	4		ngA [3] wE	2 4
CC371:	Freshwater Ecology	6	Applied Ecology and Water Quality (E)	L/S		3	EoT	3
			Field Training Water Quality (E)	E		1	EoT	3
CC921:	Instrumental Analysis	6	Instrumental Analysis (E)	L		2	oE	4
			Organic Trace Analysis of Aqueous Samples (E)	P		2	ngA [3]	2
CC925:	Mass Transfer and Reaction Kinetics [2]	4	Mass Transfer and Reaction Kinetics (E)	L		2	wE	4
CC791:	Integrated Infrastructure Planning	6	Infrastructure Planning – Socio-economic & Ecological Aspects (E)	L/E	4		ngA [3] wE	0 6
CC792:	Environmental Communication	6	Environmental Communication [1] (G)	S	2		ngA [3] EoT	0 6
CC772:	Introduction to Matlab	3	Introduction to Matlab (E)	L/E	2		ngA	3
CC571:	Fundamental Numerical Algorithms for Engineers	3	Fundamental Numerical Algorithms for Engineers (E)	L	2		wE	3
CC911:	Probability and Statistics	4	Probability and Statistics (E)	L/E		2/1	oE	4
CC931:	Remote Sensing and Positioning	6	Fundamentals of Environmental Geodesy Part B (E)	L/E		1/1	ngA [3]	2
			Methods of Remote Sensing (E)	L/E	1/1		ngA [3] oE	1 3
CC933:	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	6	Introduction to GIS for Students of Natural, Engineering and Geo Sciences (G)	L/E	4		ngA [3] wE	3 3
CC935:	Geodata Infrastructures and Web-Services	6	Geodata Infrastructures and Web-Services (G)	L/E		3	ngA [3] oE	3 1
CC912:	Numerical Mathematics for Students of Computer Science and Engineering	6	Numerical Mathematics for Students of Computer Science and Engineering (G)	L/E		3	wE	6
CC949:	Language Skills	2-6	Language Courses ()	S			ngA	2-6

explanations to Table 2:

general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English
[1]	Course is offered every semester.
[2]	Module will not be offered anymore as from summer term 2022.

type of course:

L	lecture
L/E	lecture and exercise, separate or integrated
L/S	lecture and seminar integrated
E	exercise
S	seminar
P	practical course

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment
ngA [3]	not graded accomplishment as examination prerequisite

1.2.3 Profile Studies (P)

The degree program provides opportunity for specialization within three areas of expertise in the sectoral profiles A - C . In addition, an education of generalists in water engineering is possible in the cross-sectoral profile D. Within the profile, modules of 36 CP have to be completed, of which at least 24 CP need to be covered by modules specific to the chosen profile (Tables 3 - 5). In addition, further 'Supplementary Modules' can be chosen.

Students choose one of the four profiles at the beginning of their studies. The choice of a profile is results from the online registration for the first profile-specific exam.

Profile A: Water Technologies & Urban Water Cycle (PA), compulsory elective subject

The focus of this profile is on innovative technologies for the treatment of drinking water and wastewater, as well as the sustainable design of urban and decentralized water systems. This includes biological, chemical and physical processes of water treatment, as well as planning and dimensioning of infrastructure and facilities for water supply and wastewater disposal. In addition to the basic and advanced technological principles and applications, energy efficiency and economics are important aspects.

Students in the profile 'Water Technologies & Urban Water' select modules of at least 24 CP in total from the options in Table 3, and additional 'Supplementary Modules' if desired.

Table 3: Modules PA - Water Technologies & Urban Water Cycle

Module			Course				LC	
Code	Name	LP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
PA221:	Water Technology	6	Water Technology (E)	L/E	2/1		oE	6
PA222:	Membrane Technologies in Water Treatment	6	Membrane Technologies in Water Treatment (E)	L/F		2/1	ngA [3] wE	1 5
PA982:	Applied Microbiology	8	Microbiology for Engineers (E)	L		2	oE	4
			Environmental Biotechnology (E)	L	2		oE	4
PA223:	Practical Course in Water Technology	4	Practical Course in Water Technology (E)	P	2		ngA EoT	1 3
PA321:	Wastewater Treatment Technologies	6	Wastewater Treatment Technologies (E)	L/E		4	ngA [3] wE	3 3
PA621:	Water Distribution Systems	6	Water Distribution Systems (E)	L/E	4		ngA [3] oE	2 4
PA224:	Biofilm Systems	4	Biofilm Systems (E)	L		2	oE	4
PA225:	Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact [1]	4	Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact (E)	L	2		oE	4
PA226:	Industrial Wastewater Treatment [2]	4	Industrial Wastewater Treatment (E)	L		2	oE	4

explanations to Table 3:

general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English
[1]	Module will not be offered anymore as from summer term 2022.
[2]	Module will be offered newly as from summer term 2022.

type of course:

L	lecture
L/E	lecture and exercise, separate or integrated
L/F	lecture and field trip integrated
P	practical course

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment
ngA [3]	not graded accomplishment as examination prerequisite

Profile B: Fluid Mechanics & Hydraulic Engineering (PB), compulsory elective subject

The aim of this profile is to deepen advanced hydrodynamic principles, and amplify their application for flows in the environment as well as for planning and dimensioning of hydraulic structures for water management. Emphasis is laid on the preservation and regeneration of the structural quality of water bodies, under consideration of ecological aspects. Profound knowledge in physical and numerical modeling is imparted.

Students in the profile 'Fluid Mechanics & Hydraulic Engineering' select modules of at least 24 CP in total from the options in Table 4, and additional 'Supplementary Modules' if desired.

Table 4: Modules PB - Fluid Mechanics & Hydraulic Engineering

Module			Course				LC	
Code	Name	LP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
PB421:	Environmental Fluid Mechanics	6	Environmental Fluid Mechanics (E)	L/E	4		wE	6
PB523:	Fluid Mechanics of Turbulent Flows	6	Fluid Mechanics of Turbulent Flows (E)	L/E		4	oE	6
PB524:	Modeling of Turbulent Flows - RANS and LES	6	Modeling of Turbulent Flows - RANS and LES (E)	L/E	4		oE	6
PB522:	Advanced Computational Fluid Dynamics	6	Numerical Fluid Mechanics II (E)	L/E		2	oE	3
			Parallel Programming Techniques for Engineering Problems (E)	L/E		2	oE	3
PB431:	Technical Hydraulics [1)]	6	Steady and Unsteady Operation of Hydraulic Systems (G)	L/E		4	wE	6
PB641:	Experimental Hydraulics and Measuring Techniques	6	Flow Measurement Techniques (E)	L/E	2		oE	3
			Experimental Hydraulics II (G)	L/E	2		EoT	3
PB631:	Hydraulic Structures	6	Groundwater Flow around Structures**) (E)	L/E		2	oE	3
			Interaction Flow - Hydraulic Structures (E)	L/E	2		wE	3
PB651:	Numerical Flow Modeling in Hydraulic Engineering	6	Numerical Flow Modeling in Hydraulic Engineering (G)	L/E	4		oE	6
PB653:	Hydro Power Engineering	6	Hydro Power Engineering (G)	L/E		4	oE	6
PB655:	Waterway Engineering	6	Waterway Engineering (G)	L/E		4	ngA [3)] oE	2 4
PB633:	Flow and Sediment Dynamics in Rivers [1)]	6	Morphodynamics (E)	L/E		2	ngA [3)] oE	2 4
			Flow Behavior of Rivers (E)	L/E		2		
PB634:	River Processes [2)]	6	Landscape and River Morphology (E)	L/E		2	EoT	6
			Transport Processes in Rivers (E)	L/E		2		
PB661:	Project Studies in Water Resources Management	6	Project Studies in Water Resources Management (G)	L/E	4		EoT	6

**) Course will not be offered in summer term 2022.

explanations to Table 4:

general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English
1)	Module will not be offered anymore as from summer term 2022.
2)	Module will be offered newly as from summer term 2022. Module must not be selected together with module WSEM-PB633 not offered anymore

type of course:

L	lecture
L/E	lecture and exercise, separate or integrated

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA 3)	not graded accomplishment as examination prerequisite

Profile C: Environmental System Dynamics & Management (PC), compulsory elective subject

This profile focuses on the processes of the water cycle in terrestrial systems and related matter and energy cycles. It also includes all aspects of integrated management of river basins, such as management strategies for the protection of surface and ground waters, the prediction of water-related extreme events, and the development of prevention and mitigation measures.

Students in the profile 'Environmental System Dynamics & Management' select modules of at least 24 CP in total from the options in Table 5, and additional 'Supplementary Modules' if desired.

Table 5: Modules PC - Environmental System Dynamics & Management

Module			Course				LC	
Code	Name	LP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
PC722:	Integrated Design Project in Water Resources Management	6	Integrated Design Project in Water Resources Management (E)	V/Ü		4	PaA	6
PC725:	Subsurface Flow and Contaminant Transport	6	Transport and Transformation of Contaminants in Hydrological Systems (E)	L/E		4	oE	6
PC732:	Hydrological Measurements in Environmental Systems	6	Hydrological Measurements in Environmental Systems (E)	PE		4	EoT	6
PC341:	River Basin Modeling [1)]	6	Mass Fluxes in River Basins (E)	L		2	ngA [3)]	3
			Modeling Mass Fluxes in River Basins (E)	E	2		EoT	3
PC762:	Protection and Use of Riverine Systems	6	Protection and Use of Riverine Systems (E)	L/S		4	ngA [3)] EoT	1 5
PC561:	Groundwater Management [1)]	6	Groundwater Hydraulics (E)	L/E		2	oE	3
			Numerical Groundwater Modeling (E)	Pj	2		EoT	3
PC821:	Hydrogeology: Field and Laboratory Methods	6	Preparatory Seminar (G)	S		1	EoT	6
			Field and Laboratory Exercises (G)	E		2		
PC841:	Hydrogeology: Karst and Isotopes [2)]	6	Karst Hydrogeology (G)	L/E	2		wE	6
			Isotope Methods in Hydrogeology (G)	L/E		2		
PC986:	Management of River and Wetland Ecosystems [2)]	6	Ecology of Rivers and Wetlands (G)	L	2		ngA	3
			Ecosystem Management (G)	S		2	EoT	3

explanations to Table 5:

general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English
1)	Beginning the module in summer term (S) is recommended.
2)	Beginning the module in winter term (W) is recommended.

type of course:

L	lecture
L/E	lecture and exercise, separate or integrated
L/S	lecture and seminar integrated
E	exercise
PE	practical exercise
S	seminar
Pj	project

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment
ngA 3)	not graded accomplishment as examination prerequisite

Profile D: Water Resources Engineering (PD), compulsory elective subject

This profile aims at training generalists as the individual specialization. Consequently, it features a diversification into the topics of the three profiles A to C.

Students in the profile 'Water Resources Engineering' select modules of at least 24 CP in total from the options in Tables 3 to 5, and additional 'Supplementary Modules' if desired. At least one module from each of the three profiles A to C has to be chosen.

Supplementary Modules (SM)

The individual specialization within the profile studies can be complemented by electives in order to individualize the profile studies. For that purpose, 'Supplementary Modules' can be selected in addition to the respective profile-specific modules (at least 24 CP), in order to get the 36 CP within the Profile Studies.

All subject-specific modules of the program for which an examination has not already been taken can be chosen as 'Supplementary Modules'. These could thus be further modules from the chosen profile, from other profiles, or from the subjects AF and CC (with the exception of the module 'Language Skills CC949'). Alternatively, modules from related disciplines at KIT can be chosen, such as Geoecology, Meteorology, Civil Engineering (e.g. Geotechnical Engineering), Applied Geosciences (e.g. Engineering Geology), or Chemical and Process Engineering. Available 'Additional Supplementary Modules' from other disciplines are listed in Table 6.

The choice of 'Supplementary Modules' should be coordinated with the mentor. The mentor advises on suitable modules for the chosen orientation. Other modules from related disciplines compatible to the profile and not listed in Tables 1 to 6 in this handbook might come into consideration as 'Supplementary Modules'. This requires the compilation of an individual curriculum for the student, which needs to be approved by the mentor.

Table 6: Additional Supplementary Modules

Module			Course				LC	
Code	Name	LP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
Engineering Geology								
SM879:	Thermal Use of Groundwater	4	Thermal Use of Groundwater (E)	L/E	2		oE	4
Geotechnics								
SM961:	Earthwork and Embankment Dams [1)]	6	Basics in Earthworks and Embankment Dams (G)	L/E	2		oE	6
			Embankment Dams (Advanced) (G)	L/E		2		
SM962:	Environmental Geotechnics	6	Landfills (G)	L/E	2		oE	3
			Brownfield Sites - Investigation, Evaluation, Rehabilitation (G)	L	2		oE	3
Meteorology								
SM971:	General Meteorology	6	General Meteorology (G)	L/E	3/2		ngA	6
SM974:	Applied Meteorology: Turbulent Diffusion	6	Turbulent Diffusion (E)	L/E		2/1	ngA [2)] oE	3 3

explanations to Table 6:

general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English
1)	Beginning the module in winter term (W) is recommended.

type of course:

L	lecture
L/E	lecture and exercise, separate or integrated
S	seminar

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment
ngA 2)	not graded accomplishment as examination prerequisite

1.2.4 Study Project, compulsory subject

Students carry out an interdisciplinary 'Study Project' (p. 108). The project prepares students for independent scientific working and writing, and introduces skills in project management. The topics for the 'Study Project' should be especially located at the interfaces between the water-research disciplines of the KIT. In addition to the competence of combining approaches from different fields, they acquire abilities for team work and critical evaluation of results in the context of the project. 15 CP are credited for the 'Study Project'.

It is highly recommended to have acquired the necessary subject-specific and interdisciplinary competencies needed to work on the 'Study Project' beforehand.

The assignment of a research topic, supervision and evaluation of the 'Study Project' is carried out by a full-time faculty member of the KIT Department of Civil Engineering, Geo and Environmental Sciences or of the KIT Department of Chemical and Process Engineering, who is authorized to supervise a master's thesis. Students look for a supervisor from the field they are interested in. In exceptional cases and at request of the student, the spokesperson of the study program ensures that a topic is assigned within a four week period.

For registration the respective form (http://www.wasser.kit.edu/downloads/Pruef_ZulAnmeld_StudyProject_ engl.pdf) with the admission by the Study Program Service of the department ('Studiengangservice Bau-Geo-Umwelt') is handed over to the supervisor when starting the 'Study Project'.

1.2.5 Master's Thesis/Masterarbeit

The **Master's Thesis** is an independent scientific study and includes the theoretical and/or experimental work on a complex problem. Students deal with the current state of research and apply the expertise and scientific methods acquired during the studies. They can document, discuss and evaluate the obtained results. Furthermore, they are able to present and defend the essential findings. The topic of the 'Master's Thesis' depends on the subject area that is chosen for the thesis. In case that the master thesis shall be prepared outside of KIT the leaflet 'Merkblatt - Externe Abschlussarbeiten' (http://www.haa.kit.edu/downloads/KIT_ALLGEMEIN_Merkblatt_Externe_ Abschlussarbeiten.pdf) has to be considered.

Generally, the 'Master's Thesis' is written during the 4th semester. In order to be admitted to the 'Master's Thesis', students must have successfully completed modules of at least 42 CP in the master's degree program *Water Science & Engineering*. The supervisor initiates that the master's thesis will be uploaded to the campus management system. After notification via e-mail the master's thesis has to be **registered online** at the online student portal. The **admission** is made after verification of the required prerequisites and eventual further conditions. As these steps have to be completed **before starting** the thesis (date of beginning), they shall be initiated at least two weeks in advance. It is highly recommended to have acquired the necessary subject-specific and interdisciplinary competencies needed to work on the 'Master's Thesis' beforehand.

Students look for a supervisor and a further examiner from the field they are interested in. The research topic for the 'Master's Thesis' is assigned by the supervisor, who has to be a professor, a habilitated faculty member, or an entitled research associate, who is authorized to supervise a master's thesis. This person has to be a member of the KIT Department of Civil Engineering, Geo and Environmental Sciences, or of the KIT Department of Chemical and Process Engineering. In other cases a permission of the Examination Committee Master Civil Engineering is required using the respective form (s. https://www.tmb.kit.edu/english/5583.php, *in German*). Generally, the supervisor and a second examiner evaluate the thesis. For the assignment of the research topic, the interests of the student can be taken into account. In exceptional cases, the assignment of a research topic for the 'Master's Thesis' is arranged by the chairperson of the Examination Committee Master Civil Engineering.

The processing time is six months. The 'Master's Thesis' can be written in English or German, and has to be completed with a presentation within one month after submission of the thesis. The presentation is part of the examination and is considered within the evaluation.

1.2.6 Interdisciplinary Qualifications

Generic qualifications are taught along with the modules, especially in the subjects 'Cross Cutting Methods & Competencies' and 'Study Project'.

1.2.7 Additional accomplishments

An **additional accomplishment** is a voluntarily taken examination, which is not considered in the overall grade (comp. ER/SPO § 15). In total, additional accomplishments can be taken in extent of 30 CP at maximum from the entire offer of KIT.

The examination in the desired additional accomplishment should be registered online by the student in time within the registration period. Additional accomplishments provided within the module 'Further Examinations' can be selected directly. Desired additional accomplishments or additional modules not provided there have to be announced to the Study Program Service of the department ('Studiengangservice Bau-Geo-Umwelt') via e-mail. It records the desired selection within the campus management system in order that the online registration to the examination is possible. By request to the Examination Committee Master Civil Engineering the assignment can by changed subsequently.

All taken additional accomplishments are listed in the transcript of records. If by the taken additional accomplishments a module is completed this module can be included in the master degree certificate as additional module on request by the student. This applies also to additional accomplishments which were recognized by the Examination Committee Master Civil Engineering.

1.3 Module selection, individual curriculum & mentoring

The compulsory and compulsory elective subjects are developed by the selection of modules within a specified framework. Each module consists of one or more interrelated courses and is completed by one or more examinations. The extent of a module is determined by credit points (CP) which are credited by successful passing of the module. In addition to the descriptions in the module handbook, the course catalog (online) and the postings and web pages of the institutes inform about the current details every semester (e.g. time and location of courses).

The selection options within the studies require that each student compiles an individual curriculum. The selection of the modules have to be made with care. This selection is supervised by a mentor chosen by the student at the beginning of the studies. The mentor has to be a professor of the KIT Department Civil Engineering, Geo and Environmental Sciences or of the KIT Department of Chemical and Process Engineering and has to be involved in the degree program *Water Science & Engineering*. If modules shall be selected within the compulsory and compulsory elective subjects others than listed in Tables 1 to 6 the individual curriculum need to be approved by the mentor and to be announced to the Study Advisor. Exemplary curricula can be found in the appendix.

1.4 Exams and Learning Controls

The successful completion of modules is checked by learning controls, which can be graded or not graded. Graded learning controls are written exams (wE), oral exams (oE), or examinations of other type (EoT). Not graded accomplishments (ngA) are course-related performances in written, oral or practical form.

1.4.1 Registration

The students must register for learning controls at the online student portal. The examiners can define prerequisites and deadlines for the registration. Upon registration, students have to declare the assignment of the respective module to a subject, as far as options exist. In case of an oral examination the online registration is to be combined directly with the negotiation of an examination date with the examiner.

A successful online registration covers the admission to the examination. A confirmation for this is provided by the online student portal and can serve as proof for a made registration in case of doubts. If there occurs a problem with an attempt of an online registration the Study Program Service of the department (’Studiengangservice Bau-Geo-Umwelt’) has to be informed as soon as possible in addition to the examiner in order to solve the problem in advance to the examination date.

A registered examination is either to be taken or a cancellation has to be made in advance to the deadline of cancellation.

1.4.2 Cancellation

Students may cancel their registration for written exams (wE) without giving reasons until the examination questions are handed out.

When canceling oral examinations (oE), the examiner must be informed at least three working days prior to the examination date.

Canceling of examinations of other type (EoT) as well as of not graded accomplishments (ngA) is possible up to the rendering of the respective performance or the first part of the performance. The submission of a written work (report, homework or similar) or the beginning of an oral exam (presentation, colloquium or similar) counts as rendering the performance. If deadlines are set, a cancellation can only be made in advance.

In general, a cancellation shall be made nevertheless online in time.

A later cancellation or withdrawal must be justified by valid grounds, and requires submitting a written declaration to the Examination Committee Master Civil Engineering immediately.

1.4.3 Repetition

A failed examination (wE, oE, EoT) can be repeated once in the same form. If the retake of a written exam is failed again, an oral examination takes place, in which at best the grade Passed can be achieved. Failed exams have to be retaken by the end of the examination period of the semester after the following semester.

Not graded accomplishments (ngA) may be repeated several times.

1.5 Recognition of accomplishments

1.5.1 Recognition of already obtained credits

The recognition of already obtained accomplishments, for example credits obtained in other master's programs or at other universities, have to be requested by the respective recognition form of the Examination Committee Master Civil Engineering (https://www.tmb.kit.edu/english/5583.php, *in German*). The respective lecturers confirm if the accomplishments are equivalent to their modules in the curriculum.

Accomplishments that are not equivalent to modules in the curriculum can be accredited if the acquired competences contribute to the qualification goals of the master's program. If necessary, an individual curriculum has to be compiled and approved by the mentor. The Examination Committee Master Civil Engineering decides on which accomplishments are accredited and which parts of the curriculum may be replaced.

The form for recognition has to be submitted to the Study Advisor, who will transfer it to the Examination Committee Master Civil Engineering and the Study Program Service of the department ('Studiengangservice Bau-Geo-Umwelt').

1.5.2 Accomplishments obtained outside of the Higher Education System

Accomplishments made outside of the higher education system, as for example vocational training, can be accredited if the acquired competences contribute to the qualification goals of the master's program. At maximum, 50 % of the university education can be replaced. Recognition is requested with the respective form of the Examination Committee Master Civil Engineering (https://www.tmb.kit.edu/english/5583.php, *in German*). The Examination Committee Master Civil Engineering verifies to which extent the acquired knowledge and capabilities can be recognized, and which parts of the program they can replace.

1.6 Calculation of grades, final grade

Grades are obtained for single examinations. If a module contains several examinations, or a subject contains several modules, the grade of the module or subject is obtained by calculation. If not specified otherwise, the grade of the module or subject is the average of all grades within the module or subject, respectively, weighted with the corresponding credit points. The calculated grades are cut off after the first decimal place. The credit points related to not graded accomplishments are not considered within such a calculation.

The final grade is calculated by weighting the grades of all subjects and the Master's Thesis according to their defined number of credit points, as specified in the examination regulations (ER/SPO § 20). If the grade of the master's thesis is 1.0 and the final grade is 1.2 or better, the degree is awarded 'with distinction'.

1.7 Special circumstances

1.7.1 Students with physical challenges or chronic illness

Students with physical challenges or chronic illness can get compensation for possible disadvantages ('Nachteilsausgleich'). They may be granted preferential access to place-limited courses, modification of the sequence of courses according to their needs, or modifications of the form or conditions of exams. Students should contact the study advisor in order to prepare a request in writing to the Examination Committee Master Civil Engineering including supporting documents. The Examination Committee Master Civil Engineering decides on the modified details of the courses and exams, respectively, in accordance with the student and the examiners.

Examples of possible compensations of disadvantages:

- Modified form of exams, for instance oral exams instead of written exams, and vice versa
- Conducting exams in a separate room
- Allowing necessary utilities and assistance, e.g. sign language interpreter
- Additional breaks during time-limited exams
- Extension of the periods between exams

1.7.2 Maternity leave, parental leave and family commitments

Maternity leave according to the legal regulations interrupts any time period set by the examination regulations. Parental leave and family commitments, for example time needed for caring of family members, can also be handled with modified time periods for exams. In all these cases, a request in writing including supporting documents is to be submitted to the Examination Committee Master Civil Engineering via the study advisor.

In the case of parental leave, the Examination Committee Master Civil Engineering has to be informed in writing at least four weeks in advance about the duration of the parental leave. If the conditions are met that would allow parental leave for employees, the student is informed about the modified time periods for exams.

The time period for the master's thesis cannot be interrupted due to parental leave or family commitments. In these cases, the registration of the master's thesis is canceled, and a new topic will be assigned to the student.

2 Contact persons

Dean of Study Affairs:

Prof. Dr. Peter Vortisch
Institute for Transport Studies, Bldg. 10.30, R. 305
consultation: on appointment
Phone: 0721/608-42255
Email: peter.vortisch@kit.edu

Study Advisor/Coordination:

Dr. Jan Wienhöfer
Institute for Water and River Basin Management, Hydrology, Bldg. 10.81, R. 423
consultation: on appointment
Phone: 0721/608-41932
Email: jan.wienhoefer@kit.edu

Examination Committee Master Civil Engineering:

Prof. Dr.-Ing. Kunibert Lennerts (chairperson)
Dr.-Ing. Heike Schmidt-Bäumler (person in charge)
Institute of Technology and Management in Construction, Bldg. 50.31, R. 005 (ground floor)
consultation: Wed. 13.00 – 14.00 h
Phone: 0721/608-46008
Email: pam@bgu.kit.edu
Web: https://www.tmb.kit.edu/english/PAM.php

Study Program Service ('Studiengangservice Bau-Geo-Umwelt'):

KIT Department of Civil Engineering, Geo and Environmental Sciences, Bldg. 10.81, R. 312
consultation: s. https://www.bgu.kit.edu/english/studiengangservice.php
Email: studiengangservice@bgu.kit.edu
Web: https://www.bgu.kit.edu/english/studiengangservice.php

Fachschaft:

Students in Civil Engineering
Bldg. 10.81 (Altes Bauing. Geb.), R. 317.1 (3rd floor)
consultation: s. https://www.fs-bau.kit.edu
Phone: 0721/608-43895
Email: fsbau@lists.kit.edu
Web: https://www.fs-bau.kit.edu

3 Current changes

In the following, the important changes are listed as from summer term 2022. Although this process was done with great care, other/minor changes may exist.

modules not offered anymore as from summer term 2022:

Mass Transfer and Reaction Kinetics [WSEM-CC925]

Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact [WSEM-PA225]

Flow and Sediment Dynamics in Rivers [WSEM-PB633]

modules offered newly as from summer term 2022:

Industrial Wastewater Treatment [WSEM-PA226]

River Processes [WSEM-PB634], replaces module Flow and Sediment Dynamics in Rivers [WSEM-PB633]

changes of the courses assigned to the modules as from summer term 2022:

Hydraulic Engineering [WSEM-AF601]:

The course River Engineering (6222701), 2 HpW/SWS, replaces the course Multiphase Flow in Hydraulic Engineering (6222701), 2 HpW/SWS.

changed examinations and not graded accomplishments as from summer term 2022:

Hydraulic Engineering [WSEM-AF601]:

The module examination consists of the not graded accomplishments Design Exercise River Engineering, 1 CP, and Design Exercise Hydraulic Structures, 1 CP, as examination prerequisites as well as the written examination Hydraulic Engineering, 4 CP.

4 Modules

M 4.1 Module: Modeling of Water and Environmental Systems (WSEM-AF101) [M-BGU-103374]

Responsible: Dr. Jan Wienhöfer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Advanced Fundamentals (Version 2) (mandatory)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	pass/fail	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-106757	Modeling of Water and Environmental Systems	3 CR	Wienhöfer

Competence Certificate
- 'Teilleistung' T-BGU-106757 with not graded accomplishment according to § 4 Par. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students can explain approaches to model environmental systems in different water-related disciplines. Based on this, they are able to explain common approaches and methods of environmental systemmodeling, and to name and evaluate the respective advantages, disadvantages, ranges of applicability and inherent limitations.
Students can explain universal challenges of modeling and are able to select adequate model concepts for given water-related tasks.

Content
This lecture series comprises individual lectures on environmental systems modeling from a broad range of water-related disciplines (e.g. flood forecasting, contaminant transport, fluid-particle interaction, water quality, or hydraulic design). The commonalities and differences of the modeling approaches are discussed with respect to their conceptual approach, mathematical formulation and numerical scheme. Spatial and temporal scales as well as discretization of the various models are compared and discussed. Based on this broad range of examples, universal challenges of modeling are illustrated: Intrinsic uncertainties, adequate selection of numerical schemes, calibration and validation, adequate model choice.

Module grade calculation
not graded

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture: 30 h

independent study:

- preparation and follow-up lectures: 30 h
- working on take home examination: 30 h

total: 90 h

Recommendation
none

M 4.2 Module: Fundamentals of Water Quality (WSEM-AF201) [M-CIWVT-103438]

Responsible: Dr. Gudrun Abbt-Braun
Organisation: KIT Department of Chemical and Process Engineering
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-106838	Fundamentals of Water Quality	6 CR	Abbt-Braun

Competence Certificate
- 'Teilleistung' T-CIWVT-106838 with written examination according SPO/ER § 4 Par. 2 No. 1

details about learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students can explain the relationships behind the occurrence of geogenic and anthropogenic compounds in the hydrological cycle. They are able to select adequate methods for the analysis of water constituents and microorganisms in water samples. They are familiar with the associated calculations, and they can compare and interpret the obtained data. They know how to apply different methods, how to analyze relationships and how to critically assess water quality analyses.

Content
Various types of water, legislations, analytical definitions, analytical quality, sampling methods, quick test methods, field investigations, organoleptic determinations, general investigations, optical characterization (turbidity, color, UV, Lambert-Beer`s law, photometry), titrations, acid-base-systems, buffering, main inorganic compounds (anions, cations, occurrence, ion chromatography, titration, complexometry, flame photometry, atomic spectroscopy), heavy metals and metalloids (occurrence and main methods for determination), organic compounds and organic micropollutants (occurrence, thin layer chromatography, high performance liquid chromatography, infrared spectroscopy, gas chromatography), water-specific sum parameters (DOC, AOX, COD, BOD), radioactivity, microbiology.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 45 h

independent study:

- preparation and follow-up lectures, exercises: 65 h
- examination preparation: 70 h

total: 180 h

Recommendation
none

Literature
Harris, D.C., 2010. Quantitative chemical analysis. W. H. Freeman and Company, New York.

Crittenden, J.C. et al., 2005. Water treatment – Principles and design. Wiley & Sons, Hoboken.

Patnaik, P., 2010. Handbook of environmental analysis: Chemical pollutants in air, water, soil, and solid wastes. CRC Press.

Wilderer, P., 2011. Treatise on water science, four-volume set, 1st edition, volume 3: Aquatic chemistry and biology. Elsevier, Oxford.

Leture notes in ILIAS

M 4.3 Module: Urban Water Infrastructure and Management (WSEM-AF301) [M-BGU-103358]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	2

Mandatory			
T-BGU-106600	Urban Water Infrastructure and Management	6 CR	Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-106600 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students analyze and evaluate basic methods of urban water management. They recognize the interactions between natural and technical systems. They acquire knowledge necessary to identify process engineering solutions and to implement them into functional systems (infrastructure elements). Students are able to describe urban water management issues in the context of watersheds and to take appropriate and environmentally-sound decisions in terms of energy efficiency and costs.

Content
This module provides a deep understanding of basic principles needed for the design, analysis and evaluation of urban water systems. The concept of system analysis is introduced to develop models that consider the most important biological, chemical and physical processes and are used to solve water management problems. Based on a detailed consideration of individual elements (subsystems), an overall picture of the water management system Urban Settlement and its interaction with surface and groundwater bodies can be gained. For this purpose, theoretical tools are developed and modeling approaches are reviewed. Students consider the factors energy and costs in the analysis and assessment of water management systems.

Module grade calculation
grade of the module is grade of the exam

Annotation
keine

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 90 h

Recommendation
basic knowledge in sanitary engineering

Literature
Metcalf and Eddy (2003) Wastewater Engineering – Treatment and Reuse, McGraw-Hill, New York
Imhoff, K. u. K.R. (1999) Taschenbuch der Stadtentwässerung, 29. Aufl., Oldenbourg Verlag, München, Wien

M 4.4 Module: Advanced Fluid Mechanics (WSEM-AF401) [M-BGU-103359]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-106612	Advanced Fluid Mechanics	6 CR	Eiff

Competence Certificate
- 'Teilleistung' T-BGU-106612 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students acquire a firm understanding of the fundamental mechanics of fluids with emphasis towards environmental flows on the basis of the local conservation laws. They are able to differentiate and apply the different set of assumptions and methods in order to better understand the different flow classes and solutions. They are capable of solving basic flow problems after forming the relevant assumptions. Participants are able to use the knowledge and competence gained for more detailed and applied studies of environmental flows.

Content
This module covers the fundamental mechanics of fluids forming the foundation of environmental fluid mechanics. The approach is based on the basic local conservation laws. Emphasis is on the phenomena and the possible analytical solutions associated with the various flow classes. Topics covered include the general and special forms of the governing equations, flow kinematics, viscous incompressible flows, ideal-fluid flows, shallow flows, and buoyancy effects in fluids. Waves and turbulence are also addressed as well as different methods of analysis such as scaling.

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 30 h
- home work on exercises: 30 h
- examination preparation: 60 h

total: 180 h

Recommendation
first courses in undergraduate fluid-mechanics, advanced engineering mathematics (analysis, differential and integral calculus, ordinary and partial differential equations, linear algebra, Fourier analysis, complex numbers)

Literature
I.G. Currie, Fundamental Mechanics of Fluids, Fourth Edition 2012

M 4.5 Module: Numerical Fluid Mechanics (WSEM-AF501) [M-BGU-103375]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-106758	Numerical Fluid Mechanics	6 CR	Uhlmann

Competence Certificate
- 'Teilleistung' T-BGU-106758 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are enabled to describe the fundamental approaches of numerical solution of flow problems. They are capable of evaluating the advantages and disadvantages of these approaches in the various areas of application, enabling them to make an appropriate choice. Participants are able to apply the numerical methods to simple flow problems; this involves the generation and application of basic computer programs. They are able to analyze the results with respect to precision, stability and efficiency.

Content
This module constitutes a general introduction to the numerical solution of flow-related problems. The mathematical properties of the conservation equations are analyzed. The principles of numerical discretization are studied with the aid of the finite-difference and the finite-volume method. The concept of numerical stability is introduced, and various techniques of error analysis are presented theoretically and by way of examples

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 60 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation

- Fluid Mechanics (knowledge of the fundamental processes of advection and diffusion, familiarity with the Navier-Stokes equations)
- Mathematics (analysis - partial differential equations, Fourier analysis, series expansions, complex numbers; linear algebra - matrices, determinants, eigensystems; numerics - discrete number representation, round-off, floating point operations, numerical treatment of partial differential equations)
- Knowledge in programming with Matlab is recommended; otherwise it is strongly recommended to participate in the course ’Introduction to Matlab (CC772)'

M 4.6 Module: Hydraulic Engineering (WSEM-AF601) [M-BGU-103376]

Responsible: Prof. Dr. Mario Jorge Rodrigues Pereira da Franca
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-BGU-111928	Design Exercise River Engineering	1 CR	Rodrigues Pereira da Franca
T-BGU-111929	Design Exercise Hydraulic Structures	1 CR	Rodrigues Pereira da Franca
T-BGU-106759	Hydraulic Engineering	4 CR	Rodrigues Pereira da Franca

Competence Certificate
- 'Teilleistung' T-BGU-111928 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-111929 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106759 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students will be able to describe and analyse basic processes linked to the hydraulics of rivers and hydraulic structures. They are able to carry the design of engineering works in rivers and the dimensioning of hydraulic structures with suitable approaches.

Based on the acquired process knowledge, they are able to analyse the results of the design in a critical manner.

Students are able to use and link their knowledge logically. They can work in a reflexive and self-critical manner.

Content
The module provides students with theoretical and practical knowledge of hydraulics applied to problem solving in the context of river engineering and for the design of hydraulic structures.

The course *River Engineering* contains the following topics:

- overview of catchment and river network basic processes and in the context of human usage and safety considering at the same time preservation of natural processes;
- sediment management; calculation and design of river engineering works such channels, riverbank protection, levees, groynes, detention basins; river restoration works.

In the course *Design of Hydraulics Structures* the following topics will be discussed in depth:

- overview: Hydraulic structures and water management and their integration in the river system
- design procedure, engineer standards and state of the art in hydraulic structures

Module grade calculation
grade of the module is grade ot the exam

Annotation
As from summer term 2022 two 'Design Exercises' are examination prerequisites.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- River Engineering lecture/exercise: 30 h
- Design of Hydraulic Structures lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises River Engineering: 15 h
- working on the 'Design Exercise River Engineering' (examination prerequisite): 25 h
- preparation and follow-up lecture/exercises Design of Hydraulic Structures: 15 h
- working on the 'Design Exercise Hydraulic Structures' (examination prerequisite): 25 h
- examination preparation: 40 h

total: 180 h

Recommendation
none

Literature
Dey, Subhasisch. Fluvial hydrodynamics. Berlin: Springer, 2014.

Hager, Willi H., et al. Hydraulic engineering of dams. CRC Press, 2020.

United States. Bureau of Reclamation. Design of small dams. US Department of the Interior, Bureau of Reclamation, 1987.

M 4.7 Module: Water and Energy Cycles (WSEM-AF701) [M-BGU-103360]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-106596	Water and Energy Cycles	6 CR	Zehe

Competence Certificate
- 'Teilleistung' T-BGU-106596 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to explain the most relevant processes of Hydrology including their feedbacks and limitations. They know the concepts to describe and predict these processes in the context of science and water management. Furthermore are they able to independently apply related computer-based tools for analysis and prediction for standard situations. Students are able to evaluate the required data and to quantify and evaluate the uncertainties related to the simulations and predictions.

Content
This module deepens the fundamentals of the water and energy cycles with particular regard to:

- the soil as the central control element of the water and energy cycle and the interplay of soil water and ground heat balance
- evaporation, energy balance and processes in the atmospheric boundary layer
- runoff and evaporation regimes in different hydro-climates;
- water balance and floods at the catchment scale and statistics for water management
- the interplay between runoff processes and soil water balance, and the soil as filter system
- concepts of hydrological similarity and comparative hydrology
- process-based and conceptual models to simulate water balances and predict flood

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 40 h
- preparation of term paper (examination): 80 h

total: 180 h

Recommendation
basic knowledge of hydrology and engineering hydrology;
knowledge of programming with Matlab or another similar progamming language; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab (6224907)'

Literature

Aryan, S. P. (2001): Introduction to Micrometeorology, 2nd Ed., Academic Press
Beven, K. (2004): Rainfall runoff modelling – The primer: John Wiley and Sons
Hornberger et al. (1998): Elements of physical hydrology. John Hopkins University Press
Kraus, H. (2000): Die Atmosphäre der Erde. Vieweg S. P.
Plate, E. J., ,Zehe, E. (2008): Hydrologie und Stoffdynamik kleiner Einzugsgebiete. Prozesse und Modelle, Schweizerbart, Stuttgart, 2008.

M 4.8 Module: Hydrogeology (WSEM-AF801) [M-BGU-103406]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)
Advanced Fundamentals (Version 2) (Compulsory Elective Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	2 terms	English	4	1

Mandatory			
T-BGU-106801	Hydrogeology	6 CR	Goldscheider

Competence Certificate
- 'Teilleistung' T-BGU-106801 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Annotation
The course 6310415 Field Methods in Hydrogeology will be held in the winter term 2020/21

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- General and Applied Hydrogeology lecture, exercise: 30 h
- Field Methods in Hydrogeology lecture/exercise: 15 h

independent study:

- preparation and follow-up lectures, exercises General and Applied Hydrogeology: 40 h
- preparation and follow-up lecture/exercises Field Methods in Hydrogeology: 25 h
- examination preparation: 70 h

total: 180 h

Recommendation
none

Literature
Fetter, C.W. (2001) Applied Hydrogeology. Prentice Hall: 598 S.
Hölting, B. & Coldewey, W.G. (2009) Einführung in die Allgemeine und Angewandte Hydrogeologie, Spektrum Akademischer Verlag: 384 S.
Keller, E.A. (2000) Environmental Geology. Prentice Hall: 562 S.
Langguth, H.R. & Voigt, R. (2004) Hydrogeologische Methoden, 2. Aufl., Springer: 1005 S.
Mattheß, G. (1994) Die Beschaffenheit des Grundwassers, 3. Aufl., Borntraeger: 499 S.
Mattheß, G. & Ubell, K. (2003) Allgemeine Hydrogeologie – Grundwasserhaushalt, 2. Aufl., Borntraeger: 575 S.
Younger, P. (2007) Groundwater in the Environment: An Introduction. Blackwell Publishing: 318 S.

M 4.9 Module: Freshwater Ecology (WSEM-CC371) [M-BGU-104922]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies (Usage from 4/1/2019)
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-109956	Applied Ecology and Water Quality	3 CR	Fuchs, Hilgert
T-BGU-109957	Field Training Water Quality	3 CR	Fuchs, Hilgert

Competence Certificate
- 'Teilleistung' T-BGU-109956 with examination of other type according to § 4 Par. 2 No. 3
- 'Teilleistung' T-BGU-109957 with examination of other type according to § 4 Par. 2 No. 3

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students get familiar with the basic principles of water ecology in surface waters. They are able to explain interactions between abiotic control factors (flow, chemistry, structure) and their relevance for the ecological status of standing waters and streams and to evaluate them critically. They become acquainted with field and laboratory techniques to establish water quality. With the help of these methods, they evaluate data-quality of information collected in the field regarding chemical, biological and structural water quality and determine the level of uncertainty intrinsic to the data-collection methods.Using case studies, students are able to convey and evaluate positive results as well as restrictions from water restoration processes.

Content
As part of the module, water ecology principles, their practical significance and implementation of restoring measures are presented. The following topics are covered:

- pollutants loads discharged into water bodies: discharge points, pollutants, sediment problems
- sampling methods
- oxygen content
- methods for the assessment of water quality and water general status
- practical exercises to measure water quality and condition in the field

Students get acquainted with practical examples of water protection and water remediation measures and they interpret and discuss them as part of an individual assignment. For this purpose, they implement their own framework, based on visible requirements and achievable targets.

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Annotation
The number of participants in the courses is limited to 12 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering* and *Geoecology* and further study programs. The attendance at the first meeting is mandatory. In case of absence the place will be assigned to a person on the waiting list.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Applied Ecology and Water Quality lecture/seminar: 30 h
- Field Training Water Quality (block): 30 h

independent study:

- preparation of the seminar paper with presentation (partial examination): 60 h
- preparation of the report on Field Training Water Quality (partial examination): 60 h

total: 180 h

Recommendation
none

Literature
Wetzel, Limnology, 3rd Edition, Academic Press 2001

Jürgen Schwörbel, Methoden der Hydrobiologie, UTB für Wissenschaft 1999

kursbegleitende Materialien

M 4.10 Module: Experiments in Fluid Mechanics (WSEM-CC471) [M-BGU-103377]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-106760	Experiments in Fluid Mechanics	6 CR	Eiff

Competence Certificate
- 'Teilleistung' T-BGU-106760 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students relate the hydrodynamics theory and physical concepts to the observed physical reality. They apply their knowledge and skills for the comparative analysis of basic flow situations in physical models, using appropriate measurement technologies. They assess and evaluate the results and limitations by comparing their results with theoretical deductions. They extend their results of phenomena-oriented experiments with regard to practical applications in technical hydraulics and environmental flows. Acquired competence: operation of test facilities and instrumentation, data analysis and basic statistical error analysis, team work, written and oral communication.

Content
Lecture:

- typical set-up of hydraulic and aerodynamic models
- dimensional analysis, dimensionless parameters
- measurement instrumentation
- introduction to statistical error analysis
- analogy numerical/physical modeling, model distortion
- technical writing and oral presentation

Physical experiments:

- pipe flow with orifice plate
- open channel flow with gates and hydraulic jumps
- Venturi pipe flow with cavitation- Settling velocities of spheres
- diffusion of a turbulent air jet
- turbulent wake
- dam leakage

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/lab exercise: 60 h

independent study:

- preparation and follow-up lectures: 30 h
- preparation of laboratory reports (part of the examination): 60 h
- preparation of oral examination (part of the examination): 30 h

total: 180 h

Recommendation
module Advanced Fluid Mechanics (WSEM-AF401)

Literature
Tropea, C. et.al., 2007, Springer Handbook of Experimental Fluid Mechanics, Springer Verlag Berlin

Muste, M., Aberle, J., Admiraal, D., Ettema, R., Garcia, M. H., Lyn, D., Nikora, V., Rennie, C., 2017, Experimental Hydraulics: Methods, Instumentation, Data Processing and Management, Taylor and Francis

M 4.11 Module: Fundamental Numerical Algorithms for Engineers (WSEM-CC571) [M-BGU-104920]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies (Usage from 4/1/2019)
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-109953	Fundamental Numerical Algorithms for Engineers	3 CR	Uhlmann

Competence Certificate
- 'Teilleistung' T-BGU-109953 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
The students understand the basic idea (and importance) of numerical methods for solving various mathemetical problems arising in engineering context. The students are able to choose appropriate numerical algorithms for a given mathematical problem and implement the algorithms in a high-level programming language (e.g. Matlab).

Content

- finite precision arithmetic
- numerical solution of non-linear equation (rootfinding)
- numerical integration
- solving linear algebraic systems
- interpolation / approximation
- fourier transform
- solving ODE

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture: 30 h

independent study:

- preparation and follow-up lectures: 30 h
- examination preparation: 30 h

total: 90 h

Recommendation
good knowledge of basic calculus, linear algebra, and differential equations and familiarity with some higher-level programming language

M 4.12 Module: Introduction to Matlab (WSEM-CC772) [M-BGU-103381]

Responsible: Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	pass/fail	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-106765	Introduction to Matlab	3 CR	Ehret

Competence Certificate
- 'Teilleistung' T-BGU-106765 with not graded accomplishment according to § 4 Par. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are familiar with common programming rules and the working environment and basic syntax of Matlab. They are capable of independently formulating and coding simple programs for data analysis and visualization as well as simulation of dynamical systems with Matlab. Students have thus gained the competence to independently solve computer-based modeling tasks in advanced courses. Students are able to solve problems and to present the related results in teamwork.

Content

- universal programming basics: Programing strategies, program structures, control structures, operators and variables, functions and objects, matrix calculations
- basics of Matlab: History, installation, graphical user interface, tool boxes, using help
- Matlab programming basics: syntax, debugging, reading and writing of files, data visualization

Take-home programming assignments:

- programs to analyze and visualize observation data
- design and implementation of a simple dynamical model
- preparation of ungraded assignments and presentation in small groups

Module grade calculation
not graded

Annotation
The course is limited to 60 participants. Please register via the student portal (Studierendenportal). Only in case that this should not be possible: Please register via e-mail to the responsible lecturer. Participants are selected according to their progress of study considering the following order: students of Water Science and Engineering, then students of Civil Engineering with focus 'Water and Environment', then other students.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises: 10 h
- homework: 30 h
- take-home exam: 20 h

total: 90 h

Recommendation
none

M 4.13 Module: Analysis of Spatial Data (WSEM-CC773) [M-BGU-103762]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies (Usage from 4/1/2019)
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-106605	Geostatistics	6 CR	Zehe

Competence Certificate
- 'Teilleistung' T-BGU-106605 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students can explain and apply methods for analysis and simulation of spatially and temporally distributed environmental data. Based on this, they are capable of setting up experimental designs for environmental monitoring and evaluate the suitability of available data for different tasks.Students are able to critically assess the results of analysis and simulation tools and to quantify and evaluate the related uncertainties.

Content

- fundamentals of environmental systems theory, environmental monitoring and experimental design (data types, scale triplet, measuring methods)
- experimental variograms, directional variograms, indicator variograms, variogram fitting, anisotropy
- Kriging techniques: Ordinary Kriging, screening properties of Kriging, BLUE, pure nugget effect, cross validation, RMSE
- estimation of spatial patterns in nonstationary data (External Drift Kriging, Simple Updating)
- simulation of spatial patterns: turning Bands Simulation, smoothing problems of interpolation

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
basic knowledge in statistics

module Hydrological Measurements in Environmental Systems [bauiM2S05-HY5]

knowledge of programming with Matlab; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab' (6224907)

Literature
Bárdossy, A. (2001): Introduction into Geostatistics. Inst. f. Wasserbau, Universität Stuttgart.
Kitanidis, P. K. (1999): Introduction into Geostatistics. Applications in Hydrogeology. Cambridge University Press.
Bras, R. L. and Rodriguez-Iturbe, I. (1985): Random Functions and Hydrology. Addison-Wesley Massachusetts.
Brooker, I. (1982): Two-dimensional simulation by turning bands. Math. Geology 17 (1).

M 4.14 Module: Introduction to Environmental Data Analysis and Statistical Learning (WSEM-CC774-ENVDAT) [M-BGU-104880]

Responsible: Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies (Usage from 4/1/2019)
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-109950	Homework 'Introduction to Environmental Data Analysis and Statistical Learning'	2 CR	Ehret
T-BGU-109949	Introduction to Environmental Data Analysis and Statistical Learning	4 CR	Ehret

Competence Certificate
- 'Teilleistung' T-BGU-109950 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-109949 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
The students can explain and apply methods for analysis and simulation of environmental data. Based on this they are capable of evaluating the suitability of available data, analysis and simulation methods for different tasks. The students are able to critically assess the results of analysis and simulation tools and to quantify and evaluate the related uncertainties.

Content

- explorative data analysis
- data storage / data bases
- probability theory (short summary)
- statistical tests (short summary)
- Bayesian methods
- information theory
- time series
- statistical learning / machine learning basics
- supervised learning
- unsupervised learning

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 20 h
- preparation of Homework 'Introduction to Environmental Data Analysis and Statistical Learning' (exam prerequisite): 60 h
- examination preparation: 40 h

total: 180 h

Recommendation
preliminary knowledge in statistics, e.g. successful completion of Probability and Statistics (CC911), and Matlab programming skills, e.g. successful completion of Introduction to Matlab (CC772)

Literature
Daniel Wilks (2011): Statistical Methods in the Atmospheric Sciences, Volume 100, 3rd Edition, ISBN 978-0-1238-5022-5, Academic Press.

Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani (2014): An Introduction to Statistical Learning, ISBN 978-1-4614-7137-0, Springer.

Thomas M. Cover, Joy A. Thomas (2006): Elements of Information Theory, 2nd Edition, ISBN: 978-0-471-24195-9, Wiley.

M 4.15 Module: Integrated Infrastructure Planning (WSEM-CC791) [M-BGU-103380]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-106763	Booklet Integrated Infrastructure Planning	0 CR	Kämpf
T-BGU-106764	Integrated Infrastructure Planning	6 CR	Kämpf

Competence Certificate
- 'Teilleistung' T-BGU-106763 with not graded accomplishment according to § 4 Par. 3 as examniatoin prerequisite
- 'Teilleistung' T-BGU-106764 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to rank interdisciplinary texts on development planning according to their relevance, and formulate relevant questions on this topic. Students can research systematically on a scientific problem, and they can use different technical terms.They are able to put the materials in the context of integrated development planning and current water resources problems to work on solutions for adapting to regional conditions.

Content
Socio-economic aspects:

- natural resources as economic goods
- scenario analysis of depletion and capacity of natural resources, assessment of values, additional costs
- coordination of activities on economic development; strategical planning, indicator systems
- cost-benefit analyses, investment criteria

Ecological aspects / environmental impact assessment:

- biodiversity, habitats, resilience, structure and dynamics of ecosystems; nutrient cycling
- bioindicators, ecosystem services
- history of environmental impact assessment (EIA), EIA in the EU, in other countries
- impact assessment in the EW -proje ct management (mitigation, compensation, monitoring, auditing)

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, seminar: 40 h

independent study:

- preparation and follow-up lectures, seminar: 20 h
- preparation of a booklet (examination prerequisite): 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
none

M 4.16 Module: Environmental Communication (WSEM-CC792) [M-BGU-101108]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-BGU-106620	Examination Prerequisite Environmental Communication	0 CR	Kämpf
T-BGU-101676	Environmental Communication	6 CR	Kämpf

Competence Certificate
- 'Teilleistung' T-BGU-106620 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-101676 with examination of other type according to § 4 Par. 2 No. 3

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
(see German version)

Content
(see German version)

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- seminar (lecture): 20 h

independent study:

- preparation and follow-up seminar: 40 h
- preparation of literature annotations and short presentation (exam prerequisite): 45 Std.
- preparation of presentation, manuscript and poster (exam): 75 Std.

total: 180 h

Recommendation
none

Literature
(see German version)

M 4.17 Module: Probability and Statistics (WSEM-CC911) [M-MATH-103395]

Responsible: PD Dr. Bernhard Klar
Organisation: KIT Department of Mathematics
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-MATH-106784	Probability and Statistics	4 CR	Klar

Competence Certificate
- 'Teilleistung' T-BGU-106784 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
- Students acquire basic knowledge of probability theory, and are able to model simple random phenomena

- they know the basic differences between descriptive and inferential statistics

- Students learn basic statistical methods, and are able to apply this knowledge to new examples

Content
The lecture gives a concise introduction to probability theory and covers some important statistical methods.

Key terms: random experiments, events, probability, conditional probability, independent events, random variables, probability distribution, density, sample mean, sample variance, sample correlation, point estimate, confidence interval, test, error propagation, linear regression.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 45 h

independent study:

- preparation and follow-up lectures, Exercises: 45 h
- examination preparation: 30 h

total: 120 h

Recommendation
none

M 4.18 Module: Numerical Mathematics for Students of Computer Science and Engineering (WSEM-CC912) [M-MATH-103404]

Responsible: Prof. Dr. Christian Wieners
Organisation: KIT Department of Mathematics
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners

Competence Certificate
- 'Teilleistung' T-BGU-102242 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 45 h

independent study:

- preparation and follow-up lectures, exercises: 65 h
- examination preparation: 70 h

total: 180 h

Recommendation
advanced mathematics: analysis; e.g. Advanced Mathematics I & II [0131000; 0180800]

M 4.19 Module: Instrumental Analysis (WSEM-CC921) [M-CIWVT-103437]

Responsible: Dr. Gerald Brenner-Weiß
apl. Prof. Dr. Gisela Guthausen

Organisation: KIT Department of Chemical and Process Engineering

Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-106837	Instrumental Analytics	4 CR	Guthausen
T-CIWVT-106836	Organic Trace Analysis of Aqueous Samples	2 CR	Brenner-Weiß

Competence Certificate
- 'Teilleistung' T-BGU-106836 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106837 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students are familiar with the important methods of modern instrumental analysis and their range of application. They can explain the basic physical principles of the methods. Students are able to develop solutions for analytical problems, to choose adequate procedures for sample preparation and measuring techniques. They can evaluate the measurement data and interpret the results.

Content
Instrumental Analysis:
Introduction to selected methods of modern instrumental analysis:
- Optical methods
- Magnetic resonance methods, mass spectrometry
- Imgaging methods as MRT, µCT and optical methods (CLSM and OCT)
- Basics of data analysis and image processing

Organic Trace Analysis of Aqueous Samples:
Laboratory course on methods for sample concentration, sample preparation, and analysis of organic trace compounds in aqueous samples using HPLC coupled with tandem mass spectrometry (LCMSMS)
To participate in the lab course, please make an appointment with Dr. Brenner-Weiß (IFG).

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Instrumental Analysis lecture: 30 h
- Organic Trace Analysis of Aqueous Samples practical training: 30 h

independent study:

- preparation and follow-up lectures Instrumental Analysis: 60 h
- analyses and report on laboratory work (examination prerequisite): 30 h
- examination preparation: 30 h

total: 180 h

Recommendation
module 'Fundamentals of Water Quality (AF201)'

M 4.20 Module: Remote Sensing and Positioning (WSEM-CC931) [M-BGU-103442]

Responsible: Dr.-Ing. Michael Mayer
Dr.-Ing. Hael Sumaya
Dr.-Ing. Uwe Weidner

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	2 terms	English	4	4

Mandatory			
T-BGU-101759	Methods of Remote Sensing, Prerequisite	1 CR	Weidner
T-BGU-109329	Fundamentals of Environmental Geodesy Part B	1 CR	Kutterer, Mayer
T-BGU-106843	Remote Sensing and Positioning	4 CR	Mayer, Sumaya, Weidner

Competence Certificate
- 'Teilleistung' T-BGU-106843 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-101759 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-109329 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Positioning (Fundamentals of Environmental Geodesy Part B):

The students know the basic concepts of GNSS positioning and are able to familiarize themselves with new GNSS-related topics. The students work autonomous and self-organized in the field of geodesy and have communicative as well as organizational competences with respect to collaboration, presentation and discussion.

Remote Sensing:

Students are able to explain the fundamentals of multispectral remote sensing, namely the basics of pixel- and segment-based classification approaches, their communalities and their differences. Students are able to use their knowledge and transfer it to other fields of applications.

Content
Positioning (Fundamentals of Environmental Geodesy Part B):

- Contributions of Geodesy to Water Science
- GNSS positioning: Segments, signals, code and phase measurements, error sources and error reduction, processing strategies, differential and absolute positioning, real-time/post-processing, RTK and static mode, Precise Point Positioning, services
- Height concepts, vertical reference frames
- GNSS levelling

Remote Sensing:

- This module provides an overview of multispectral remote sensing. It introduces to concepts of data processing, also including sensor aspects where required. Based on a selection of applications like land cover/used classification and change detection / monitoring approaches are presented and compared. The module consists of lectures and labs.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Fundamentals of Environmental Geodesy Part B lecture, exercise: 30 h
- Methods of Remote Sensing lecture, exercise: 30 h

independent study: 120 h

- consolidation of Fundamentals of Environmental Geodesy Part B by recapitulation of lectures and excerises, by use of references, and by own inquiry: 30 h
- preparations of exercises and presentations Fundamentals of Environmental Geodesy Part B (examination prerequisite): 30 h
- consolidation of Methods of Remote Sensing by recapitulation of lectures and exercises, by use of references, and by own inquiry: 15 h
- preparations of exercises Methods of Remote Sensing, Prerequisite (examination prerequisite): 15 h
- preparations for examination Remote Sensing and Positioning: 30 h

total: 180 h

Recommendation
fundamentals of geometric optics, oscillations and waves, linear algebra (vectors, coordinate geometry, trigonometry)

M 4.21 Module: Introduction to GIS for Students of Natural, Engineering and Geo Sciences (WSEM-CC933) [M-BGU-101846]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-BGU-103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite *This item will not influence the grade calculation of this parent.*	3 CR	Rösch, Wursthorn
T-BGU-101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	3 CR	Rösch, Wursthorn

Competence Certificate
- 'Teilleistung' T-BGU-103541 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-101681 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 60 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- examination preparation, incl. online test (examination prerequisite): 60 h

total: 180 h

Recommendation
none

M 4.22 Module: Geodata Infrastructures and Web-Services (WSEM-CC935) [M-BGU-101044]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-BGU-101757	Geodata Infrastructures and Web-Services, Prerequisite *This item will not influence the grade calculation of this parent.*	3 CR	Wursthorn
T-BGU-101756	Geo Data Infrastructures and Web Services	1 CR	Wursthorn

Competence Certificate
- 'Teilleistung' T-BGU-101757 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-101756 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 20 h

independent study:

- preparation and follow-up lectures, exercises: 20 h
- working on exercises (examination prerequisite): 60 h
- examination preparation: 40 h

total: 120 h

Recommendation
none

M 4.23 Module: Language Skills 1 (2 CP) (WSEM-CC949) [M-BGU-103466]

Responsible: Dr. Jan Wienhöfer
Organisation: University
Part of: Cross-Cutting Methods & Competencies

Credits	Grading scale	Recurrence	Duration	Level	Version
2	pass/fail	Each term	1 term	4	1

Language Skills 1 (Election: 2 credits)			
T-BGU-106884	Wildcard 1 Language Skills 1	2 CR	
T-BGU-106885	Wildcard 2 Language Skills	2 CR	

Competence Certificate
One or more learning controls, depending in th selected module, can be taken in form of a written test. These can be graded or not graded.

Attendance of classes is compulsory. Further information is provided by Sprachenzentrum (www.spz.kit.edu), Studienkolleg für ausländische Studierende (www.stk.kit.edu).

The learning controls can be taken graded or not graded. The registration is done directly at the 'Sprachenzentrum' (www.spz.kit.edu) or 'Studienkolleg für ausländische Studierende' (www.stk.kit.edu) but not online. For crediting after passing the course please contact the Study Program Service ('Studiengangservice Bau Geo Umwelt', https://www.bgu.kit.edu/studiengangservice.php).

Prerequisites
Only one module can be selected. This module must not be selected together with one of the modules

M-BGU-103468 - Language Skills 2 (3 CP)
M-BGU-103469 - Language Skills 3 (4 CP)
M-BGU-103470 - Language Skills 4 (5 CP)
M-BGU-103471 - Language Skills 5 (6 CP)

The same is valid for the other modules.

Language courses in the native language of the student are not accredited.

English language courses below or at the level required for admission to the master's degree program Water Science & Engineering are not accredited. By this, courses with the GER level C1 or higher can be selected. Independent of this, courses regarding writing and presentation skills can be selected ('Scientific Writing', 'Writing Skills', 'Effective Presentations').

Competence Goal
Students acquire skills in cross-cultural communication.

Content
Students can acquire and improve knowledge of a language of their choice. Information on the courses offered and on the registration procedure are given at: www.spz.kit.edu.

Students who are not native German speakers may attend German courses at Studienkolleg: www.stk.kit.edu/deutsch_kurse.php.

Module grade calculation
not graded

Annotation
Language Skills can be taken in extent of 2 - 6 CPs. For the desired amount of CPs the respective module has to be selected. The Module Handbook provides exemplarily the description for the module 'M-BGU-103466 - Language Skills 1 (2 CP)'.

The module can only be selcted within the subject 'Cross-Cutting Methods and Competencies' or accredited as additional accomplishment.

Workload
corresponding to the selected language course/s

Recommendation
none

M 4.24 Module: Water Technology (WSEM-PA221) [M-CIWVT-103407]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules A)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-106802	Water Technology	6 CR	Horn

Competence Certificate
- 'Teilleistung' T-CIWVT-106802 with oral examination according to § 4 Par. 2 No. 2

details about learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students learn fundamental knowledge in water chemistry and how to apply it to processes in aquatic systems in general and in reactors for water treatment. Water treatment will be taught for drinking water and partly waste water. The students are able to apply physical, chemical and biochemical treatment for the respective removal of particulate and dissolved components in water. They are able to use the fundamental design parameters for the different types of unit operations.

Content
Water cycle, different types of raw water (ground and surface water). Water as solvent, carbonate balance, differentiation between microbiological and chemical population. Unit operations: sieving, sedimentation, filtration, flocculation, flotation, ion exchange, aeration, oxidation, disinfection, adsorption). For all unit operations design parameters will be provided. Simple 1D models will be discussed for description of kinetics and retention time in reactors for water treatment.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 45 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 75 h

total: 180 h

Recommendation
none

Literature
Crittenden, J.C. et al., 2005. Water treatment – Principles and design. Wiley & Sons, Hoboken.

Jekel, M., Gimbel, R., Ließfeld, R., 2004. DVGW-Handbuch: Wasseraufbereitung – Grundlagen und Verfahren. Oldenbourg, München.

Lecture notes will be provided in ILIAS

M 4.25 Module: Membrane Technologies in Water Treatment (WSEM-PA222) [M-CIWVT-105380]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia

Organisation: KIT Department of Chemical and Process Engineering

Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 4/1/2020)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2020)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2020)
Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 4/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-CIWVT-110864	Excursions: Membrane Technologies	1 CR	Horn, Saravia
T-CIWVT-110865	Membrane Technologies in Water Treatment	5 CR	Horn, Saravia

Competence Certificate
- 'Teilleistung' T-CIWVT-110864 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-CIWVT-110865 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students have a fundamental knowledge on membrane technology in water and waste water treatment. They learn how the different membrane systems (reverse osmosis, nanofiltration, ultrafiltration, microfiltration, and dialysis) have to be applied to produce a certain water quality. They are able to design such systems.

Content

- The solution-diffusion model
- Concentration polarization and the consequences for membrane module design.
- Membrane production and properties.
- Membrane configuration and design
- Membrane systems for desalination and brackish water treatment
- Membrane bio reactors for waste water treatment
- Biofouling, scaling and prevention of both
- Excursions with introduction: applied membrane processes in waste water disposal and drinking water supply.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise (incl. excursions): 45 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- preparation of excursion reports (examination prerequisite): 10 h
- examination preparation (examination): 65 h

total: 180 h

Recommendation
module 'Water Technology (WSEM-PA221)'

Literature

- Melin, T., Rautenbach, R., 2007. Membranverfahren - Grundlagen der Modul- und Anlagenauslegung. Springer Verlag Berlin Heidelberg.
- Mulder, M.H., 2000. Basic Principles of Membrane Technology. Kluwer Academic, Dordrecht.
- Schäfer, A.I., 2005. Nanofiltration: Principles and Applications. Elsevier, Oxford.
- Staude, E., 1992. Membranen und Membranprozesse. Verlag Chemie, Weinheim.
- Vorlesungsunterlagen in ILIAS

M 4.26 Module: Practical Course in Water Technology (WSEM-PA223) [M-CIWVT-103440]

Responsible: Dr. Gudrun Abbt-Braun
Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules A)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	3

Mandatory			
T-CIWVT-106840	Practical Course in Water Technology	3 CR	Abbt-Braun, Hille-Reichel, Horn
T-CIWVT-110866	Excursions: Water Supply	1 CR	Abbt-Braun, Horn

Competence Certificate
- 'Teilleistung' T-CIWVT-110866 with not graded accomplishment according according to § 4 Par. 3
- 'Teilleistung' T-CIWVT-106840 with examination of other type according to § 4 Par. 2 No. 3

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
The module "Water Technology (WSEM-PA221)" has to be begun, i.e. at least the registration has to be made.

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.

Competence Goal
Students can explain the most important processes in water treatment. They are able to do calculations, and to compare and interpret data. They learn how to use different methods, and to interpret different processes.

Content
6 different experiments out of: equilibrium study of the calcium carbonate system, flocculation, adsorption, oxidation, atomic absorption spectroscopy, ion chromatography, liquid chromatography, sum parameter, and an oral presentation of the student. In addition, excursions to two different treatment plants (waste water, drinking water).

Module grade calculation
grade of the module is the grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/practical training, excursions: 36 Std.

independent study:

- preparation of reports on practical training (examination): 40 h
- preparation of excursion reports (not graded accomplishment): 10 h
- examination preparation: 34 h

total: 120 h

Recommendation
none

Literature

- Harris, D.C., 2010. Quantitative chemical analysis. W. H. Freeman and Company, New York.
- Crittenden, J.C. et al., 2005. Water treatment – Principles and design. Wiley & Sons, Hoboken.
- Patnaik, P., 2010. Handbook of environmental analysis: Chemical pollutants in air, water, soil, and solid wastes. CRC Press.
- Wilderer, P., 2011. Treatise on water science, four-volume set, 1st edition, volume 3: Aquatic chemistry and biology. Elsevier, Oxford.
- Vorlesungsskript im ILIAS
- Praktikumsskript

M 4.27 Module: Biofilm Systems (WSEM-PA224) [M-CIWVT-103441]

Responsible: Prof. Dr. Johannes Gescher
Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn
Dr. Michael Wagner

Organisation: KIT Department of Chemical and Process Engineering

Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules A)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-106841	Biofilm Systems	4 CR	Horn

Competence Certificate
- 'Teilleistung' T-CIWVT-106841 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students can describe the structure and function of biofilms in natural habitats as well as in technical systems. They can explain the major influencing factors and processes for the formation of biofilms. They are familiar with techniques for visualizing biofilm structures as well as with models for simulating biofilm growth. They are able to select appropriate methods for the analysis of biofilms and to evaluate the habitat conditions.

Content
Microorganisms typically organize in the form of biofilms in technical and natural aquatic systems. However, biofilms are not only accumulated microorganisms at interfaces: They are bound together by a matrix of extracellular polymeric substances (EPS). In this course, the structure and function of biofilms in different natural habitats and technical applications (biofilm reactors, biofilms in natural waters, biofouling in technical systems and biofilms for power generation in microbial fuel cells) are presented and discussed. Biofilm growth and abrasion as well as models for the simulation of these processes are introduced. Furthermore, microscopic techniques for the visualization of biofilm structures are presented.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture: 30 h

independent study:

- preparation and follow-up lectures: 30 h
- examination preparation: 60 h

total: 120 h

Recommendation
none

M 4.28 Module: Industrial Wastewater Treatment (WSEM-PA226) [M-CIWVT-105903]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 4/1/2022)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2022)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2022)
Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	5	1

Mandatory			
T-CIWVT-111861	Industrial Wastewater Treatment	4 CR	Horn

Competence Certificate
- 'Teilleistung' T-CIWVT-111861 with oral examination according SPO/ER § 4 Par. 2 No. 2

details about learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
The students will be able to differentiate the composition of different types of industrial wastewater. Moreover, the students will have knowledge of treatment technologies, which can be applied to industrial wastewater. The students will be able to judge the biodegradability of industrial wastewater and can use that to design the needed treatment trains. The students do know treatment steps, which can be used enhance reuse the treated wastewater.

Content
This module provides the huge range of industrial wastewater composition for different industries (food, pulp and paper, chemical and pharmaceutical industry). The biodegradability will be analyzed and discussed with respect to potential treatment systems. A main focus will be biological treatment systems, especially biofilm reactors. Finally, the potential of water reuse in industrial processes will be discussed and solution will be provided.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture: 30 h

independent study:

- preparation and follow-up lectures: 60 h
- examination preparation: 30 h

total: 120 h

Recommendation
none

Literature

- Horn, H. et al. (2017) Wastewater, 1. Introduction, Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA.
- Telgmann, L., et al. (2019) Wastewater, 2. Aerobic Biological Treatment. Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA.
- Rosenwinkel K.H. et al., (2020) Taschenbuch der Industrieabwasserreinigung, Vulcan Verlag

M 4.29 Module: Wastewater Treatment Technologies (WSEM-PA321) [M-BGU-104917]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	3

Mandatory			
T-BGU-111282	Term Paper 'Wastewater Treatment Technologies'	3 CR	Fuchs
T-BGU-109948	Wastewater Treatment Technologies	3 CR	Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-111282 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-109948 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students acquire knowledge about typical techniques and facilities in wastewater treatment at local and international level. They are able to perform a technical evaluation and describe dimensioning approaches taking into consideration legal boundary conditions. Students analyze, evaluate and optimize operation of plant technologies. They focus on energy-efficient plant designs considering the most relevant factors affecting the total costs.Students can analyze the situation in emerging and developing countries making a comparison with that in industrialized countries. Based on that, they are able to develop water-related management strategies.

Content
Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany and abroad. They analyze, evaluate the applied technologies and take decisions when new and more holistic oriented methods can be implemented. Different mechanical, biological and chemical treatment technologies are considered, whereby the treatment of waste water from housholds and industry as well as the treatment of rainwater is discussed. The visits of different facilities in Germany complete the course.

Module grade calculation
grade of the module is grade of the exam

Annotation
The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering* and *Geoecology* and further study programs. The topics for the Term Paper are assigned at the beginning of the course.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 30 h
- preparation of Term Paper 'Wastewater Treatment Technologies' (exam prerequisite): 60 h
- examination preparation: 30 h

total: 180 h

Recommendation
module "Urban Water Infrastructure and Management (AF301)"

Literature
Imhoff, K. u. K.R. (1999) Taschenbuch der Stadtentwässerung, 29. Aufl., Oldenbourg Verlag, München, Wien
ATV-DVWK (1997) Handbuch der Abwassertechnik: Biologische und weitergehende Abwasserreinigung, Band 5, Verlag Ernst & Sohn, Berlin
ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , Berlin
Sperling, M.; Chernicaro, C.A.L. (2005) Biological wastewater treatment in warm climate regions, IWA publishing, London
Wilderer, P.A., Schroeder, E.D. and Kopp, H. (2004) Global Sustainability - The Impact of Local Cultures. A New Perspective for Science and Engineering, Economics and Politics WILEY-VCH

M 4.30 Module: Water Distribution Systems (WSEM-PA621) [M-BGU-104100]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 4/1/2018)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2018)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2018)
Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 4/1/2018)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-108485	Project Report Water Distribution Systems	2 CR	Oberle
T-BGU-108486	Water Distribution Systems	4 CR	Oberle

Competence Certificate
- 'Teilleistung' T-BGU-108485 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-108486 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students will have profound knowledge of the components and operational requirements of water supply systems. They are enabled to plan, design and optimize water distribution systems. They are capable to critically analyze concepts and designs based on their knowledge. Participants are able to set up and apply numerical models of water distribution systems for planning and analysis. Students have competences in work organization, presentation and discussion of results.

Content
The module covers the following topics:

- fundamentals of water distribution
- fundamentals of water distribution system modeling
- introduction to the software Epanet (water distribution system model) and ArcGIS (geographic information system)
- water demand
- water losses
- calibrating a water distribution system model
- designing pipe networks, storage tanks and pump stations
- application of the technical standards (DVGW)

The participants apply the theoretical knowledge to analyze and design an exemplary water distribution network.

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 30 h
- project work water distribution (exam prerequisite): 60 h
- examination preparation: 30 h

total: 180 h

Recommendation
hydromechanics (specifically pipe hydraulics)

Literature
Mutschmann und Stimmelmayr (2007). Taschenbuch der Wasserversorgung, 14. Auflg., Vieweg.
Walski, T. M., Chase, D. V., Savic, D. A., Grayman, W., Beckwith, S. und Koelle, E. (2003). Advanced Water Distribution Modeling Management, Haestad Methods Inc., Waterbury.
Schrifttum zur Vorlesung (auf Deutsch und Englisch)

M 4.31 Module: Applied Microbiology (WSEM-PA982) [M-CIWVT-103436]

Responsible: Prof. Dr. Thomas Schwartz
Andreas Tiehm

Organisation: KIT Department of Chemical and Process Engineering

Part of: Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules A)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	2 terms	English	4	1

Mandatory			
T-CIWVT-106834	Microbiology for Engineers	4 CR	Schwartz
T-CIWVT-106835	Environmental Biotechnology	4 CR	Tiehm

Competence Certificate
- 'Teilleistung' T-CIWVT-106834 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-CIWVT-106835 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students can explain the microbiological principles and their technical applications. Students are able to apply technically relevant biochemical and molecular biology issues to ecological, biotechnical and environmental processes. They can analyze and evaluate factors limiting operations in e.g. biotechnology and water technology and can combine processes for enhanced turnover rates in the sense of ecology and/or economy.

Content
Main issues are the structures and functions of microorganisms, their interactions with global element cycles and other organisms, the microbial impact on energy and corrosion as well as strategies against microbes. Basing on the fundamental metabolism biotechnology operations and specific monitoring strategies are presented.

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Microbiology for Engineers lecture: 30 h
- Environmental Biotechnology lecture: 30 h

independent study:

- preparation and follow-up lectures Microbiology for Engineers: 45 h
- examination preparation Microbiology for Engineers: 45 h
- preparation and follow-up lectures Environmental Biotechnology: 45 h
- examination preparation Environmental Biotechnology: 45 h

total: 240 h

Recommendation
understanding of microbiological processes in the environment and in technical systems

M 4.32 Module: Environmental Fluid Mechanics (WSEM-PB421) [M-BGU-103383]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-106767	Environmental Fluid Mechanics	6 CR	Eiff

Competence Certificate
- 'Teilleistung' T-BGU-106767 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students identify fundamental hydrodynamic processes in the natural environment in water and air applications and solve related problems. They can relate the observed phenomena to fundamental principles of hydrodynamics and to the specific nature of the flow conditions. They can critically evaluate the different models and approximations made to obtain solutions and predictions and can make first estimates.

Content
This module covers the fundamental concepts and flow models of environmental fluid mechanics in both water and air. The topics include turbulence structure in rivers and open channels, diffusion and dispersion, atmospheric boundary layers, internal waves, instabilities and mixing, stratified turbulence, buoyant jets and plumes.

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
modules 'Advanced Fluid Mechanics (AF401)', 'Analysis of Turbulent Flows (PB521)'

M 4.33 Module: Advanced Computational Fluid Dynamics (WSEM-PB522) [M-BGU-103384]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-BGU-106769	Parallel Programming Techniques for Engineering	3 CR	Uhlmann
T-BGU-106768	Numerical Fluid Mechanics II	3 CR	Uhlmann

Competence Certificate
- 'Teilleistung' T-BGU-106768 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-106769 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
module 'Numerical Fluid Mechanics (AF501)' must be completed

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-BGU-103375 - Numerical Fluid Mechanics must have been passed.

Competence Goal
Students are able to numerically solve simplified flow problems based upon the Navier-Stokes equations in an independent fashion. This involves the design of a solution method, the analysis of its properties (concerning stability, precision, computational effort), the algorithmic implementation, the validation with respect to appropriate test cases, and the final documentation of the results. Furthermore, participants of this course are enabled to judge techniques for the use of massively parallel computer systems to solve fluid mechanics problems as to their efficiency and applicability. They are capable of applying the appropriate parallel programming techniques to selected model problems.

Content
In the present module, advanced skills in the numerical solution of fluid mechanics problems are imparted, building upon the material of the course Numerical Fluid Mechanics I. Here, various numerical solution methods for the time-dependent Navier-Stokes equations in several spatial dimensions are demonstrated with the aid of practical examples. This includes the following aspects: coupling and decoupling of velocity and pressure fields in incompressible flows, numerical treatment of discontinuities (shock waves, hydraulic jumps), computation of scalar transport, numerical tracking of inertial particles, linear stability analysis.

The course Parallel Programing Techniques for Engineering Problems conveys the fundamental programming concepts for massively-parallel computer systems. First, the common parallel computer architectures and the most widely used programming paradigms are introduced. Then techniques for implementing standard algorithms of numerical fluid mechanics (and other disciplines involving field problems) are presented, analyzed and practiced with the aid of the Message Passing Interface (MPI) standard.

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Parallel Programming Techniques for Engineering Problems lecture, exercise: 30 h
- Numerical Fluid Mechanics II lecture, exercise: 30 h

independent study:

- preparation and follow-up lectures, exercises Parallel Programming Techniques for Engineering Problems: 30 h
- examination preparation Parallel Programming Techniques for Engineering Problems (partial exam): 30 h
- preparation and follow-up lectures, exercises Numerical Fluid Mechanics II: 30 h
- examination preparation Numerical Fluid Mechanics II (partial exam): 30 h

total: 180 h

Recommendation
Programing skills in at least one compiler language (C,C++, FORTRAN or equivalent)

Literature
C. Hirsch “Numerical computation of internal and external flows” Butterworth-Heinemann, 2nd edition, 2007.
J.H. Ferziger and M. Peric “Computational Methods for Fluid Dynamics”, Springer, 3rd edition, 2001.
N. Carriero “How to Write Parallel Programs: A First Course”, MIT Press, 1990.
T.G. Mattson, B.A. Sanders, B.L. Massingill “Patterns for Parallel Programming” Addison-Wesley, 2004.
M. Snir, S. Otto, S. Huss-Lederman, D. Walker, J. Dongarra “MPI: The Complete Reference”, MIT Press, 1995.

M 4.34 Module: Fluid Mechanics of Turbulent Flows (WSEM-PB523) [M-BGU-105361]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2020)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules) (Usage from 4/1/2020)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2020)
Profile Studies / Water Resources Engineering (Compulsory Modules B) (Usage from 4/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-110841	Fluid Mechanics of Turbulent Flows	6 CR	Uhlmann

Competence Certificate
- 'Teilleistung' T-BGU-110841 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Participants are able to describe the characteristics of turbulent flows, and to quantify their effect upon the transport rates of momentum, heat and mass. They are aware of the problems associated with computationally determining turbulent flow quantities. With this knowledge, they are able to weigh the prosand cons of the different modeling approaches; they are further able to choose an appropriate approach for a given application.

Content
The mathematical description of the physics of turbulence is successively developed. The module presents the phenomenology of turbulent flows, introduces the statistical description of turbulent flow processes, discusses the characteristics of free and wall-bounded shear flows, and presents an analysis of the turbulent energy cascade.

Module grade calculation
grade of the module is grade of the exam

Annotation
The module will be offered newly as from summer term 2020. It will replace the module Analysis of Turbulent Flows by parts.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 60 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
Basic fluid mechanics (experience in working with the Navier-Stokes equations)
Mathematics (analysis – partial differential equations, Fourier series, vectors/tensors, matrices and eigenvalues; statistics)
Knowledge in programming with Matlab is recommended; otherwise it is strongly recommended to participate in the course ’Introduction to Matlab (CC772)’.

M 4.35 Module: Modeling of Turbulent Flows - RANS and LES (WSEM-PB524) [M-BGU-105362]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2020)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules) (Usage from 4/1/2020)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2020)
Profile Studies / Water Resources Engineering (Compulsory Modules B) (Usage from 4/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-BGU-110842	Modeling of Turbulent Flows - RANS and LES	6 CR	Uhlmann

Competence Certificate
- 'Teilleistung' T-BGU-110842 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Participants are able to weigh the prosand cons of the different modeling approaches; they are further able to choose an appropriate approach for a given application. Participants have the ability to critically evaluate the expected outcome of a range of turbulence models with respect to their predictive capabilities and the required computational effort.

Content
In this module covers the required mathematical tools and the most useful modeling approaches for fluids engineering problems. First the statistical approach to turbulence modeling, based upon Reynolds averaging (RANS) is presented, starting with the simplest algebraic model and ranging up to Reynolds stress transport models. Furthermore, an introduction to the concept of large-eddy simulation (LES) is given.

Module grade calculation
grade of the module is grade of the exam

Annotation
The module will be offered newly as from winter term 2020/21. It will replace the module Analysis of Turbulent Flows by parts.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Modeling of Turbulent Flows - RANS and LES lecture, exercise: 60 h

independent study:

- preparation and follow-up lectures, exercises Modeling of Turbulent Flows - RANS and LES: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
Basic fluid mechanics (experience in working with the Navier-Stokes equations)
Mathematics (analysis – partial differential equations, Fourier series, vectors/tensors, matrices and eigenvalues; statistics)
Knowledge in programming with Matlab is recommended; otherwise it is strongly recommended to participate in the course 'Introduction to Matlab (CC772)'.

Taking the module Fluid Mechanics of Turbulent Flows [PB523] preliminarily is strongling recommended.

M 4.36 Module: Hydraulic Structures (WSEM-PB631) [M-BGU-103389]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	2 terms	English	4	2

Mandatory			
T-BGU-106774	Groundwater Flow around Structures	3 CR	Trevisan
T-BGU-110404	Interaction Flow - Hydraulic Structures	3 CR	Gebhardt

Competence Certificate
- 'Teilleistung' T-BGU-106774 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-110404 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to analyze and calculate steady and unsteady flow forces on hydraulic structures. They can describe groundwater flow processes and derive flow parameters with common measurement calculations . Based on the acquired knowledge, they can analyze concepts for preventing groundwater-related structural damage in a critical manner.Students characterize and categorize flow-induced structural vibrations. They can apply their knowledge to application examples.

Content
In this module, the following topics are discussed in depth:

- potential theory
- groundwater flow
- structural adjustment to groundwater flow
- determination of hydrostatic and hydrodynamic flow forces
- overview of sealing mechanisms: flood sluices, weirs, gates
- flow-induced structural vibrations

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Groundwater Flow around Structures lecture/exercise: 30 h
- Interaction Flow - Hydraulic Structures lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises Groundwater Flow around Structures: 30 h
- examination preparation Groundwater Flow around Structures (partial exam): 30 h
- preparation and follow-up lecture/exercises Interaction Flow - Hydraulic Structures: 30 h
- examination preparation Interaction Flow - Hydraulic Structures (partial exam): 30 h

total: 180 h

Recommendation
none

Literature

Erbisti, P.C.F., 2004, Design of Hydraulic Gates, Balkema Pub., Tokyo
Naudascher; E, 1991, Hydrodynamic Forces, Balkema Pub., Rotterdam
C. Lang, Skript Interaktion Strömung - Wasserbauwerk

M 4.37 Module: River Processes (WSEM-PB634) [M-BGU-105927]

Responsible: Prof. Dr. Mario Jorge Rodrigues Pereira da Franca
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2022)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules) (Usage from 4/1/2022)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2022)
Profile Studies / Water Resources Engineering (Compulsory Modules B) (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-111930	River Processes	6 CR	Rodrigues Pereira da Franca

Competence Certificate
- 'Teilleistung' T-BGU-111930 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
This module must not be selected together with the module Flow and Sediment Dynamics in Rivers [WSEM-PB633] not offered anymore.

Competence Goal
The module provides students with theoretical and practical knowledge of landscape and river processes, related to hydromorphodynamics and transported phases. The students will be able to transfer immature scientific knowledge into engineering praxis.

After successfully completing the course on *Landscape and River Morphology*, the student will be able to:

- describe the main morphology processes happening at the landscape and river scale,
- describe and identify the governing processes of singularities in the river networks such as confluences, bifurcations, bends, among others,
- identify possible implications of climate change in morphological processes of the river basin,
- identify the main hydromorphodynamic processes relevant to river ecology,
- transfer immature knowledge from scientific literature into engineering praxis.

After successfully completing the course on *Transport Processes in Rivers*, the student will be able to:

- describe the engineering and ecological implications of different types of moving elements (debris) in rivers,
- identify relevant sources and sinks of debris transported by rivers,
- quantify transport processes relative to river debris,
- plan monitoring campaigns based on state-of-the-art techniques.

Transfer scientific literature in river debris into practical applications.

Content
The course *Landscape and River Morphology* contains the following topics:

- morphology processes at the landscape scale
- morphology processes at the river scale
- intersection of hydromorphodynamic processes with engineering praxis
- safety and stability of river networks
- fluvial ecomorphology

The course *Transport Processes in Rivers* studies the sources, transport and transformations, and sinks of different types of elements:

- sediment transport (bed and suspended load)
- woody and vegetation debris
- plastic and urban (cars and urban furniture) debris
- bubbles and gas transfer
- contaminant plumes

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Landscape and River Morphology lecture/exercise: 30 h
- Transport Processes in Rivers lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises Landscape and River Morphology: 10 h
- preparation of the seminar paper Landscape and River Morphology: 40 h
- preparation and follow-up lecture/exercises Transport Processes in Rivers: 10 h
- preparation of the seminar paper Transport Processes in Rivers: 40 h
- preparation of colloquium: 20 h

total: 180 h

Recommendation
basic knowledge in hydromechanics and hydraulic engineering

M 4.38 Module: Experimental Hydraulics and Measuring Techniques (WSEM-PB641) [M-BGU-103388]

Responsible: Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German/English	4	2

Mandatory			
T-BGU-106773	Experimental Hydraulics II	3 CR	Seidel
T-BGU-110411	Flow Measurement Techniques	3 CR	Gromke

Competence Certificate
- 'Teilleistung' T-BGU-106773 with examination of other type according to § 4 Par. 2 No. 3
- 'Teilleistung' T-BGU-110411 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to describe the principles of different flow measurement methods and combine this information with the basics of today's flow measurement technology. They have basic knowledge about the structure and can analyze the suitability of measurement methods and set application boundaries.Students have basic knowledge about experimentation in hydraulics. They know the similarity mechanical requirements and assign them to the hydromechanical basics. Students are able to analyze applications in the field of multiphase hydraulics and select suitable model concepts. They can present their own thoughts and ideas in a structured manner and discuss the themes with specialists.

Content
In this module, the following topics will be discussed in depth:

- basic equations in fluid mechanics
- measurement methods and their fields of application
- experimental models with movable beds
- experiments related to multiphase flow problems (water-air, water-solid)

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Flow Measurement Techniques lecture/exercise: 30 h
- Experimental Hydraulics II lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises Flow Measurement Techniques: 30 h
- examination preparation Flow Measurement Techniques (partial exam): 30 h
- preparation and follow-up lecture/exercises Experimental Hydraulics II: 30 h
- preparation of term paper (partial exam): 30 h

total: 180 h

Recommendation
module 'Experiments in Fluid Mechanics (CC471)', hydraulic lab practice

M 4.39 Module: Numerical Flow Modeling in Hydraulic Engineering (WSEM-PB651) [M-BGU-103390]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-BGU-106776	Numerical Flow Modeling in Hydraulic Engineering	6 CR	Oberle

Competence Certificate
- 'Teilleistung' T-BGU-106776 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
see German version

Content
see German version

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 60 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
basic knowledge of hydrology, hydraulic engineering and water management as well as open channel hydraulics

Literature
lecture notes

M 4.40 Module: Hydro Power Engineering (WSEM-PB653) [M-BGU-100103]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-BGU-100139	Hydro Power Engineering	6 CR	Oberle

Competence Certificate
- 'Teilleistung' T-BGU-100139 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to describe the different turbine types and can define selection criteria for their usage. They are able to reproduce the basic approaches in the planning and design of hydropower plants and to make own calculations to select turbines. They can select and apply the necessary tools in a methodical matter.
Students are able to discuss the current political conditions in terms of energy policy with other students and support their personal opinion on these issues with technical arguments.

Content
The course explains the technical background for planning and designing waterpower plants. Among others, it covers the constructional characteristics of river and high-pressure power plants, the operating modes and selection criteria of different types of turbines as well as electro-technical aspects of the plants` operation. In addition, ecological aspects and energy policy are considered as frame conditions. The lecture sessions are complemented by the presentation of current projects and excursions.

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 60 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
course Hydraulic Engineering and Water Management (6200511)

Literature
Folienumdrucke;

Giesecke J., Mosonyi E., 2005, Wasserkraftanlagen, Planung, Bau und Betrieb, Springer Verlag, Berlin

M 4.41 Module: Waterway Engineering (WSEM-PB655) [M-BGU-103392]

Responsible: Dr.-Ing. Andreas Kron
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-BGU-106779	Seminar Paper 'Waterway Engineering'	1 CR	Kron
T-BGU-106780	Waterway Engineering	5 CR	Kron

Competence Certificate
- 'Teilleistung' T-BGU-106779 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106780 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students are knowledgeable about the various types of navigable waterways and their hydraulic structures. They are able to describe and apply the hydraulic basics for the design of these hydraulic structures and the interaction between ship and waterway. Students can assign the tasks and responsibilities of waterway engineering to the administrative structure of the waterways and shipping.

Content

- inland waterways
- types of navigation locks and ship lifts
- hydraulics and design of navigation locks and ship lifts
- reinforcement of embankments, banks and beds
- interaction ship-waterway

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lectures/exercises: 30 h
- preparation of the seminar paper (exam prerequisite): 30 h
- examination preparation: 60 h

total: 180 h

Recommendation
course Hydraulic Engineering and Water Management (6200511)

M 4.42 Module: Project Studies in Water Resources Management (WSEM-PB661) [M-BGU-103394]

Responsible: Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules B)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-BGU-106783	Project Studies in Water Resources Management	6 CR	Seidel

Competence Certificate
- 'Teilleistung' T-BGU-106783 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
see German version

Content
see German version

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 30 h

independent study:

- preparation and follow-up lectures, exercises: 30 h
- preparation of term paper (exam): 120 h

total: 180 h

Recommendation
module 'Flow and Sediment Dynamics in Rivers (PB633)'

M 4.43 Module: River Basin Modeling (WSEM-PC341) [M-BGU-103373]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Profile Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules C)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	2 terms	English	4	2

Mandatory			
T-BGU-111061	Mass Fluxes in River Basins	3 CR	Fuchs
T-BGU-106603	River Basin Modeling	3 CR	Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-111061 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106603 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to explain the basic relationships between water-driven material cycles in river basins and their budget in aquatic ecosystems. They are able to analyze the impact of anthropogenic activities on water condition and quality. Students gain knowledge regarding transport pathways of substances and biochemical and physical interactions in water bodies in order to formulate mathematical model approaches. Using simulation models, they are able to quantify substance emissions; to predict the impact from external influences on the water quality relevant processes and; to perform different scenario analysis. Students are capable of evaluating model results in terms of their plausibility and uncertainty.

Content
This module provides students with a broad-based understanding of the fundamentals of materials flows (N, P, pollutants) and their relevant transport pathways in river basins. Different modeling approaches for a quantitative description of the processes will be presented. Students receive a single-user version of the simulation tool MoRE (Modelingof Regionalized Emissions). They have to develop and implement their own model in small groups and interpret simulation results.

Module grade calculation
grade of the module is grade of the exam

Annotation
As from summer term 2021 the not graded accomplishment 'Mass Fluxes in River Basins' is examination prerequisite.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Mass Fluxes in River Basins lecture: 30 h
- Modeling Mass Fluxes in River Basins exercise: 30 h

independent study:

- preparation and follow-up lectures Mass Fluxes in River Basins: 30 h
- working on exercises and final presentation Mass Fluxes in River Basins (examination prerequisite): 30 h
- project work on River Basin Modeling (examination): 60 h

total: 180 h

Recommendation
modules 'Urban Water Infrastructure and Management (AF301)', 'Freshwater Ecology (CC371)'

Literature

Schwoerbel, J. (1993): Einführung in die Limnologie, 7. Aufl., Fischer Verlag, Stuttgart
Kummert, R. (1989): Gewässer als Ökosysteme: Grundlagen des Gewässerschutzes, 2. Aufl., Teubner Verlag, Stuttgart
Stumm, W.; Morgan, J.J. (1996): Aquatic Chemistry – Chemical equilibria and rates in natural waters, Wiley Interscience, NY

M 4.44 Module: Groundwater Management (WSEM-PC561) [M-BGU-100340]

Responsible: Dr. Ulf Mohrlok
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Profile Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules C)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	2 terms	English	4	1

Mandatory			
T-BGU-100624	Groundwater Hydraulics	3 CR	Mohrlok
T-BGU-100625	Numerical Groundwater Modeling	3 CR	Mohrlok

Competence Certificate
- 'Teilleistung' T-BGU-100624 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-100625 with examination of other type according to § 4 Par. 2 No. 3

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Based on the understanding of hydrogeological settings and fluid-mechanical processes in the subsurface students can characterize different kinds of groundwater systems by means of hydraulics. They can quantify the relevant flow and transport processes with simple analytical and numerical methods for different problems regarding groundwater quantity and quality. Thereby, they are able to conceive and evaluate the relations important for the management of groundwater resources.

Content

- groundwater systems
- fluid-mechanical processes in porous media
- methods of balancing groundwater flow and solute transport processes
- examples of groundwater management
- project work

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Groundwater Hydraulics lecture/exercise: 30 h
- Numerical Groundwater Modeling presentations/project discussions: 15 h

independent study:

- preparation and follow-up lecture/exercises, working on exercises Groundwater Hydraulics: 40 h
- examination preparation Groundwater Hydraulics (partial exam): 20 h
- project work Numerical Groundwater Modeling, incl. presentation and preparation of the report (partial exam): 80 h

total: 185 h

Recommendation
basic knowledge in fluid mechanics, hydrology, solute transport and numerical methods

Literature

Bear, J. (1979). Hydraulics of Groundwater. McGraw Hill.

Chiang, W.H. (2005). 3D - Groundwater Modeling with PMWIN: A Simulation System for Modeling Groundwater Flow and Transport Processes, 2/e, incl. CD-Rom. Berlin, Heidelberg, D.: Springer.

Fetter, C.W. (1999). Contaminant Hydrogeology , 2/e. Upper Saddle River, NJ, U.S.A.: Prentice Hall.

Mohrlok, U. (2009). Bilanzmodelle in der Grundwasserhydraulik: quantitative Beschreibung von Strömung und Transport im Untergrund, Karlsruhe, D.: Universitätsverlag.

Schwartz, F. and H. Zhang (2003). Fundamentals of Ground Water. New York, NY, U.S.A.: John Wiley & Sons.

M 4.45 Module: Integrated Design Project in Water Resources Management (WSEM-PC722) [M-BGU-105637]

Responsible: Dr.-Ing. Uwe Ehret
Dr.-Ing. Frank Seidel

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2021)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2021)
Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 4/1/2021)
Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 4/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-111275	Integrated Design Project in Water Resources Management	6 CR	Ehret, Seidel

Competence Certificate
- 'Teilleistung' T-BGU-111275 with written examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to independently undergo the basic steps of planning and design in water resources management. They can identify engineering problems and apply the respective design approaches.

Students are able to work in a self-organized and reflexive manner. They are able to use and link their knowledge logically and have organizational skills in the areas of teamwork and presentation.

Content
In this module, students will work in teams to independently plan and design a flood protection measure for a small catchment. This comprises:

- identifying the legally required flood protection level
- establishing and comparing possible flood protection strategies
- setting up a hydrological model for the project catchment
- establishing hydrological design values based on design storms applied to the hydrological model, and designing flood values from extreme value statistics
- designing the outlet works and the flood release system of a flood retention basin based on the hydrological flood values with a special focus in capacity and energy dissipation.

In the lectures, the following topics required to successfully accomplish the design project will be covered:

- basic introduction to Water Resources Management
- basic planning methodology in water management projects
- basic hydrological modeling
- introduction to extreme-value statistics and design storms
- introduction to the related design standards and legal requirements (DIN 19700 and others)
- introduction to the design of hydraulic structures with a special focus on flood retention basins
- principals of Computer Aided Design (AutoCAD)
- background on operation and maintenance of flood retention basins
- practical example: excursion to a build flood retention basin

Module grade calculation
grade of the module is grade of the exam

Annotation
newly offered as from summer term 2021

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises: 30 h
- preparation of the study project and the report (examination): 120 h

total: 180 h

Recommendation
basic knowledge in hydrology, hydrological modeling, hydromechanics, hydraulic engineering

Matlab skills (for hydrological modeling), e.g. successful completion of Introduction to Matlab (WSE-CC772)

M 4.46 Module: Subsurface Flow and Contaminant Transport (WSEM-PC725) [M-BGU-103872]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-106598	Transport and Transformation of Contaminants in Hydrological Systems	6 CR	Zehe

Competence Certificate
- 'Teilleistung' T-BGU-106598 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to explain processes of transport and decomposition related to nutrients and pollutants in surface runoff and in the unsaturated zone of rural catchments.

Students are able to independently apply analytical and process-based models: estimation of model parameters from field investigations, estimation of water and substance fluxes and balance in the critical zone, statements on the risks related to contaminant mobilization in natural soils.

Students are able to evaluate the limits of applicability of modeling approaches in natural, heterogeneous soils.

Content
Transport processes in the unsaturated zone related to infiltration, surface runoff, and movement of soil water:

- advective-dispersive transport in homogeneous and heterogeneous soils
- particulate transport by erosion
- adsorption
- chemical and microbial processes of reaction and decay in soils
- modeling contaminant transport (e.g. pesticides) in soils using analytical models
- risk assessment for pesticides in soils (transport, residence times, adsorption, decay)
- estimation of model parameters from field exploration
- parameterization of adsorption isotherms
- breakthrough curve

Computer exercise:

- simulation of water and substance transport with process-based models
- independently conducted risk-assessments for pesticides using simple simulation techniques

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendation
modules Water and Energy Cycles [WSEM-AF701] and Hydrological Measurements in Environmental Systems [WSEM-PC732]; knowledge of programming with Matlab; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab' (6224907)

Literature
Jury, W. and Horton, R. (2004): Soil physics. John Wiley
Hillel, D. (1995): Environmental Soil Physics. Academic Press
Fritsche, W. (1998) Umweltmikrobiologie, Grundlagen und Anwendungen. Gustav Fischer Verlag, 248pp.

M 4.47 Module: Hydrological Measurements in Environmental Systems (WSEM-PC732) [M-BGU-103763]

Responsible: Dr. Jan Wienhöfer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 4/1/2019)
Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-106599	Hydrological Measurements in Environmental Systems	6 CR	Wienhöfer

Competence Certificate
- 'Teilleistung' T-BGU-106599 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students know and understand measurement principles for catchment properties, catchment states, and water fluxes. They are able to independently plan and conduct measurements on various scales (soil column, plot, hillslope, catchment) in the field and the laboratory. Students can analyze observation data with statistical methods, and are able to quantify and evaluate the related uncertainties. Students are able to present the related results in teamwork.

Content

- introduction to environmental observations (scales, uncertainties), statistical data analysis and error analysis
- seminar on hydrological measurement devices in field and laboratory: Discharge, soil moisture, infiltration, hydraulic conductivity
- lab and field work (several days) where students conduct hydrological measurements

Module grade calculation
grade of the module is grade of the exam

Annotation
The course requires a minimum number of 6 and a maximum number of 30 participants. Please register online for the course (not exam!), 6224807, via the Campus portal (in exceptional cases via e-mail to the responsible lecturer). Participants are selected according to their progress of study considering the following order: students of *Water Science and Engineering*, students of *Civil Engineering*, students of *Geoecology*.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- laboratory and field exercise: 70 h

independent study:

- preparation and follow-up laboratory and field exercises: 10 h
- preparation of presentations and reports (exam): 100 h

total: 180 h

Recommendation
knowledge in hydrology

Literature
notes for field exercises

M 4.48 Module: Protection and Use of Riverine Systems (WSEM-PC762) [M-BGU-103401]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Profile Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules C)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-106790	Prerequisite Protection and Use of Riverine Systems	1 CR	Kämpf
T-BGU-106791	Protection and Use of Riverine Systems	5 CR	Kämpf

Competence Certificate
- 'Teilleistung' T-BGU-106790 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106791 with examination of other type according to § 4 Par. 2 No. 3

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to rank interdisciplinary texts on riverine systems according to their relevance, and formulate relevant questions on this topic. Students can research systematically on a scientific problem. They are able to put the materials in the context of integrated management strategies and current water resources problems to work on solutions for adapting to regional conditions.

Content
Integrated Water Management:

- planning of water management projects
- adapted technologies (small hydropower systems)
- water distribution networks
- consideration of the geographical, social and political environmen

International Nature Conservation:

- FFH Directive, Natura 2000, wildlife conservation concepts
- renaturation concepts

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- seminar, excursion: 50 h

independent study:

- preparation and follow-up seminar, excursion: 40 h
- preparation of literature annotation, short presentation and excursion report (examination prerequisite): 30 Std.
- preparation of presentation and manuscript (examination): 60 Std.

total: 180 h

Recommendation
none

M 4.49 Module: Hydrogeology: Field and Laboratory Methods (WSEM-PC821) [M-BGU-102441]

Responsible: Dr. rer. nat. Nadine Göppert
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Profile Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules C)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-BGU-104834	Hydrogeology: Field and Laboratory Methods	6 CR	Göppert

Competence Certificate
- 'Teilleistung' T-BGU-104834 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Annotation
For organizational reasons, the number of participants must be limited to a maximum of 20. The registration takes place via ILIAS. Priority will be given to students from Applied Geosciences, Water Science and Engineering, then Geoecology and others. The allocation will be done considering the study progress. The practical portion of this course is done in presence. The field exercises are mandatory for the study progress of the participants.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Preparatory Seminar: 15 Std.
- Field and Laboratory Excercises: 25 Std.

independent study:

- preparation and follow-up Preparatory Seminar: 10 h
- presentation Preparatory Seminar (part of examination): 40 h
- preparation of the report on Field and Laboratory Excercises (part of examination): 80 h

total: 170 h

Recommendation
module 'Hydrogeology (AF801)'

M 4.50 Module: Hydrogeology: Karst and Isotopes (WSEM-PC841) [M-BGU-102440]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Profile Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules C)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	2 terms	German	4	1

Mandatory			
T-BGU-104758	Hydrogeology: Karst and Isotopes	6 CR	Goldscheider

Competence Certificate
- 'Teilleistung' T-BGU-104758 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Karst Hydrogeology lecture/exercise: 30 h
- Isotope Methods in Hydrogeology lecture/exercise: 15 h

independent study:

- preparation and follow-up lecture/exercises Karst Hydrogeology: 45 h
- preparation and follow-up lecture/exercises Isotope Methods in Hydrogeology: 20 h
- examination preparation: 70 h

total: 180 h

Recommendation
module 'Hydrogeology (AF801)'

M 4.51 Module: Sustainable Management of rivers and Floodplains (WSEM-PC986) [M-BGU-103391]

Responsible: Prof. Dr. Florian Wittmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Profile Modules)
Profile Studies / Water Resources Engineering (Compulsory Modules C)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	2 terms	German	4	2

Mandatory			
T-BGU-106778	Ecosystem Management	3 CR	Damm, Wittmann
T-BGU-102997	River and Floodplain Ecology	3 CR	Wittmann

Competence Certificate
- 'Teilleistung' T-BGU-102997 with not graded accomplishment according § 4 Par. 3
- 'Teilleistung' T-BGU-106778 with examination of other type according § 4 Par. 2 No. 3

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Module grade calculation
grade of the module is grade of the exam

Annotation
None

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Ecology of Rivers and Wetlands lecture: 30 h
- Ecosystem Management seminar: 30 h

independent study:

- preparation and follow-up lectures Ecology of Rivers and Wetlands: 30 h
- preparation test Ecology of Rivers and Wetlands (not graded accomplishment): 30 h
- preparation and follow-up lectures Ecosystem Management: 30 h
- preparation of presentation Ecosystem Management (examination): 30 h

total: 180 h

Recommendation
start in winter term with course 'Ecology of Rivers and Wetlands'

M 4.52 Module: Module Master Thesis (WSE-MSC-THESIS) [M-BGU-104995]

Responsible: Prof. Dr.-Ing. Peter Vortisch
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Master Thesis (Usage from 7/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	Grade to a tenth	Each term	1 term	German/English	5	1

Mandatory			
T-BGU-110134	Master Thesis	30 CR	Vortisch

Competence Certificate
thesis and final presentation according to § 14 ER/SPO

Prerequisites
Prerequiste for the admission to the Master Thesis is that the student has passed module examinations in the extent of minimum 42 CP. The examination board decides about exceptions on request of the student (ER/SPO § 14 Par. 1).

Competence Goal
The student is able to investigate independently a complex problem within a particular research field of his choice in limited time, following scientific methods. He can search autonomously for literature, can find own approaches, can evaluate his results and can classify them according to the state of the art. He is further able to present clearly the essential matter and results in his master thesis and in a comprehensive presentation.

Content
The Master Thesis is an independent written report and comprises the theoretical or experimental work on a complex problem within a particular field of civil engineering with scientific methods. The topic of the master thesis derives from the students choice of a particular field. The student and can make proposals for the topic.

Module grade calculation
The grade of the module results from the evaluation of the Master Thesis and the final presentation.

Annotation
Information about the procedure regarding admission and registration of the Master Thesis see chap. 1.2.5.

Workload

- working on thesis project: 720 h
- thesis writing: 150 h.
- preparation of presentation: 30 h

total: 900 h

Recommendation
All technical skills and soft skills required for working on the selected topic and the preparation of the thesis should be attained.

M 4.53 Module: Thermal Use of Groundwater (WSEM-SM879) [M-BGU-103408]

Responsible: Prof. Dr. Philipp Blum
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	2

Mandatory			
T-BGU-106803	Thermal Use of Groundwater	4 CR	Blum

Competence Certificate
- 'Teilleistung' T-BGU-106803 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students get familiar with the topic ‘Thermal Use of Groundwater’ and will be able to integrate their knowledge in particular in an urban water energy nexus. They get knowledge about the fundamentals of thermal transport in groundwater and their application to shallow geothermal systems such as ground source and groundwater heat pump systems. Hence, analytical and numerical simulations will be performed using Excel and Matlab scripted codes. They will be able to perform their own simulations and will be able to design shallow geothermal systems in context of the water energy nexus.

Content
The content of this module is mainly based on the textbook on ’Thermal Use of Shallow Groundwater’ and is therefore structured as follows:
- Fundamentals (theory of heat transport in the subsurface)
- Analytical solutions for closed and open systems
- Numerical solutions for shallow geothermal systems
- Long-term operability and sustainability
- Field methods such as thermal tracer tests and thermal response tests (TRT)
- Case studies and applications

Analytical simulations are performed using Excel and Matlab scripted codes. In addition, calibration and validation exercises are performed using existing field and monitoring data. Finally, the students are actively planning an own geothermal system from the application up to the long-term performance of such a system. Hence, a final planning report should be written.

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises: 40 h
- examination preparation: 50 h

total: 120 h

Recommendation
knowledge of programming with Matlab; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab' (6224907)

Literature
Stauffer, F., Bayer, P., Blum, P., Molina-Giraldo, N., Kinzelbach W. (2013): Thermal Use of Shallow Groundwater. 287 pages, CRC Press.
Other documents such as recent publications are made available on ILIAS

M 4.54 Module: Earthwork and Embankment Dams (WSEM-SM961) [M-BGU-103402]

Responsible: Prof. Dr.-Ing. Theodoros Triantafyllidis
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	2 terms	German	4	1

Mandatory			
T-BGU-106792	Earthwork and Embankment Dams	6 CR	Bieberstein

Competence Certificate
- 'Teilleistung' T-BGU-106792 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
see German version

Content
see German version

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Basics in Earthworks and Embankment Dams lecture/exercise: 30 Std.
- Embankment Dams (Advanced) lecture/exercise: 30 Std.

independent study:

- preparation and follow-up lecture/exercises Basics in Earthworks and Embankment Dams: 30 h
- preparation and follow-up lecture/exercises Embankment Dams (Advanced): 30 h
- examination preparation: 60 h

total: 180 h

Recommendation
none

M 4.55 Module: Environmental Geotechnics (WSEM-SM962) [M-BGU-100079]

Responsible: Dr.-Ing. Andreas Bieberstein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-BGU-100084	Landfills	3 CR	Bieberstein
T-BGU-100089	Brownfield Sites - Investigation, Evaluation, Rehabilitation	3 CR	Bieberstein

Competence Certificate
- 'Teilleistung' T-BGU-100084 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-100089 with oral examination according to § 4 Par. 2 No. 2

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
The students can describe the legal guidelines regarding the disposal of wastes and the permitted threshold value for brownfields. They can outline the geotechnical concerns in the construction of landfill sites depending on the particular landfill classification, landfill elements, their relevant requirements and necessary certifications. They are able to interlink interdisciplinarily the chemical, mineralogical, biological, hydraulic and geotechnical aspects dealing with brownfileds. They can choose reasonably between the relevant remediation technologies and assess their limits of applications and risks.

Content
The module covers geotechnical techniques in dealing with waste and brownfields. The environmental engineering, scientific and legal basics are discussd. Working steps of project planning, building materials, ways of construction and proofs are presented. Techniques for burning and immobilisation are explained as well as different microbiological, electrokinetic, hydraulic and pneumatic soil remediation methods.

Module grade calculation
grade of the module is CP weighted average of grades of the partial exams

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Landfills lecture/exercise: 30 h
- Brownfield Sites - Investigation, Evaluation, Rehabilitation lecture: 30 h
- Excursion: 10 h

independent study:

- preparation and follow-up lecture/exercises Landfills: 25 h
- examination preparation Landfills (partial exam): 30 h
- preparation and follow-up lectures Brownfield Sites - Investigation, Evaluation, Rehabilitation: 25 h
- examination preparation Brownfield Sites - Investigation, Evaluation, Rehabilitation (partial exam): 30 h

total: 180 h

Recommendation
none

Literature

DGGT, GDA-Empfehlungen – Geotechnik der Deponien und Altlasten, Ernst und Sohn, Berlin
Drescher (1997), Deponiebau, Ernst und Sohn, Berlin
Reiersloh, D und Reinhard, M. (2010): Altlastenratgeber für die Praxis, Vulkan-V. Essen

M 4.56 Module: General Meteorology (WSEM-SM971) [M-PHYS-103732]

Responsible: apl. Prof. Dr. Michael Kunz
Organisation: KIT Department of Physics
Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	pass/fail	Each winter term	1 term	German	4	1

Mandatory			
T-PHYS-101091	General Meteorology	6 CR	Kunz

Competence Certificate
- 'Teilleistung' T-PHYS-101091 with not graded accomplishment according to § 4 Par. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students will be able to describe basic phenomena of meteorology using adequate terminology and explain them with the help of the underlying physical processes.

Content
This lecture is designed to introduce students to the fundamental aspects of meteorology. In addition to the fundamental physical laws of the atmosphere (radiation, thermodynamics, energetics), the composition of air, basic meteorological variables, air motions, and phase transitions of water will be covered.

(1) Introduction and Overview: Atmosphere, weather and climate
(2) Composition of air
(3) Important meteorological variables and state variables.
(4) Weather elements, weather observations, and introduction to synoptic meteorology.
(5) Structure of the atmosphere and basic laws
(6) Radiation
(7) Thermodynamic fundamentals: state variables and vertical motions
(8) Condensation processes and precipitation formation
(9) Dynamical fundamentals: motions and simplified balances

Module grade calculation
not graded

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 75 h

independent study:

- preparation and follow-up lectures, exercises: 55 h
- preparation of the exercise to present: 20 h
- test preparation: 30 h

total: 180 h

Recommendation
none

M 4.57 Module: Applied Meteorology: Turbulent Diffusion (WSEM-SM974) [M-PHYS-105776]

Responsible: Prof. Dr. Corinna Hoose
Dr. Gholamali Hoshyaripour

Organisation: KIT Department of Physics

Part of: Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 10/1/2021)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2021)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 10/1/2021)
Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 10/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-PHYS-109981	Examination on Turbulent Diffusion	3 CR	Hoshyaripour, Kunz
T-PHYS-111427	Turbulent Diffusion	3 CR	Hoose, Hoshyaripour

Competence Certificate
- 'Teilleistung' T-PHYS-111427 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-PHYS-109981 with oral examination according to § 4 Par. 2 No. 2

details about the learning controls see at the respective 'Teilleistung'

Prerequisites
none

Competence Goal
Students will be able to explain essential aspects of the dispersion of air pollutants in a professional manner. They are able to describe the underlying processes qualitatively and quantitatively and to derive effects from weather information.

Content
Dispersion of air impurities:

- relevant trace gases
- diurnal variation of emissions and concentrations
- temperature profile and motion processes in the lower atmosphere
- turbulent diffusion
- turbulence parameterization
- chemical transformation processes
- numerical models

Module grade calculation
grade of the module is grade of the exam

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lectures, exercise: 45 h

independent study:

- preparation and follow-up lectures, exercises Turbulent Diffusion, incl. working on a simulation (examination prerequisite): 105 h
- examination preparation: 30 h

total: 180 h

Recommendation
basic knowledge in meteorology, e.g. module 'General Meteorology (SM971)'

M 4.58 Module: Study Project (WSEM-SP111) [M-BGU-103439]

Responsible: Ph.D. Luca Trevisan
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Study Project

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
15	Grade to a tenth	Each term	1 term	German/English	4	1

Mandatory			
T-BGU-106839	Study Project	15 CR	Trevisan

Competence Certificate
- 'Teilleistung' T-BGU-106839 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students are able to work on an interdisciplinary, water-related project using scientific methods. They can, with guidance, plan, structure, prepare, conduct, and document a study. They are able to select appropriate methods for the solution of the given problem.

Students are able to work self-organized and structured. They possess skills in the field of project management, teamwork and presentation, both orally and in writing.

Content
Conducting a water-related, interdisciplinary project work. This may be of a theoretical and/or experimental type. The focus is on the development of conclusions using scientific methods, project management and presentation of the results.

The project can also be worked on in student teams. In this case, each student works on a particular aspect of an overall problem as part of a joint project.

Students are invited to make suggestions for topics.

It is possible to conduct the project in cooperation with external partners.

Module grade calculation
grade of the module is grade of the exam

Annotation
none

Workload
processing time appr. 3 months

Recommendation
The knowledge and technical and interdisciplinary skills needed to work on the selected topic and to prepare the 'Study Project' should have been acquired.

5 Courses

T 5.1 Course: Advanced Fluid Mechanics [T-BGU-106612]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103359 - Advanced Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	1

Events					
ST 2022	6221701	Advanced Fluid Mechanics	4 SWS	Lecture / Practice (/	Eiff

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.2 Course: Applied Ecology and Water Quality [T-BGU-109956]

Responsible: PD Dr.-Ing. Stephan Fuchs
Dr.-Ing. Stephan Hilgert
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104922 - Freshwater Ecology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	1

Events					
ST 2022	6223813	Applied Ecology and Water Quality	2 SWS	Seminar /	Hilgert, Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
term paper, appr. 8-15 pages, and
presentation, appr. 15 min.

Prerequisites
none

Recommendation
none

Annotation
The number of participants in the course is limited to 12 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering* and *Geoecology* and further study programs. The attendance at the first meeting is mandatory. In case of absence the place will be assigned to a person on the waiting list.

T 5.3 Course: Biofilm Systems [T-CIWVT-106841]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103441 - Biofilm Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2022	22617	Biofilm Systems	2 SWS	Lecture / 🗣	Hille-Reichel, Wagner

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.4 Course: Booklet Integrated Infrastructure Planning [T-BGU-106763]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103380 - Integrated Infrastructure Planning

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	6224910	Infrastructure Planning – Socio-economic & Ecological Aspects		Lecture / Practice (	Kämpf, Walz

Competence Certificate
booklet; DIN A5, appr. 15 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.5 Course: Brownfield Sites - Investigation, Evaluation, Rehabilitation [T-BGU-100089]

Responsible: Dr.-Ing. Andreas Bieberstein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-100079 - Environmental Geotechnics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each winter term	1

Events					
WT 21/22	6251915	Brownfield Sites - Investigation, Evaluation, Rehabilitation	2 SWS	Lecture /	Bieberstein, Eiche, Würdemann, Mohrlok

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.6 Course: Design Exercise Hydraulic Structures [T-BGU-111929]

Responsible: Prof. Dr. Mario Jorge Rodrigues Pereira da Franca
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103376 - Hydraulic Engineering

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	1

Events					
ST 2022	6222703	Design of Hydraulic Structures	2 SWS	Lecture / Practice (/	Seidel

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
1 design exercise, report about 10 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.7 Course: Design Exercise River Engineering [T-BGU-111928]

Responsible: Prof. Dr. Mario Jorge Rodrigues Pereira da Franca
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103376 - Hydraulic Engineering

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	1

Events					
ST 2022	6222701	River Engineering	2 SWS	Lecture / Practice (/	Rodrigues Pereira da Franca

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
1 design exercise, report about 10 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.8 Course: Earthwork and Embankment Dams [T-BGU-106792]

Responsible: Dr.-Ing. Andreas Bieberstein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103402 - Earthwork and Embankment Dams

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 21/22	6251703	Basics in Earthworks and Embankment Dams	2 SWS	Lecture / Practice (/	Bieberstein
ST 2022	6251816	Embankment Dams (Advanced)	2 SWS	Lecture / Practice (/	Bieberstein

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 40 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.9 Course: Ecosystem Management [T-BGU-106778]

Responsible: Dr. rer. nat. Christian Damm
Prof. Dr. Florian Wittmann

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-103391 - Sustainable Management of rivers and Floodplains

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	1

Events					
ST 2022	6111234	Ecosystem Management	2 SWS	Seminar /	Damm

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presentation, appr. 20-30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.10 Course: Environmental Biotechnology [T-CIWVT-106835]

Responsible: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103436 - Applied Microbiology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 21/22	22614	Environmental Biotechnology	2 SWS	Lecture /	Tiehm

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, ca. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.11 Course: Environmental Communication [T-BGU-101676]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101108 - Environmental Communication

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	2

Events					
WT 21/22	6224905	Umweltkommunikation / Environmental Communication	2 SWS	Seminar	Kämpf
ST 2022	6224905	Environmental Communication	2 SWS	Seminar /	Kämpf

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presentation, appr. 15 min.,
manuscript, appr. 6000 words, and
Poster DIN-A3

Prerequisites
The accomplishment 'Examination Prerequisite Environmental Communication' (T-BGU-106620) has to be passend.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-106620 - Examination Prerequisite Environmental Communication must have been passed.

Recommendation
none

Annotation
none

T 5.12 Course: Environmental Fluid Mechanics [T-BGU-106767]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103383 - Environmental Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 21/22	6221909	Environmental Fluid Mechanics	4 SWS	Lecture / Practice (/	Eiff

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.13 Course: Examination on Turbulent Diffusion [T-PHYS-109981]

Responsible: Dr. Gholamali Hoshyaripour
apl. Prof. Dr. Michael Kunz
Organisation: KIT Department of Physics
Part of: M-PHYS-105776 - Applied Meteorology: Turbulent Diffusion

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	3

Events					
ST 2022	4052081	Turbulent Diffusion	2 SWS	Lecture /	Hoshyaripour, Hoose
ST 2022	4052082	Exercises to Turbulent Diffusion	1 SWS	Practice /	Hoshyaripour, Hoose, Bruckert

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
The not graded accomplishment 'Turbulent Diffusion' (T-PHYS-111427) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-PHYS-111427 - Turbulent Diffusion must have been passed.

Recommendation
none

Annotation
none

T 5.14 Course: Examination Prerequisite Environmental Communication [T-BGU-106620]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101108 - Environmental Communication

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Events					
WT 21/22	6224905	Umweltkommunikation / Environmental Communication	2 SWS	Seminar	Kämpf
ST 2022	6224905	Environmental Communication	2 SWS	Seminar / 🏵	Kämpf

Legend: 🖳 Online, 🏵 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
2 literature annotations, appr. 150 words each, and
short presentation, appr. 10 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.15 Course: Excursions: Membrane Technologies [T-CIWVT-110864]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105380 - Membrane Technologies in Water Treatment

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Events					
ST 2022	22606	Practical in Membrane Technologies in Water Treatment	1 SWS	Practice / 🗣	Horn, Saravia, und Mitarbeiter

Legend: 💻 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
attendance at two excursions, delivery of excursion reports

Prerequisites
none

Recommendation
none

Annotation
none

T 5.16 Course: Excursions: Water Supply [T-CIWVT-110866]

Responsible: Dr. Gudrun Abbt-Braun
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	1

Competence Certificate
attendance at two excursions, delivery of excursion reports

Prerequisites
none

Recommendation
none

Annotation
none

T 5.17 Course: Experimental Hydraulics II [T-BGU-106773]

Responsible: Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103388 - Experimental Hydraulics and Measuring Techniques

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	1

Events					
WT 21/22	6222907	Experimental Hydraulics II	2 SWS	Lecture / Practice (	Seidel

Competence Certificate
term paper, appr. 10 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.18 Course: Experiments in Fluid Mechanics [T-BGU-106760]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103377 - Experiments in Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	2

Events					
ST 2022	6221802	Experiments in Fluid Mechanics	4 SWS	Lecture / Practice (/	Eiff, Mitarbeiter/innen

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
laboratory reports with analyses of the experiments in small teams, each appr. 10 pages including figures and tables, and oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.19 Course: Field Training Water Quality [T-BGU-109957]

Responsible: PD Dr.-Ing. Stephan Fuchs
Dr.-Ing. Stephan Hilgert
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104922 - Freshwater Ecology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	1

Events					
ST 2022	6223814	Field Training Water Quality	2 SWS	Practice / 🗣	Hilgert, Fuchs

Legend: 💻 Online, 🎭 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
report on field training, appr. 8-15 pages

Prerequisites
The 'Teilleistung' Appplied Ecology and Water Quality (T-BGU-109956, seminar paper with presentation) has to be begun, i.e. at least the registration has to be made.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109956 - Applied Ecology and Water Quality must have been started.

Recommendation
none

Annotation
The number of participants in the course is limited to 12 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering* and *Geoecology* and further study programs. The attendance at the first meeting is mandatory. In case of absence the place will be assigned to a person on the waiting list.

T 5.20 Course: Flow Measurement Techniques [T-BGU-110411]

Responsible: Dr.-Ing. Christof-Bernhard Gromke
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103388 - Experimental Hydraulics and Measuring Techniques

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each term	1 terms	1

Events					
WT 21/22	6221907	Flow Measurement Techniques	2 SWS	Lecture / Practice (/	Gromke

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.21 Course: Fluid Mechanics of Turbulent Flows [T-BGU-110841]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105361 - Fluid Mechanics of Turbulent Flows

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
ST 2022	6221806	Fluid Mechanics of Turbulent Flows	4 SWS	Lecture / Practice (/	Uhlmann

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 45 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.22 Course: Fundamental Numerical Algorithms for Engineers [T-BGU-109953]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104920 - Fundamental Numerical Algorithms for Engineers

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each term	1

Events					
WT 21/22	6221912	Fundamental Numerical Algorithms for Engineers	2 SWS	Lecture /	Uhlmann, Herlina

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 60 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.23 Course: Fundamentals of Environmental Geodesy Part B [T-BGU-109329]

Responsible: Prof. Dr.-Ing. Hansjörg Kutterer
Dr.-Ing. Michael Mayer

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-103442 - Remote Sensing and Positioning

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	2

Events					
ST 2022	6020151	Fundamentals of Environmental Geodesy - Part B	2 SWS	Lecture / Practice (/	Kutterer, Mayer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
successfully completed exercises and oral presentation

Prerequisites
none

Recommendation
none

Annotation
none

T 5.24 Course: Fundamentals of Water Quality [T-CIWVT-106838]

Responsible: Dr. Gudrun Abbt-Braun
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103438 - Fundamentals of Water Quality

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 21/22	22626	Fundamentals of Water Quality - Exercises	1 SWS	Practice /	Abbt-Braun, und Mitarbeiter

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.25 Course: General Meteorology [T-PHYS-101091]

Responsible: apl. Prof. Dr. Michael Kunz
Organisation: KIT Department of Physics
Part of: M-PHYS-103732 - General Meteorology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	6	pass/fail	Each winter term	1

Events					
WT 21/22	4051011	Allgemeine Meteorologie	3 SWS	Lecture /	Kunz
WT 21/22	4051012	Übungen zur Allgemeinen Meteorologie	2 SWS	Practice /	Kunz, Maurer, Augenstein

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presenting one exercise and
test (not graded)

Prerequisites
none

Recommendation
none

Annotation
none

T 5.26 Course: Geo Data Infrastructures and Web Services [T-BGU-101756]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101044 - Geodata Infrastructures and Web-Services

Type	Credits	Grading scale	Recurrence	Version
Oral examination	1	Grade to a third	Each summer term	2

Events					
ST 2022	6026204	Geodateninfrastrukturen und Webdienste	1 SWS	Lecture / 🗣	Wursthorn
ST 2022	6026205	Geodateninfrastrukturen und Webdienste, Übung	2 SWS	Practice / 🗣	Wursthorn

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
The accomplishment 'Geodata Infrastructures and Web-Services, Prerequisite' (T-BGU-101757) has to be passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101757 - Geodata Infrastructures and Web-Services, Prerequisite must have been passed.

Recommendation
none

Annotation
none

T 5.27 Course: Geodata Infrastructures and Web-Services, Prerequisite [T-BGU-101757]

Responsible: Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101044 - Geodata Infrastructures and Web-Services

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	2

Events					
ST 2022	6026204	Geodateninfrastrukturen und Webdienste	1 SWS	Lecture / 🗣	Wursthorn
ST 2022	6026205	Geodateninfrastrukturen und Webdienste, Übung	2 SWS	Practice / 🗣	Wursthorn

Legend: 📱 Online, 💮 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
working on exercises

Prerequisites
none

Recommendation
none

Annotation
none

T 5.28 Course: Geostatistics [T-BGU-106605]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103762 - Analysis of Spatial Data

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
ST 2022	6224805	Geostatistics	4 SWS	Lecture / Practice (/	Zehe, Mälicke, Wienhöfer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.29 Course: Groundwater Flow around Structures [T-BGU-106774]

Responsible: Ph.D. Luca Trevisan
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103389 - Hydraulic Structures

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	1

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.30 Course: Groundwater Hydraulics [T-BGU-100624]

Responsible: Dr. Ulf Mohrlok
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-100340 - Groundwater Management

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	1

Events					
ST 2022	6221801	Groundwater Hydraulics	2 SWS	Lecture / Practice (/	Mohrlok

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.31 Course: Homework 'Introduction to Environmental Data Analysis and Statistical Learning' [T-BGU-109950]

Responsible: Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104880 - Introduction to Environmental Data Analysis and Statistical Learning

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	1

Events					
WT 21/22	6224908	Introduction to Environmental Data Analysis and Statistical Learning	4 SWS	Lecture / Practice (/	Ehret

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
course associated assignments, short reports appr. 1 page each

Prerequisites
none

Recommendation
none

Annotation
none

T 5.32 Course: Hydraulic Engineering [T-BGU-106759]

Responsible: Prof. Dr. Mario Jorge Rodrigues Pereira da Franca
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103376 - Hydraulic Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	2

Events					
ST 2022	6222701	River Engineering	2 SWS	Lecture / Practice (/	Rodrigues Pereira da Franca
ST 2022	6222703	Design of Hydraulic Structures	2 SWS	Lecture / Practice (/	Seidel

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 75 min.

Prerequisites
The not graded accomplishments 'Design Exercise River Engineering', T-BGU-111928, and 'Design Exercise Hydraulic Structures', T-BGU-111929, have to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111928 - Design Exercise River Engineering must have been passed.
2. The course T-BGU-111929 - Design Exercise Hydraulic Structures must have been passed.

Recommendation
none

Annotation
none

T 5.33 Course: Hydro Power Engineering [T-BGU-100139]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-100103 - Hydro Power Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
ST 2022	6222801	Hydro Power Engineering	4 SWS	Lecture / Practice (/	Oberle

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.34 Course: Hydrogeology [T-BGU-106801]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103406 - Hydrogeology

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
WT 21/22	6310415	Field Methods in Hydrogeology	1 SWS	Lecture / Practice (/	Göppert
ST 2022	6310416	General & Applied Hydrogeology	2 SWS	Lecture /	Goldscheider

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.35 Course: Hydrogeology: Field and Laboratory Methods [T-BGU-104834]

Responsible: Dr. rer. nat. Nadine Göppert
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-102441 - Hydrogeology: Field and Laboratory Methods

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	1

Events					
ST 2022	6310412	Field and Laboratory Exercises	2 SWS	Practice /	Göppert
ST 2022	6310414	Preparatory Workshop	1 SWS	Seminar /	Göppert

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presentation within the "Preparatory Seminar" and
term paper on the results of the "Field and Laboratory Exercises"

Prerequisites
none

Recommendation
none

Annotation
none

T 5.36 Course: Hydrogeology: Karst and Isotopes [T-BGU-104758]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-102440 - Hydrogeology: Karst and Isotopes

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	1

Events					
WT 21/22	6339076	Karsthydrogeologie	2 SWS	Lecture / Practice (	Goldscheider
ST 2022	6310411	Isotope Methods in Hydrologeology	1 SWS	Lecture / Practice (/	Himmelsbach

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.37 Course: Hydrological Measurements in Environmental Systems [T-BGU-106599]

Responsible: Dr. Jan Wienhöfer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103763 - Hydrological Measurements in Environmental Systems

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	1

Events					
ST 2022	6224807	Hydrological Measurements in Environmental Systems	4 SWS	/ 🗣	Wienhöfer, Mitarbeiter/innen

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
The examination consists of four parts:

1. active participation in the seminar (presentation ~ 20 mins)
2. active participation in field and lab work
3. documentation of the field experiments (report ~ 10 pages)
4. analysis of field data (presentation ~ 20 mins and report ~10 pages)

Each part is graded with points, and the overall grade is determined by the number of points obtained.

Passing the exam requires at least 1 point in each of the four parts, and in total the minimum number of points.

Prerequisites
none

Recommendation
none

Annotation
The course requires a minimum number of 6 and a maximum number of 30 participants. Please register online for the course (not exam!), 6224807, via the Campus portal (in exceptional cases via e-mail to the responsible lecturer). Participants are selected according to their progress of study considering the following order: students of *Water Science and Engineering*, students of *Civil Engineering*, students of *Geoecology*.

T 5.38 Course: Industrial Wastewater Treatment [T-CIWVT-111861]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105903 - Industrial Wastewater Treatment

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2022	22619	Industrial Wastewater Treatment	2 SWS	Lecture / 🗣	Horn

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.39 Course: Instrumental Analytics [T-CIWVT-106837]

Responsible: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103437 - Instrumental Analysis

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2022	22942	Instrumental Analytics	2 SWS	Lecture / 🗣	Guthausen

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, 30 min.

Prerequisites
The accomplishment 'Organic Trace Analysis of Aqueous Samples' (T-CIWVT-106836) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-106836 - Organic Trace Analysis of Aqueous Samples must have been passed.

Recommendation
none

Annotation
none

T 5.40 Course: Integrated Design Project in Water Resources Management [T-BGU-111275]

Responsible: Dr.-Ing. Uwe Ehret
Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105637 - Integrated Design Project in Water Resources Management

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each term	1 terms	1

Events					
ST 2022	6224801	Integrated Design Project in Water Resources Management	4 SWS	Lecture / Practice (/	Ehret, Seidel

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
project work, report approx. 15 pages with presentation approx. 15 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.41 Course: Integrated Infrastructure Planning [T-BGU-106764]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103380 - Integrated Infrastructure Planning

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 21/22	6224910	Infrastructure Planning – Socio-economic & Ecological Aspects		Lecture / Practice (	Kämpf, Walz

Competence Certificate
written exam, 60 min.

Prerequisites
The accomplishment 'Booklet Integrated Infrastructure Planning' (T-BGU-106763) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-106763 - Booklet Integrated Infrastructure Planning must have been passed.

Recommendation
none

Annotation
none

T 5.42 Course: Interaction Flow - Hydraulic Structures [T-BGU-110404]

Responsible: Dr.-Ing. Michael Gebhardt
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103389 - Hydraulic Structures

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	3	Grade to a third	Each term	1 terms	1

Events					
WT 21/22	6221903	Interaction Flow - Hydraulic Structures	2 SWS	Lecture / Practice (	Gebhardt

Competence Certificate
written exam, 60 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.43 Course: Introduction to Environmental Data Analysis and Statistical Learning [T-BGU-109949]

Responsible: Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104880 - Introduction to Environmental Data Analysis and Statistical Learning

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	1

Events					
WT 21/22	6224908	Introduction to Environmental Data Analysis and Statistical Learning	4 SWS	Lecture / Practice (/	Ehret

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 60 min.

Prerequisites
The accomplishment Homework 'Introduction to Environmental Data Analysis and Statistical Learning' (T-BGU-109265) has to be passend.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109950 - Homework 'Introduction to Environmental Data Analysis and Statistical Learning' must have been passed.

Recommendation
none

Annotation
none

T 5.44 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences [T-BGU-101681]

Responsible: Dr.-Ing. Norbert Rösch
Dr.-Ing. Sven Wursthorn
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-101846 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each winter term	1

Events					
WT 21/22	6071101	Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen, V/Ü	4 SWS	Lecture / Practice (/	Wursthorn

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
online test 'Introduction to GIS for Students of Natural, Engineering and Geo Sciences' (T-BGU-103541) has to be passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-103541 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite must have been passed.

Recommendation
none

Annotation
none

T 5.45 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite [T-BGU-103541]

Responsible: Dr.-Ing. Norbert Rösch
Dr.-Ing. Sven Wursthorn

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-101846 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	2

Events					
WT 21/22	6071101	Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen, V/Ü	4 SWS	Lecture / Practice (/	Wursthorn

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
online test

Prerequisites
none

Recommendation
none

Annotation
none

T 5.46 Course: Introduction to Matlab [T-BGU-106765]

Responsible: Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103381 - Introduction to Matlab

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	1

Events					
WT 21/22	6224907	Introduction to Matlab	2 SWS	Lecture / Practice (/	Ehret, Wienhöfer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Implementation of a Matlab code within a class exercise

Prerequisites
none

Recommendation
none

Annotation
The course is limited to 60 participants. Please register via the student portal (Studierendenportal). Only in case that this should not be possible: Please register via e-mail to the responsible lecturer. Participants are selected according to their progress of study considering the following order: students of Water Science and Engineering, then students of Civil Engineering with focus 'Water and Environment', then other students.

T 5.47 Course: Landfills [T-BGU-100084]

Responsible: Dr.-Ing. Andreas Bieberstein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-100079 - Environmental Geotechnics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each winter term	1

Events					
WT 21/22	6251913	Landfills	2 SWS	Lecture / Practice (/	Bieberstein

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.48 Course: Mass Fluxes in River Basins [T-BGU-111061]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103373 - River Basin Modeling

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	3	pass/fail	Each summer term	1 terms	1

Events					
ST 2022	6223812	Mass Fluxes in River Basins	2 SWS	Lecture /	Fuchs, Morling

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
working on exercises: report, appr. 5 pages, and presentation , appr. 10 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.49 Course: Master Thesis [T-BGU-110134]

Responsible: Prof. Dr.-Ing. Peter Vortisch
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104995 - Module Master Thesis

Type	Credits	Grading scale	Recurrence	Version
Final Thesis	30	Grade to a third	Each term	1

Competence Certificate
duration appr. 6 months
presentation within one month after submission of the thesis

Prerequisites
defined for the module Master Thesis

Final Thesis
This course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	3 months
Correction period	8 weeks

This thesis requires confirmation by the examination office.

Recommendation
see module

Annotation
Information about the procedure regarding admission and registration of the Master Thesis see chap. 1.2.5.

T 5.50 Course: Membrane Technologies in Water Treatment [T-CIWVT-110865]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105380 - Membrane Technologies in Water Treatment

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each summer term	2

Events					
ST 2022	22605	Membrane Technologies in Water Treatment	2 SWS	Lecture / 🗣	Horn, Saravia
ST 2022	22606	Practical in Membrane Technologies in Water Treatment	1 SWS	Practice / 🗣	Horn, Saravia, und Mitarbeiter

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
excursion reports has to be graded as passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-110864 - Excursions: Membrane Technologies must have been passed.

Recommendation
none

Annotation
none

T 5.51 Course: Methods of Remote Sensing, Prerequisite [T-BGU-101759]

Responsible: Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103442 - Remote Sensing and Positioning

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	2

Events					
WT 21/22	6048101	Methods of Remote Sensing, Lecture	1 SWS	Lecture /	Weidner
WT 21/22	6048102	Methods of Remote Sensing, Exercises	1 SWS	Practice /	Weidner

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
successfully completed exercises

Prerequisites
none

Recommendation
none

Annotation
none

T 5.52 Course: Microbiology for Engineers [T-CIWVT-106834]

Responsible: Prof. Dr. Thomas Schwartz
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103436 - Applied Microbiology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2022	22633	Microbiology for Engineers	2 SWS	Lecture / 🗣	Schwartz

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.53 Course: Modeling of Turbulent Flows - RANS and LES [T-BGU-110842]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105362 - Modeling of Turbulent Flows - RANS and LES

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	6	Grade to a third	Each term	1 terms	1

Events					
WT 21/22	6221911	Modelling of Turbulent Flows - RANS and LES	4 SWS	Lecture / Practice (/	Uhlmann

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 45 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.54 Course: Modeling of Water and Environmental Systems [T-BGU-106757]

Responsible: Dr. Jan Wienhöfer
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103374 - Modeling of Water and Environmental Systems

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	1

Events					
WT 21/22	6220701	Modeling of Water and Environmental Systems	2 SWS	Lecture /	Wienhöfer, Mitarbeiter/innen

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
online test (multiple choice test with knowledge and comprehension questions about the contents of the lecture series)

Prerequisites
none

Recommendation
none

Annotation
none

T 5.55 Course: Numerical Flow Modeling in Hydraulic Engineering [T-BGU-106776]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103390 - Numerical Flow Modeling in Hydraulic Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
WT 21/22	6222903	Numerische Strömungsmodellierung im Wasserbau	4 SWS	Lecture / Practice (	Oberle

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.56 Course: Numerical Fluid Mechanics [T-BGU-106758]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103375 - Numerical Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	2

Events					
WT 21/22	6221702	Numerical Fluid Mechanics I	4 SWS	Lecture / Practice (/	Uhlmann

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.57 Course: Numerical Fluid Mechanics II [T-BGU-106768]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103384 - Advanced Computational Fluid Dynamics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	1

Events					
ST 2022	6221809	Numerical Fluid Mechanics II	2 SWS	Lecture / Practice (/	Uhlmann

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
module 'Numerical Fluid Mechanics (AF501)' must be completed

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-BGU-103375 - Numerical Fluid Mechanics must have been passed.

Recommendation
none

Annotation
none

T 5.58 Course: Numerical Groundwater Modeling [T-BGU-100625]

Responsible: Dr. Ulf Mohrlok
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-100340 - Groundwater Management

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	1

Events					
WT 21/22	6221901	Numerical Groundwater Modeling	2 SWS	Project (P / ⛭	Mohrlok

Legend: 🖳 Online, ⛭ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
project report, appr. 15 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.59 Course: Numerical Mathematics for Students of Computer Science [T-MATH-102242]

Responsible: Prof. Dr. Andreas Rieder
Dr. Daniel Weiß
Prof. Dr. Christian Wieners

Organisation: KIT Department of Mathematics

Part of: M-MATH-103404 - Numerical Mathematics for Students of Computer Science and Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	3

Events					
ST 2022	0187400	Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen	2 SWS	Lecture	Weiß
ST 2022	0187500	Übungen zu 0187400	1 SWS	Practice	Weiß

Competence Certificate
written exam, 120 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.60 Course: Organic Trace Analysis of Aqueous Samples [T-CIWVT-106836]

Responsible: Dr. Gerald Brenner-Weiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103437 - Instrumental Analysis

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	1

Events					
ST 2022	22629	Organic Trace Analysis of Aqueous Samples	2 SWS	Practical course /	Brenner-Weiß

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written report on the analyses of laboratory data, maximum 5 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.61 Course: Parallel Programming Techniques for Engineering [T-BGU-106769]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103384 - Advanced Computational Fluid Dynamics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each term	2

Events					
ST 2022	6221807	Parallel programming techniques for engineering problems	2 SWS	Lecture / Practice (/	Uhlmann

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
module 'Numerical Fluid Mechanics (AF501)' must be completed

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-BGU-103375 - Numerical Fluid Mechanics must have been passed.

Recommendation
none

Annotation
none

T 5.62 Course: Practical Course in Water Technology [T-CIWVT-106840]

Responsible: Dr. Gudrun Abbt-Braun
Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	3

Events					
WT 21/22	22664	Practical Course: Water Quality and Water Assessment	2 SWS	Practical course /	Horn, Abbt-Braun, und Mitarbeiter

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
The grade of the examination of other type is determined as follows:
In total 150 points can be achieved:

- maximum 60 points for 6 experiments incl. entrance test and report (10 points each),
- maximum 15 points for the presentation about one experiment,
- maximum 75 points for the final certificate.

At least 80 points must be achieved in order to pass the examination of other type.

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.
2. The course T-CIWVT-110866 - Excursions: Water Supply must have been passed.

Recommendation
none

Annotation
none

T 5.63 Course: Prerequisite Protection and Use of Riverine Systems [T-BGU-106790]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103401 - Protection and Use of Riverine Systems

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	2

Events					
ST 2022	6220801	Protection and Use of Riverine Systems	2 SWS	Lecture /	Kämpf, Rodrigues Pereira da Franca, Kron

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
literature annotation, appr. 150 words,
short presentation, appr. 10 min., and
excursion report, appr. 2 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.64 Course: Probability and Statistics [T-MATH-106784]

Responsible: PD Dr. Bernhard Klar
Organisation: KIT Department of Mathematics
Part of: M-MATH-103395 - Probability and Statistics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2022	0188100	Probability and Statistics	2 SWS	Lecture	Klar
ST 2022	0188110	Tutorial for 0188100	1 SWS	Practice	Klar

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.65 Course: Project Report Water Distribution Systems [T-BGU-108485]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104100 - Water Distribution Systems

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	2

Events					
WT 21/22	6222905	Water Distribution Systems	4 SWS	Lecture / Practice (	Oberle

Competence Certificate
project report, appr. 15 pages, and
presentation, appr. 15 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.66 Course: Project Studies in Water Resources Management [T-BGU-106783]

Responsible: Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103394 - Project Studies in Water Resources Management

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

Events					
WT 21/22	6222901	Projektstudium: Wasserwirtschaftliche Planungen	4 SWS	Lecture / Practice (	Seidel

Competence Certificate
project work: term paper, appr. 15 pages, with presentation

Prerequisites
none

Recommendation
none

Annotation
none

T 5.67 Course: Protection and Use of Riverine Systems [T-BGU-106791]

Responsible: Dr. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103401 - Protection and Use of Riverine Systems

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	5	Grade to a third	Each summer term	2

Events					
ST 2022	6220801	Protection and Use of Riverine Systems	2 SWS	Lecture /	Kämpf, Rodrigues Pereira da Franca, Kron

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
about a topic selected by oneself out of the field water management or international nature conservation:

presentation, appr. 15-20 min., and
maunscript, appr. 2500 words

Prerequisites
The accomplishment 'Prerequisite Protection and Use of Riverine Systems' (T-BGU-106790) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-106790 - Prerequisite Protection and Use of Riverine Systems must have been passed.

Recommendation
none

Annotation
none

T 5.68 Course: Remote Sensing and Positioning [T-BGU-106843]

Responsible: Dr.-Ing. Michael Mayer
Dr.-Ing. Hael Sumaya
Dr.-Ing. Uwe Weidner

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-103442 - Remote Sensing and Positioning

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	3

Events					
WT 21/22	6048101	Methods of Remote Sensing, Lecture	1 SWS	Lecture /	Weidner
WT 21/22	6048102	Methods of Remote Sensing, Exercises	1 SWS	Practice /	Weidner

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
The examination prerequisites Fundamentals of Environmental Geodesy Part B (T-BGU-109329) and Methods of Remote Sensing, Prerequisite (T-BGU-101759) has to be passed both.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-101759 - Methods of Remote Sensing, Prerequisite must have been passed.
2. The course T-BGU-109329 - Fundamentals of Environmental Geodesy Part B must have been passed.

Recommendation
none

Annotation
none

T 5.69 Course: River and Floodplain Ecology [T-BGU-102997]

Responsible: Prof. Dr. Florian Wittmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103391 - Sustainable Management of rivers and Floodplains

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	3	pass/fail	Each winter term	1

Events					
WT 21/22	6111231	River and Floodplain Ecology	2 SWS	Lecture /	Wittmann

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
not graded written test with 60 min.

Prerequisites
None

Recommendation
None

Annotation
None

T 5.70 Course: River Basin Modeling [T-BGU-106603]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103373 - River Basin Modeling

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	2

Events					
WT 21/22	6223904	Modelling Mass Fluxes in River Basins	2 SWS	Lecture / Practice (/	Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
project report, appr. 10 pages, and
presentation, appr. 15 min.

Prerequisites
The not graded accomplishment 'Mass Fluxes in River Basins' has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111061 - Mass Fluxes in River Basins must have been passed.

Recommendation
none

Annotation
none

T 5.71 Course: River Processes [T-BGU-111930]

Responsible: Prof. Dr. Mario Jorge Rodrigues Pereira da Franca
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105927 - River Processes

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each summer term	1 terms	1

Events					
ST 2022	6222805	Landscape and River Morphology	2 SWS	Lecture / Practice (/	Rodrigues Pereira da Franca
ST 2022	6222807	Transport Processes in Rivers	2 SWS	Lecture / Practice (/	Rodrigues Pereira da Franca

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
report about student project on Landscape and River Morphology, appr. 10 pages;
report about student project on Transport Processes in Rivers, appr. 10 pages;
final colloquium, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.72 Course: Seminar Paper 'Waterway Engineering' [T-BGU-106779]

Responsible: Dr.-Ing. Andreas Kron
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103392 - Waterway Engineering

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	2

Events					
ST 2022	6222803	Waterway Engineering	4 SWS	Lecture / Practice (/	Kron

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
seminar paper, appr. 15 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 5.73 Course: Study Project [T-BGU-106839]

Responsible: Ph.D. Luca Trevisan
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103439 - Study Project

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	15	Grade to a third	Each term	1

Competence Certificate
report, appr. 30 pages, and
presentation, appr. 20 min.

Prerequisites
none

Recommendation
The knowledge and technical and interdisciplinary skills needed to work on the selected topic and to prepare the 'Study Project' should have been acquired.

Annotation
none

T 5.74 Course: Term Paper 'Wastewater Treatment Technologies' [T-BGU-111282]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104917 - Wastewater Treatment Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	3	pass/fail	Each summer term	1 terms	2

Events					
ST 2022	6223801	Wastewater Treatment Technologies	4 SWS	Lecture / Practice (/	Azari Najaf Abad, Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presentation, appr. 15 min., term paper, appr. 10 pages

Prerequisites
none

Recommendation
none

Annotation
The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering* and *Geoecology* and further study programs. The topics for the Term Paper are assigned at the beginning of the course.

T 5.75 Course: Thermal Use of Groundwater [T-BGU-106803]

Responsible: Prof. Dr. Philipp Blum
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103408 - Thermal Use of Groundwater

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 21/22	6339115	Thermal Use of Groundwater	2 SWS	Lecture / Practice (	Blum

Competence Certificate
oral exam, appr. 15 min.

Prerequisites
none

Recommendation
knowledge of programming with Matlab; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab' (6224907)

Annotation
none

T 5.76 Course: Transport and Transformation of Contaminants in Hydrological Systems [T-BGU-106598]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103872 - Subsurface Flow and Contaminant Transport

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	2

Events					
ST 2022	6224803	Transport and Transformation of Contaminants in Hydrological Systems	4 SWS	Lecture / Practice (/ 🗣	Zehe, Wienhöfer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.77 Course: Turbulent Diffusion [T-PHYS-111427]

Responsible: Prof. Dr. Corinna Hoose
Dr. Gholamali Hoshyaripour
Organisation: KIT Department of Physics
Part of: M-PHYS-105776 - Applied Meteorology: Turbulent Diffusion

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	2

Events					
ST 2022	4052081	Turbulent Diffusion	2 SWS	Lecture /	Hoshyaripour, Hoose
ST 2022	4052082	Exercises to Turbulent Diffusion	1 SWS	Practice /	Hoshyaripour, Hoose, Bruckert

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
There are 7 exercises with 100 points in total.

To be admitted for the oral exam the students must:

- Obtain at least 50 points from exercises.
- Present and explain at least one of the ICON-ART exercises in the class.

Prerequisites
None

Recommendation
None

Annotation
None

T 5.78 Course: Urban Water Infrastructure and Management [T-BGU-106600]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103358 - Urban Water Infrastructure and Management

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	2

Events					
WT 21/22	6223701	Urban Water Infrastructure and Management	4 SWS	Lecture / Practice (/	Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 60 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.79 Course: Wastewater Treatment Technologies [T-BGU-109948]

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104917 - Wastewater Treatment Technologies

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	3

Events					
ST 2022	6223801	Wastewater Treatment Technologies	4 SWS	Lecture / Practice (/	Azari Najaf Abad, Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 60 min.

Prerequisites
The accomplishment Term Paper 'Wastewater Treatment Technologies' (T-BGU-111282) has to be passend.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111282 - Term Paper 'Wastewater Treatment Technologies' must have been passed.

Recommendation
none

Annotation
The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering* and *Geoecology* and further study programs. The topics for the Term Paper are assigned at the beginning of the course.

T 5.80 Course: Water and Energy Cycles [T-BGU-106596]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103360 - Water and Energy Cycles

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	2

Events					
WT 21/22	6224702	Water and Energy Cycles in Hydrological Systems: Processes, Predictions and Management	4 SWS	Lecture / Practice (/	Zehe

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
submission of at least 50% of the weekly exercises plus a written term paper on a given topic, approx. 10 to 15 pages

Prerequisites
none

Recommendation
none

Annotation
as from summer term 2020 examination of other type

T 5.81 Course: Water Distribution Systems [T-BGU-108486]

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-104100 - Water Distribution Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 21/22	6222905	Water Distribution Systems	4 SWS	Lecture / Practice (	Oberle

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
The accomplishment 'Project Report Water Distribution Systems' (T-BGU-108485) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-108485 - Project Report Water Distribution Systems must have been passed.

Recommendation
none

Annotation
none

T 5.82 Course: Water Technology [T-CIWVT-106802]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103407 - Water Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 21/22	22621	Water Technology	2 SWS	Lecture /	Horn
WT 21/22	22622	Excersises to Water Technology	1 SWS	Practice /	Horn, und Mitarbeiter

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 5.83 Course: Waterway Engineering [T-BGU-106780]

Responsible: Dr.-Ing. Andreas Kron
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103392 - Waterway Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	5	Grade to a third	Each summer term	2

Events					
ST 2022	6222803	Waterway Engineering	4 SWS	Lecture / Practice (/	Kron

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
The accomplishment 'Seminar Paper Waterway Engineering' (T-BGU-106779) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-106779 - Seminar Paper 'Waterway Engineering' must have been passed.

Recommendation
none

Annotation
none

T 5.84 Course: Wildcard 1 Language Skills 1 [T-BGU-106884]

Organisation: University
Part of: M-BGU-103466 - Language Skills 1 (2 CP)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each term	1

T 5.85 Course: Wildcard 2 Language Skills [T-BGU-106885]

Organisation: University
Part of: M-BGU-103466 - Language Skills 1 (2 CP)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each term	1

Example Curricula

This section contains example curricula for each of the four profiles. Please note that these are only one out of many other possible combinations. The students can ask the mentors for advice on the selection of modules.

Abbreviations

Subjects

AF	Advanced Fundamentals
CC	Cross-Cutting Methods & Competencies
P	Profile Studies
PA	Profile A
PB	Profile B
PC	Profile C
PD	Profile D
P/SM	Profile Studies/Supplementary Modules
SP	Study Project
MT	Master's Thesis

General Information

CP	credit points
HPW	class hours per week
LC	learning control
G	German
E	English
G/E	teaching language: German/documents: English

Type of Courses

L	lecture
T	tutorial
S	seminar
P	practical training
E	excursion

Learning Controls

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment

Example Curriculum PA - Water Technologies & Urban Water Cycle

1st Semester (winter semester)

Hours per week: 18; credit points: 31; exams: 5 (not graded accomplishments)

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF201	Fundamentals of Water Quality	6	3	L/T	wE	E
	AF301	Urban Water Infrastructure and Management	6	4	L/T	wE	E
	AF701	Water and Energy Cycles	6	4	L/T	EoT	E
P	PA982	Applied Microbiology	4	2	L	oE	E
	PA221	Water Technology	6	3	L/T	oE	E

2nd Semester (summer semester)

Hours per week: 19; credit points: 30; exams: 4

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF801	Hydrogeology	2	2	L/T	-	E
CC	CC921	Instrumental Analysis	6	4	L/P	oE + ngA	E
	CC949	Language Skills	6	4	L/T	ngA	E
P	PA222	Membrane Technologies in Water Treatment	6	3	L/E	wE + ngA	E
	PA321	Wastewater Treatment Technologies	6	4	L/T	wE + ngA	E
	PA982	Applied Microbiology	4	2	L	oE	E

3rd Semester (winter semester)

Hours per week: 7 + Study Project (3 months); credit points: 29; exams: 4

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF801	Hydrogeology	4	1	L/T	wE	E
P	PA223	Practical Course in Water Technology	4	2	L/P	EoT+ ngA	E
	PA621	Water Distribution Systems	6	4	L/T	oE + ngA	E
SP	SP	Study Project	15	-	-	EoT	E

4th Semester (summer semester)

Master's thesis (6 months); credit points: 30; exams: 1

Example Curriculum PB - Fluid Mechanics & Hydraulic Engineering

1st Semester (summer semester)

Hours per week: 20; credit points: 30; exams: 5 (ungraded LC are not counted)

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF401	Advanced Fluid Mechanics	6	4	L/T	wE	E
	AF601	Hydraulic Engineering	6	4	L/T	wE	E
CC	CC471	Experiments in Fluid Mechanics	6	4	L/T	EoT	E
P	PB523	Fluid Mechanics of Turbulent Flows	6	4	L/T	oE	E
	PB634	River Processes	6	4	L/T	EoT	E

2nd Semester (winter semester)

Hours per week: 20; credit points: 30; exams: 5

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF701	Water and Energy Cycles	6	4	L/T	EoT	E
	AF501	Numerical Fluid Mechanics	6	4	L/T	wE	E
P	PB524	Modeling of Turbulent Flows - RANS and LES	6	4	L/T	oE	E
	PB421	Environmental Fluid Mechanics	6	4	L/T	wE	E
	PB631	Hydraulic Structures	3	2	L/T	wE	E

3rd Semester (summer semester)

Hours per week: 10 + Study Project (3 months); credit points: 30; exams: 4

Subject	Module	Title	CP	HPW	Type	LC	G/E
P	PB631	Hydraulic Structures	3	2	L/T	oE	E
P/SM	PC722	Integrated Design Project in Water Resources Management	6	4	L/T	EoT	E
CC	CC371	Freshwater Ecology	6	4	L/S/T	EoT + ngA	E
SP	SP111	Study Project	15	-	-	EoT	E

4th Semester (winter semester)

Master's thesis (6 months); credit points: 30; exams: 1

Example Curriculum PC - Environmental System Dynamics & Management

1st Semester (winter semester)

Hours per week: 19; credit points: 30; exams: 4 (ungraded LC are not counted)

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF201	Fundamentals of Water Quality	6	3	L/T	wE	E
	AF701	Water and Energy Cycles	6	4	L/T	EoT	E
	AF301	Urban Water Infrastructure and Management	6	4	L/T	wE	E
CC	CC774	Introduction to Environmental Data Analysis and Statistical Learning	6	4	L/T	wE + ngA	E
	CC772	Introduction to Matlab	3	2	L/T	ngA	E

2nd Semester (summer semester)

Hours per week: 22; credit points: 32; exams: 5

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF801	Hydrogeology	2	2	L/T	-	E
CC	CC949	Language Skills	3	2	L/T	ngA	G
P	PC561	Groundwater Management	3	2	L/T	oE	E
	PC725	Subsurface Flow and Contaminant Transport	6	4	L/T	oE	E
	PC731	Hydrological Measurements	6	4	L/P	EoT	E
	PC722	Integrated Design Project in Water Resources Management	6	4	L/T	EoT	E
P/SM	CC773	Analysis of Spatial Data	6	4	L/T	oE	E

3rd Semester (winter semester)

Hours per week: 7 + Study Project (3 months); credit points: 28; exams: 4

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF801	Hydrogeology	4	1	L/T	wE	E
P	PC561	Groundwater Management	3	2	T	EoT	E
P/SM	CC933	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	6	4	L/T	wE+ ngA	G
SP	SP111	Study Project	15	-	-	EoT	E

4th Semester (summer semester)

Master's thesis (6 months); credit points: 30; exams: 1

Example Curriculum PD - Water Resources Engineering

1st Semester (winter semester)

Hours per week: 18; credit points: 30; exams: 4 (ungraded LC are not counted)

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF201	Fundamentals of Water Quality	6	3	L/T	wE	E
	AF301	Urban Water Infrastructure and Management	6	4	L/T	wE	E
	AF701	Water and Energy Cycles	6	4	L/T	EoT	E
CC	CC772	Introduction to Matlab	3	2	L/T	ngA	E
P	PA221	Water Technology	6	3	L/T	oE	E

2nd Semester (summer semester)

Hours per week: 19; credit points: 30; exams: 5

Subject	Module	Title	CP	HPW	Type	LC	G/E
AF	AF601	Hydraulic Engineering	6	3	L/T	wE	E
P	PA321	Wastewater Treatment Technologies	6	4	L/T	wE + ngA	E
	PB633	River Processes	6	4	L/T	EoT	E
	PC722	Integrated Design Project in Water Resources Management	6	4	L/T	EoT	E
CC	CC774	Analysis of Spatial Data	6	4	L/T	oE	E

3rd Semester (winter semester)

Hours per week: 10 + Study Project (3 months); credit points: 30; exams: 4

Subject	Module	Title	CP	HPW	Type	LC	G/E
P	PA621	Water Distribution Systems	6	4	L/T	oE + ngA	E
P/SM	CC774	Introduction to Environmental Data Analysis and Statistical Learning	6	4	L/T	wE + ngA	E
CC	CC571	Fundamentals of Numerical Algorithms for Engineers	3	2	L	wE	E
SP	SP111	Study Project	15	-	-	EoT	E

4th Semester (summer semester)

Master's thesis (6 months); credit points: 30; exams: 1