Karlsruher Institut für Technologie

Module Handbook

Water Science and Engineering Master (Master of Science (M.Sc.), ER/SPO 2024)

Winter term 2024/25

Date: 02/10/2024

KIT DEPARTMENT OF CIVIL ENGINEERING, GEO AND ENVIRONMENTAL SCIENCES

Table Of Contents

1. Curriculum 7
1.1. Objectives of the master degree program 7
1.2. Structure of the master degree program 8
1.2.1. Profile A: Water Technologies & Urban Water Management (PA), compulsory elective subject 9
1.2.2. Profile B: Fluid Mechanics & Hydraulic Engineering (PB), compulsory elective subject 11
1.2.3. Profile C: Hydrological Dynamics & Hazards (PC), compulsory elective subject 13
1.2.4. Cross-Cutting Methods & Competencies (CC), compulsory subject 15
1.2.5. Supplementaries (Sup), compulsory subject 16
1.2.6. Study Project (SP), compulsory subject 17
1.2.7. Master's Thesis/Masterarbeit 17
1.2.8. Interdisciplinary Qualifications 17
1.2.9. Additional accomplishments 18
1.3. Module selection, individual curriculum & mentoring 18
1.4. Exams and Learning Controls 18
1.4.1. Registration 18
1.4.2. Cancellation 19
1.4.3. Repetition 19
1.5. Recognition of accomplishments 19
1.5.1. Recognition of already obtained credits 19
1.5.2. Accomplishments obtained outside of the Higher Education System 19
1.6. Calculation of grades, final grade 19
1.7. Semester abroad 19
1.8. Special circumstances 20
2. Contact persons 21
3. Modules 22
3.1. Modeling of Water and Environmental Systems [WSEM-AF101] - M-BGU-103374 22
3.2. Fundamentals of Water Quality [WSEM-AF201] - M-CIWVT-103438 23
3.3. Urban Water Infrastructure and Management [WSEM-AF301] - M-BGU-103358 24
3.4. Advanced Fluid Mechanics [WSEM-AF401] - M-BGU-103359 26
3.5. Numerical Fluid Mechanics [WSEM-AF501] - M-BGU-103375 27
3.6. Hydraulic Engineering [WSEM-AF601] - M-BGU-103376 28
3.7. Water and Energy Cycles [WSEM-AF701] - M-BGU-103360 30
3.8. Hydrogeology [WSEM-AF801] - M-BGU-103406 32
3.9. Freshwater Ecology [WSEM-CC371] - M-BGU-104922 33
3.10. Experiments in Fluid Mechanics [WSEM-CC471] - M-BGU-103377 35
3.11. Introduction to Matlab [WSEM-CC772] - M-BGU-103381 37
3.12. Analysis of Spatial Data [WSEM-CC773] - M-BGU-103762 38
3.13. Introduction to Environmental Data Analysis and Statistical Learning [WSEM-CC774] - M-BGU-104880 40
3.14. Integrated Infrastructure Planning [WSEM-CC791] - M-BGU-103380 42
3.15. Environmental Communication [WSEM-CC792] - M-BGU-101108 43
3.16. Probability and Statistics [WSEM-CC911] - M-MATH-103395 44
3.17. Numerical Mathematics for Students of Computer Science and Engineering [WSEM-CC912] - M-MATH-103404 45
3.18. Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation [WSEM-CC922] - M-CIWVT-106680 46
3.19. Remote Sensing and Positioning [WSEM-CC931] - M-BGU-103442 47
3.20. Introduction to GIS for Students of Natural, Engineering and Geo Sciences [WSEM-CC933] - M-BGU-101846 49
3.21. Geodata Infrastructures and Web-Services [WSEM-CC935] - M-BGU-101044 50
3.22. Introduction to Python [WSEM-CC936] - M-BGU-106199 51
3.23. Interdisciplinary Competencies 1 (2 CP) [WSEM-CC950-1] - M-BGU-106883 52
3.24. Water Technology [WSEM-PA221] - M-CIWVT-103407 54
3.25. Membrane Technologies in Water Treatment [WSEM-PA222] - M-CIWVT-105380 55
3.26. Practical Course in Water Technology [WSEM-PA223] - M-CIWVT-103440 57
3.27. Biofilm Systems [WSEM-PA224] - M-CIWVT-103441 58
3.28. Industrial Wastewater Treatment [WSEM-PA226] - M-CIWVT-105903 59
3.29. Wastewater Treatment Technologies [WSEM-PA321] - M-BGU-104917 60
3.30. Stormwater Management [WSEM-PA322] - M-BGU-106112 62
3.31. Modeling Wastewater Treatment Processes [WSEM-PA323] - M-BGU-106113 63
3.32. Water Distribution Systems [WSEM-PA621] - M-BGU-104100 65
3.33. Applied Microbiology [WSEM-PA982] - M-CIWVT-103436 67

3.34. Environmental Fluid Mechanics [WSEM-PB421] - M-BGU-103383 68
3.35. Advanced Computational Fluid Dynamics [WSEM-PB522] - M-BGU-103384 69
3.36. Fluid Mechanics of Turbulent Flows [WSEM-PB523] - M-BGU-105361 71
3.37. Modeling of Turbulent Flows - RANS and LES [WSEM-PB524] - M-BGU-105362 72
3.38. Hydraulic Structures [WSEM-PB631] - M-BGU-103389 73
3.39. River Processes [WSEM-PB634] - M-BGU-105927 75
3.40. Experimental Hydraulics and Measurement Techniques [WSEM-PB642] - M-BGU-106114 77
3.41. Numerical Flow Modeling in Hydraulic Engineering [WSEM-PB651] - M-BGU-103390 78
3.42. Hydro Power Engineering [WSEM-PB653] - M-BGU-100103 79
3.43. Waterway Engineering [WSEM-PB655] - M-BGU-103392 80
3.44. Project Studies in Water Resources Management [WSEM-PB661] - M-BGU-103394 81
3.45. River Basin Modeling [WSEM-PC341] - M-BGU-103373 82
3.46. Groundwater Management [WSEM-PC561] - M-BGU-100340 83
3.47. Integrated Design Project in Water Resources Management [WSEM-PC722] - M-BGU-105637 85
3.48. Subsurface Flow and Contaminant Transport [WSEM-PC725] - M-BGU-103872 87
3.49. Hydrological Measurements in Environmental Systems [WSEM-PC732] - M-BGU-103763 89
3.50. Deep Learning in Hydrological Modeling [WSEM-PC733] - M-BGU-105994 90
3.51. Protection and Use of Riverine Systems [WSEM-PC762] - M-BGU-103401 92
3.52. Karst Hydrogeology [WSEM-PC842] - M-BGU-105790 93
3.53. Sustainable Management of Rivers and Floodplains [WSEM-PC986] - M-BGU-103391 95
3.54. Thermal Use of Groundwater [WSEM-SM879] - M-BGU-103408 96
3.55. Earthwork and Embankment Dams [WSEM-SM961] - M-BGU-103402 97
3.56. Environmental Geotechnics [WSEM-SM962] - M-BGU-100079 98
3.57. General Meteorology [WSEM-SM971] - M-PHYS-103732 99
3.58. Applied Meteorology: Turbulent Diffusion [WSEM-SM974] - M-PHYS-105776 100
3.59. Study Project [WSEM-SP111] - M-BGU-103439 101
3.60. Module Master's Thesis [WSEM-THESIS] - M-BGU-106879 102
3.61. Further Examinations [WSEM-ZL] - M-BGU-106855 103
3.62. Supplementary Studies on Science, Technology and Society - M-FORUM-106753 104

4. Courses 108

4.1. Advanced Fluid Mechanics - T-BGU-106612 108
4.2. Applied Ecology and Water Quality - T-BGU-109956 109
4.3. Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration - T-FORUM-113579 110
4.4. Biofilm Systems - T-CIWVT-106841 111
4.5. Booklet Integrated Infrastructure Planning - T-BGU-106763 112
4.6. Brownfield Sites - Investigation, Evaluation, Rehabilitation - T-BGU-100089 113
4.7. Deep Learning in Hydrological Modeling - T-BGU-112171 114
4.8. Design Exercise Hydraulic Structures - T-BGU-111929 115
4.9. Design Exercise River Engineering - T-BGU-111928 116
4.10. Earthwork and Embankment Dams - T-BGU-106792 117
4.11. Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration - T-FORUM-113580 118
4.12. Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration - T-FORUM-113582 119
4.13. Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration - T-FORUM-113581 120
4.14. Environmental Biotechnology - T-CIWVT-106835 121
4.15. Environmental Communication - T-BGU-101676 122
4.16. Environmental Fluid Mechanics - T-BGU-106767 123
4.17. Examination on Turbulent Diffusion - T-PHYS-109981 124
4.18. Examination Prerequisite Environmental Communication - T-BGU-106620 125
4.19. Excercises: Membrane Technologies - T-CIWVT-113235 126
4.20. Excursions: Water Supply - T-CIWVT-110866 127
4.21. Experimental Hydraulics - T-BGU-112374 128
4.22. Experiments in Fluid Mechanics - T-BGU-106760 129
4.23. Field Training Water Quality - T-BGU-109957 130
4.24. Field Trip Karst Hydrogeology - T-BGU-110413 131
4.25. Flow Measurement Techniques - T-BGU-110411 132
4.26. Fluid Mechanics of Turbulent Flows - T-BGU-110841 133
4.27. Fundamentals of Environmental Geodesy Part B - T-BGU-109329 134
4.28. Fundamentals of Water Quality - T-CIWVT-106838 135
4.29. General Meteorology - T-PHYS-101091 136

4.30. Geo Data Infrastructures and Web Services - T-BGU-101756 137
4.31. Geodata Infrastructures and Web-Services, Prerequisite - T-BGU-101757 138
4.32. Geostatistics - T-BGU-106605 139
4.33. GPT for Programming in Matlab and Python - T-BGU-113739 140
4.34. Groundwater Flow around Structures - T-BGU-106774 141
4.35. Groundwater Hydraulics - T-BGU-100624 142
4.36. Homework 'Introduction to Environmental Data Analysis and Statistical Learning' - T-BGU-109950 143
4.37. Hydraulic Engineering - T-BGU-106759 144
4.38. Hydro Power Engineering - T-BGU-100139 145
4.39. Hydrogeology - T-BGU-106801 146
4.40. Hydrological Measurements in Environmental Systems - T-BGU-106599 147
4.41. Industrial Wastewater Treatment - T-CIWVT-111861 148
4.42. Integrated Design Project in Water Resources Management - T-BGU-111275 149
4.43. Integrated Infrastructure Planning - T-BGU-106764 150
4.44. Interaction Flow - Hydraulic Structures - T-BGU-110404 151
4.45. Introduction to Environmental Data Analysis and Statistical Learning - T-BGU-109949 152
4.46. Introduction to GIS for Students of Natural, Engineering and Geo Sciences - T-BGU-101681 153
4.47. Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite - T-BGU-103541 154
4.48. Introduction to Matlab - T-BGU-106765 155
4.49. Introduction to Python - T-BGU-112598 156
4.50. Karst Hydrogeology - T-BGU-111592 157
4.51. Landfills - T-BGU-100084 158
4.52. Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration - T-FORUM-113578 159
4.53. Mass Fluxes in River Basins - T-BGU-111061 160
4.54. Master's Thesis - T-BGU-113795 161
4.55. Membrane Technologies in Water Treatment - T-CIWVT-113236 162
4.56. Methods of Remote Sensing, Prerequisite - T-BGU-101759 163
4.57. Microbiology for Engineers - T-CIWVT-106834 164
4.58. Modeling of Turbulent Flows - RANS and LES - T-BGU-110842 165
4.59. Modeling of Water and Environmental Systems - T-BGU-106757 166
4.60. Modeling Wastewater Treatment Processes - T-BGU-112371 167
4.61. Numerical Flow Modeling in Hydraulic Engineering - T-BGU-106776 168
4.62. Numerical Fluid Mechanics - T-BGU-106758 169
4.63. Numerical Fluid Mechanics II - T-BGU-106768 170
4.64. Numerical Groundwater Modeling - T-BGU-100625 171
4.65. Numerical Mathematics for Students of Computer Science - T-MATH-102242 172
4.66. Parallel Programming Techniques for Engineering - T-BGU-106769 173
4.67. Practical Course in Water Technology - T-CIWVT-106840 174
4.68. Prerequisite Protection and Use of Riverine Systems - T-BGU-106790 175
4.69. Presentation 'Urban Water Infrastructure and Management' - T-BGU-112369 176
4.70. Probability and Statistics - T-MATH-106784 177
4.71. Project Report Water Distribution Systems - T-BGU-108485 178
4.72. Project Studies in Water Resources Management - T-BGU-106783 179
4.73. Protection and Use of Riverine Systems - T-BGU-106791 180
4.74. Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society - T-FORUM-113587 181
4.75. Remote Sensing and Positioning - T-BGU-106843 182
4.76. River and Floodplain Ecology - T-BGU-102997 183
4.77. River Basin Modeling - T-BGU-106603 184
4.78. River Processes - T-BGU-111930 185
4.79. Self Assignment HoC-FORUM 1 graded - T-BGU-113800 186
4.80. Self Assignment HoC-FORUM 1 not graded - T-BGU-113799 187
4.81. Seminar Paper 'Waterway Engineering' - T-BGU-106779 188
4.82. Stormwater Management - T-BGU-112370 189
4.83. Study Project - T-BGU-106839 190
4.84. Thermal Use of Groundwater - T-BGU-106803 191
4.85. Transport and Transformation of Contaminants in Hydrological Systems - T-BGU-106598 192
4.86. Turbulent Diffusion - T-PHYS-111427 193
4.87. Urban Water Infrastructure and Management - T-BGU-106600 194
4.88. Wastewater Treatment Technologies - T-BGU-109948 195
4.89. Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation - T-CIWVT-113433 196
4.90. Water and Energy Cycles - T-BGU-106596 197

4.91. Water Distribution Systems - T-BGU-108486 198
4.92. Water Technology - T-CIWVT-106802 199
4.93. Waterway Engineering - T-BGU-106780 200
4.94. Wetlands - T-BGU-112845 201
5. Example Curricula 202

For informational use only. For legally binding information, please refer to the german version of this handbook.

Publisher:

KIT Department of Civil Engineering, Geo and Environmental Sciences
Karlsruhe Institute of Technology (KIT)
76128 Karlsruhe

Photographs:

1. Harald Horn
2. Bettina Waibel
3. IWG- Hydrologie
4. Harald Horn
5. Ulrike Scherer
6. IWG- Hydrologie

Contact:
michele.trevisson@kit.edu
cansu.schmunk@kit.edu

1 Curriculum

This module handbook is the key 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, 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 are specified in addition to the general examination regulations (ER/SPO). 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 compilation of module descriptions (Chapt. 3), which provides information on the requirements and recommendations for the modules. Details about the learning controls are described at the so-called 'Teilleistungen' (Chapt. 4). Links are also provided to the respective courses in the online course catalog which should be attended for taking the learning controls.

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 their bachelor degree program. The lectures and classes on 'Advanced Fundamentals' are complemented by lectures and classes on engineering and scientific methods ('Specialization' and 'Supplementaries') 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 sessions 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 graduates specialize in one of the three profiles 'Water Technologies & Urban Water Management', 'Fluid Mechanics & Hydraulic Engineering', and 'Hydrological Dynamics & Hazards', 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). It is subdivided into a compulsory elective block, the **Profile Studies** (51 CP), a compulsory block, the **Supplementary Studies** (24 CP), the **Study Project** (15 CP), and the **Master's Thesis** (30 CP) (see Fig. 1). In the Profile Studies one of the **Study Profiles** must be selected:

A: Water Technologies & Urban Water Management
B: Fluid Mechanics & Hydraulic Engineering
C: Hydrological Dynamics & Hazards

The study profiles provide the opportunity for specialization within one of the three areas of expertise in accordance to the different characteristics of the corresponding professional sectors. The area of expertise of the individual study profile is defined by the assigned modules (see Tab. 1 - 3). Each profile has two compulsory elective subjects. In the one compulsory elective subject (27 CP) three to four specific **Advanced Fundamentals Modules (P-AF)** are predefined. The other compulsory elective subject (24 CP) is characterized by the corresponding module catalog with the **Specialization Modules (P-S)**.

The Supplementary Studies cover the two compulsory subjects **Cross-Cutting Methods and Competencies (CC)** (12 CP) and **Supplementaries (Sup)** (12 CP). Within the subject Cross-Cutting Methods and Competencies disciplinary and interdisciplinary competences will be obtained selecting modules freely from the module catalog in Table 4. Within the subject Supplementaries all modules not yet selected or predefined (depending on selected profile) can be freely selected as **Supplementary Modules**. A few **Additional Supplementary Modules** are listed in Table 5.

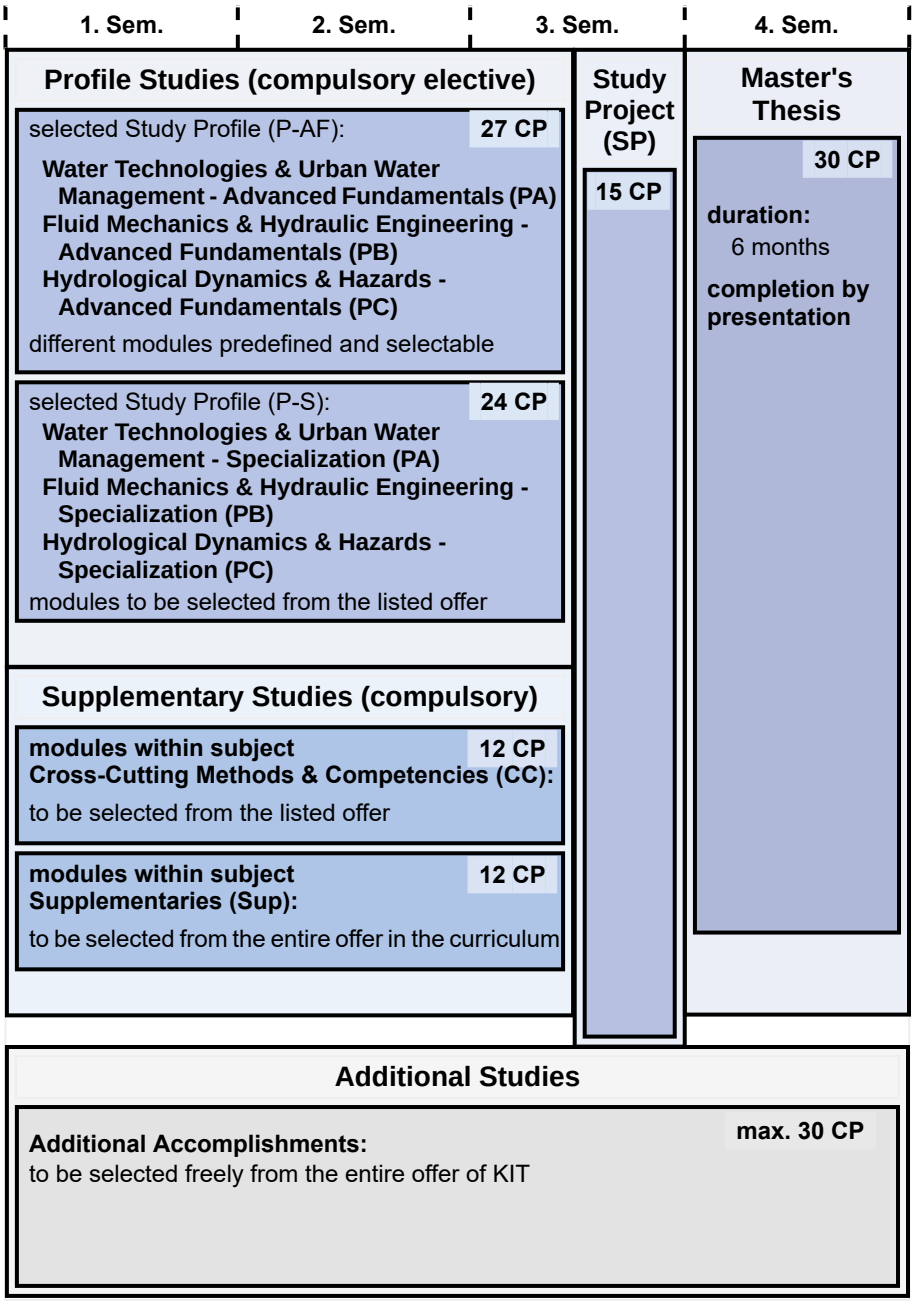

Figure 1: Structure of the master degree program Water Science & Engineering.

1.2.1 Profile A: Water Technologies & Urban Water Management (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.

Three modules in the extent of 15 CP are predefined in the subject Advanced Fundamentals for profile 'Water Technologies & Urban Water Management' (PA): 'Modeling of Water and Environmental Systems', 'Fundamentals of Water Quality' and 'Urban Water Infrastructure and Management' (Tab. 1). Two further modules in extent of 12 CP have to be selected from the list of the subject Advanced Fundamentals and modules in the extent of 24 CP from the list of the subject Specialization in Table 1.

Table 1: Modules PA - Water Technologies & Urban Water Management

Module			Course				LC	
Code	Name	CP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
Modules Water Technologies & Urban Water Management - Advanced Fundamentals (PA-AF): #) predefined; *) 12 CP selectable								
AF101:	Modeling of Water and Environmental Systems **#)**	3	Modeling of Water and Environmental Systems (E)	L	2		ngA	3
AF201:	Fundamentals of Water Quality **#)**	6	Fundamentals of Water Quality (E)	L/E	2/1		oE	6
AF301:	Urban Water Infrastructure and Management **#)**	6	Urban Water Infrastructure and Management (E)	L/E	4		ngA [1)] wE	2 4
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 [1)]	1
			Design of Hydraulic Structures (E)	L/E		2	ngA [1)] wE	1 4
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 ***)**	6	General and Applied Hydrogeology (E)	L/E		3	wE	6
Modules Water Technologies & Urban Water Management - Specialization (PA-S): 24 CP selectable								
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 [1)] 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		wE	6
PA322:	Stormwater Management	6	Stormwater Management (E)	L/E		4	EoT	6
PA323:	Modeling Wastewater Treatment Processes	6	Modeling Wastewater Treatment Processes (E)	L/E		4	EoT	6
PA621:	Water Distribution Systems	6	Water Distribution Systems (E)	L/E	4		ngA [1)] oE	2 4
PA224:	Biofilm Systems	4	Biofilm Systems (E)	L		2	oE	4
PA226:	Industrial Wastewater Treatment	4	Industrial Wastewater Treatment (E)	L		2	oE	4

explanations to Table 1:

in general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English

type of course:

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

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment
ngA [1)]	not graded accomplishment as examination prerequisite

1.2.2 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.

Four modules in the extent of 21 CP are predefined in the subject Advanced Fundamentals for profile 'Fluid Mechanics & Hydraulic Engineering' (PB): 'Modeling of Water and Environmental Systems', 'Advanced Fluid Mechanics', 'Numerical Fluid Mechanics' and 'Hydraulic Engineering' (Tab. 2). One further module in extent of 6 CP has to be selected form the list of the subject Advanced Fundamentals and modules in the extent of 24 CP from the list of the subject Specialization in Table 2.

Table 2: Modules PB - Fluid Mechanics & Hydraulic Engineering

Module			Course				LC	
Code	Name	CP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
Modules Fluid Mechanics & Hydraulic Engineering - Advanced Fundamentals (PB-AF): #) predefined; *) 6 CP selectable								
AF101:	Modeling of Water and Environmental Systems **#)**	3	Modeling of Water and Environmental Systems (E)	L	2		ngA	3
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 [1)]	1
			Design of Hydraulic Structures (E)	L/E		2	ngA [1)] wE	1 4
AF201:	Fundamentals of Water Quality ***)**	6	Fundamentals of Water Quality (E)	L/E	2/1		oE	6
AF301:	Urban Water Infrastructure and Management ***)**	6	Urban Water Infrastructure and Management (E)	L/E	4		ngA [1)] wE	2 4
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 ***)**	6	General and Applied Hydrogeology (E)	L/E		3	wE	6
Modules Fluid Mechanics & Hydraulic Engineering - Specialization (PB-S): 24 CP selectable								
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
PB642:	Experimental Hydraulics and Measuring Techniques	6	Flow Measurement Techniques (E)	L/E	2		oE	3
			Experimental Hydraulics (E)	L/E	2		EoT	3
PB631:	Hydraulic Structures	6	Groundwater Flow around Structures (E)	L/E		2	wE	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 [1)] oE	2 4
PB634:	River Processes	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

explanations to Table 2:

in general:

LC	learning control
CP	credit point
HpW / SWS	hours per week
W / S	winter term / summer term
G / E	language German / English

type of course:

L/E	lecture and exercise, integrated

type of learning control:

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment
ngA [1)]	not graded accomplishment as examination prerequisite

1.2.3 Profile C: Hydrological Dynamics & Hazards (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.

Three modules in the extent of 15 CP are predefined in the subject Advanced Fundamentals for profile 'Hydrological Dynamics & Hazards' (PC): 'Modeling of Water and Environmental Systems', 'Water and Energy Cycles' and 'Hydrogeology' (Tab. 3). Two further modules in extent of 12 CP have to be selected form the list of the subject Advanced Fundamentals and modules in the extent of 24 CP from the list of the subject Specialization in Table 3.

Table 3: Modules PC - Hydrological Dynamics & Hazards

Module			Course				LC	
Code	Name	CP	Name (Language)	Type	HpW / SWS		Type	CP
(WSEM-)					W	S		
Modules Hydrological Dynamics & Hazards - Advanced Fundamentals (PC-AF): #) predefined; *) 12 CP selectable								
AF101:	Modeling of Water and Environmental Systems **#)**	3	Modeling of Water and Environmental Systems (E)	L	2		ngA	3
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 **#)**	6	General and Applied Hydrogeology (E)	L/E		3	wE	6
AF201:	Fundamentals of Water Quality ***)**	6	Fundamentals of Water Quality (E)	L/E	2/1		oE	6
AF301:	Urban Water Infrastructure and Management ***)**	6	Urban Water Infrastructure and Management (E)	L/E	4		ngA [3)] wE	2 4
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 [3)]	1
			Design of Hydraulic Structures (E)	L/E		2	ngA [3)] wE	1 4
Modules Hydrological Dynamics & Hazards - Specialization (PC-S): 24 CP selectable								
PC722:	Integrated Design Project in Water Resources Management	6	Integrated Design Project in Water Resources Management (E)	L/E		4	EoT	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
PC733:	Deep Learning in Hydrological Modeling	6	Deep Learning in Hydrological Modeling (E)	L/E		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
PC842:	Karst Hydrogeology [2)]	6	Karst Hydrogeology (G)	L/E	2		wE	4
			Field Trip Karst Hydrogeology (G)	E		1	ngA	2
PC986:	Management of River and Wetland Ecosystems [2)]	6	Ecology of Rivers and Wetlands (G)	L	2		ngA	3
			Wetlands (G)	S		2	EoT	3

explanations to Table 3:

in 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, 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

1.2.4 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 4. Further, interdisciplinary qualifications and language courses up to 6 CP in total can be taken in the module 'Interdisciplinary Competencies'.

Table 4: Modules CC - Cross-Cutting Methods & Competencies (CC)

Module			Course				LC	
Code	Name	CP	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	EoT	6
CC774:	Introduction to Environmental Data Analysis and Statistical Learning	6	Introduction to Environmental Data Analysis and Statistical Learning (E)	L/E	4		ngA [2)] 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
CC922:	Water - Energy - Environment Nexus in a Circular Economy: Research Proposal Preparation	5	Circular Economy Water Energy Environment: Research Proposal Preparation (E)	L		4	EoT	5
CC791:	Integrated Infrastructure Planning	6	Infrastructure Planning – Socio-economic & Ecological Aspects (E)	L/E	4		ngA [2)] wE	0 6
CC792:	Environmental Communication	6	Environmental Communication [1)] (G)	S	2	2	ngA [2)] EoT	0 6
CC772:	Introduction to Matlab *)	3	Introduction to Matlab (E)	L/E	2		ngA	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 [2)]	2
			Methods of Remote Sensing (E)	L/E	1/1		ngA [2)] 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 [2)] wE	3 3
CC935:	Geodata Infrastructures and Web-Services	6	Geodata Infrastructures and Web-Services (G)	L/E		3	ngA [2)] oE	3 1
CC936:	Introduction to Python *)	3	Introduction to Python (E)	L/E	2		ngA	3
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
CC950:	Interdisciplinary Competencies	2-6	courses on interdisciplinary qualifications, languages, etc.	S			ngA	2-6

*) GPT for Programming in Matlab and Python can be taken as supplemental additional accomplishment

explanations to Table 4:

in 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.

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 2)	not graded accomplishment as examination prerequisite

1.2.5 Supplementaries (Sup), compulsory subject

The individual specialization is complemented by electives. 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 subject CC (with the exception of the module 'Interdisciplinary Competencies CC950'). 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 5.

The choice of 'Supplementary Modules' should be coordinated with the mentor. The mentor advises in regard to suitable modules for the orientation of the intended specialization. In addition, other modules from related disciplines compatible to the study program and not listed in Tables 1 - 5 in this handbook might come into consideration as 'Supplementary Modules'.

Table 5: Additional Supplementary Modules (Sup)

Module			Course				LC	
Code	Name	CP	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 5:

in 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

type of learning control:

oE	oral examination
ngA	not graded accomplishment
ngA [2)]	not graded accomplishment as examination prerequisite

1.2.6 Study Project (SP), compulsory subject

Students carry out an interdisciplinary **'Study Project'**. 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 in the context of the project, they acquire abilities for teamwork and critical evaluation of results. 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 is handed over to the supervisor when starting the 'Study Project'.

1.2.7 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. If the master's thesis is written outside of KIT, consider the instruction on 'Merkblatt - Externe Abschlussarbeiten' (http://www.haa.kit.edu/downloads/KIT_ALLGEMEIN_Merkblatt_Externe_ Abschlussarbeiten.pdf; *in German*).

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* as well as the module 'Study Project'. The supervisor initiates the master's thesis to be uploaded to the campus management system. After notification via e-mail, the master's thesis has to be **registered online** in the portal Campus Management for Students. The **admission** follows after the required prerequisites and eventual further conditions are verified. As these steps have to be completed **before starting** the thesis (scheduled starting date), they should 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 from the field they are interested in who assigns the research topic for the '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 as professor or habilitated faculty member or he/she is authorized to supervise a master's thesis as entitled research associate. 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 preparation time is six months. The 'Master's Thesis' can be written in English or German. Within one month after submission it has to be completed with a presentation. The presentation is part of the examination and is considered within the evaluation.

Further information about the processes related to the master's thesis can be found in "Handreichung Masterarbeiten Bauingenieurwesen" (*in German*) on the website of the Study Program Service under the link "Abschlussarbeiten".

1.2.8 Interdisciplinary Qualifications

Interdisciplinary qualifications are taught along with the modules, especially in the subjects 'Cross Cutting Methods & Competencies' and 'Study Project'. Specific courses on interdisciplinary qualifications, languages, among others in the extent of 2 - 6 CPs can be taken by selecting one of the modules **Interdisciplinary Competencies** (module description by example). For the desired amount of CPs the corresponding module has to be selected.

The House of Competence (HoC) and the 'General Studies. Forum Science and Society' (FORUM, formerly ZAK) offer a wide range of courses on key competences. The registration to their courses is done directly with them. Completed interdisciplinary qualifications of HoC or FORUM are uploaded as 'Not assigned grades' and can be self assigned by the students selecting the 'Teilleistungen' with the title "Self Assignment HoC-FORUM ..." according to the grading scale, not graded or graded. Title and CP of the taken exam are taken over by the assignment automatically.

Language courses are offered by the 'Sprachenzentrum' (SpZ; in German) and German courses for not native German speakers by the 'Studienkolleg für ausländische Studierende'. The registration is done directly there. To credit the language courses the form assignment of non-assigned activity statements (*in German*) has to be submitted to the Study Program Service of the department.

Courses accepted generally by the Examination Committee are available directly as selection option in the module. The registration to their exams can be done online via the portal Campus Management for Students. In special cases, the Examination Committee Master Civil Engineering can permit or approve further suitable courses as interdisciplinary qualifications beyond the mentioned options. This requires the mentor's support. Registering for the exams of these courses as well as courses offered by FORUM as General Studies has also to take place online. Therefore, the Study Program Service of the department has to be informed in time, so that the corresponding learning control can be selected in the campus management system within the registration period.

1.2.9 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 to the extent of max. 30 CP from offers within KIT.

The examination in the desired additional accomplishment should be registered online by the student within the registration period. The online registration to one of these exams requires first the selection of the module and the desired 'Teilleistungen'. The additional module for the Accompanying Studies of FORUM (formerly ZAK) can be selected directly. If selecting this module it has to be considered that the extent of possible further additional accomplishments is reduced by the extent of the FORUM module even if this is not completed. Additional accomplishments available in the module Further Examinations can also be selected directly. Designated additional accomplishments not available in the module Further Examinations or further additional modules must be conveyed to the Study Program Service of the department via e-mail. The desired selection will then be made available in the campus management system enabling the online exam registration within the registration period. The assignment can be changed later by sending a request to the Examination Committee Master Civil Engineering.

All additional accomplishments are listed in the transcript of records. Completed modules can be included in the master degree certificate as additional modules if requested by the student. This also applies to additional accomplishments 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 after passing the module successfully. 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 has to be supervised by a mentor chosen by the student at the beginning of the studies (see ER/PO § 17 a). 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. Depending on the selected study profile possible mentors are:

Profile A: Prof. H. Horn, PD S. Fuchs
Profile B: Prof. O. Eiff, Prof. M. Franca, Prof. M. Uhlmann
Profile C: Prof. N. Goldscheider, Prof. E. Zehe, PD U. Ehret, PD S. Fuchs, PD U. Mohrlok

The selected profile determines the corresponding predefined three to four **Advanced Fundamental Modules (P-AF)**. The remaining two to one Advanced Fundamental Modules as well as the **Specialization Modules (P-S)** are chosen from the corresponding module catalog (see Tab. 1 - 3). Within the subject **Cross-Cutting Methods and Competencies (CC)** further modules have to be chosen from Table 4. The modules in the subject **Supplementaries (Sup)** can be selected from the master degree program 'Water Science and Engineering' from the Tables 1 - 4 as far as not yet selected or predefined in the selected profile, from the listed **Additional Supplementary Modules** (Tab. 5), or from any related program.

The form for selecting modules within the study profiles and the supplementary studies is available on the web page of M.Sc. Water Science and Engineering, https://www.wasser.kit.edu/english/117.php. This has to filled in by the student, signed by both student and mentor, and forwarded to the Study Advisor via the mentor for it to be entered into the Campus Management System. The modules must be entered in time to register for the exams in the first semester of the master degree program (comp. ER/SPO § 19 Par. 4). This ensures that the examination management (registration, deregistration if applicable, result booking etc.) can be processed smoothly. The individual curriculum is accessible at any time via the portal Campus Management for Students, https://campus.studium.kit.edu/english/index.php. Exemplary curricula can be found in the appendix.

The modules should be chosen with care. Firstly, the assignment of the modules to the corresponding part of the program, Profile Studies or Supplementary Studies respectively, is later transferred to the master degree certificate. Secondly, changes in the module selection have to be in agreement with the selected mentor and should be limited to exceptional cases only, e.g. if a compulsory elective module is not offered at short notice. As long as the corresponding module has not yet begun, changes of the module selection are generally possible.

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 online in the portal Campus Management for Students. 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 the case of an oral examination, the online registration has directly to be combined with the negotiation of an examination date with the examiner.

A successful online registration covers the admission to the examination. The portal Campus Management for Students provides the confirmation, which can serve as proof of registration in case of doubt. If problems occur with an online registration, the Study Program Service of the department as well as the examiner have to be informed as soon as possible to solve the problem in advance of examination date.

A registered examination either has to be taken or canceled 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 reasons, 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 web page of M.Sc. Water Science and Engineering, https://www.wasser.kit.edu/english/117.php. 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.

For crediting passed **prior master's examinations** the form Transfer of prior master's examinations (*in German*) has to be filled and transferred to the Study Program Service of the department.

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. For this purpose, an informal request has to be sent to the Examination Committee Master Civil Engineering and a counseling interview has to be arranged. Then, 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 Semester abroad

The department recommends students to study for one to two semesters at a foreign university. KIT offers a variety of exchange programs. Within Europe, this is the well-known ERASMUS program. General information on planning a stay abroad is available on the website of the International Student Office (IStO), https://www.intl.kit.edu/ostudies/index.php, and specific information is available on the website of the KIT-Department of Civil Engineering, Geo and Environmental Sciences, https://bgu.kit.edu/english/outgoing.php. It is compulsory to agree on the intended accomplishments with the personal mentor in advance, particularly with regard to the possibility of crediting in the personal curriculum. The proposed Learning Agreement has to be approved and signed by the Erasmus Coordinator.

1.8 Special circumstances

Students in special circumstances are students with disabilities, chronic diseases, or on maternity leave, with children or dependents in need of care. The regulations on compensation for disadvantages include preferential access to courses with limited attendance, taking examinations under individually designed conditions, or adjustments to deadlines. These are described in detail in the Satzung über nachteilsausgleichende Regelungen in den Bachelor- und Masterstudiengängen am Karlsruher Institut für Technologie (KIT) (*in German*).

For compensation for a disadvantage, the student should submit an informal application to the Examination Committee Master Civil Engineering and provide the appropriate proof. The Examination Committee Master Civil Engineering decides on the application as well as on the kind and extent of the individually necessary measures and informs the student.

2 Contact persons

Dean of Study Affairs:

Prof. Dr.-Ing. Steffen Freitag
Institute for Structural Analysis, Bldg. 10.50, 2nd floor
consultation: on appointment
Phone: 0721/608-42280
Email: steffen.freitag@kit.edu

Study Advisor/Coordination:

Dr.-Ing. Michele Trevisson, until December 20, 2024
Institute for Water and Environment
consultation (online): on appointment
Email: michele.trevisson@kit.edu

Dr. Cansu Schmunk
Institute for Water and Environment, Bldg. 10.81, R. 105
consultation: on appointment
Phone: 0721/608-47791
Email: cansu.schmunk@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: on appointment
Phone: 0721/608-46008
Email: pam@bgu.kit.edu
Web: https://www.tmb.kit.edu/english/PAM.php

Study abroad:

Prof. Dr. Olivier Eiff (Erasmus Coordinator)
Mrs. Angelika Fels (person in charge)
Institute for Hydromechanics, Bldg. 10.81, R. 128 (1st floor)
consultation: on appointment
Phone: 0721/608-47245
Email: erasmus-civil@bgu.kit.edu
Web: https://www.bgu.kit.edu/english/outgoing_erasmus.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: info@fs-bau.kit.edu
Web: https://www.fs-bau.kit.edu

3 Modules

M 3.1 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: Water Technologies and Urban Water Management (mandatory)
Fluid Mechanics and Hydraulic Engineering (mandatory)
Hydrological Dynamics and Hazards (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 3.2 Module: Fundamentals of Water Quality (WSEM-AF201) [M-CIWVT-103438]

Responsible: Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Water Technologies and Urban Water Management (mandatory)
Fluid Mechanics and Hydraulic Engineering (Compulsory Elective Profile B: Advanced Fundamentals)
Hydrological Dynamics and Hazards (Compulsory Elective Profile C: Advanced Fundamentals)
Supplementaries

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	Wagner

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

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

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 3.3 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: Water Technologies and Urban Water Management (mandatory)
Fluid Mechanics and Hydraulic Engineering (Compulsory Elective Profile B: Advanced Fundamentals)
Hydrological Dynamics and Hazards (Compulsory Elective Profile C: Advanced Fundamentals)
Supplementaries

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

Mandatory			
T-BGU-112369	Presentation 'Urban Water Infrastructure and Management'	2 CR	Azari Najaf Abad, Fuchs
T-BGU-106600	Urban Water Infrastructure and Management	4 CR	Azari Najaf Abad, Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-112369 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106600 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 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
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
- preparation Presentation 'Urban Water Infrastructure and Management' (examination prerequisite): 60 Std.
- examination preparation: 30 h

total: 180 h

Recommendation
basic knowledge in sanitary engineering

Literature

Imhoff, K. u. K.R. (1999) Taschenbuch der Stadtentwässerung, 29. Aufl., Oldenbourg Verlag, München, Wien

Metcalf & Eddy, Abu-Orf, M., Bowden, G., Burton, F.L., Pfrang, W., Stensel, H.D., Tchobanoglous, G., Tsuchihashi, R. and AECOM (Firm), (2014). Wastewater engineering: treatment and resource recovery. McGraw Hill Education.

M 3.4 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: Water Technologies and Urban Water Management (Compulsory Elective Profile A: Advanced Fundamentals)
Fluid Mechanics and Hydraulic Engineering (mandatory)
Hydrological Dynamics and Hazards (Compulsory Elective Profile C: Advanced Fundamentals)
Supplementaries

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 3.5 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: Water Technologies and Urban Water Management (Compulsory Elective Profile A: Advanced Fundamentals)
Fluid Mechanics and Hydraulic Engineering (mandatory)
Hydrological Dynamics and Hazards (Compulsory Elective Profile C: Advanced Fundamentals)
Supplementaries

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 3.6 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: Water Technologies and Urban Water Management (Compulsory Elective Profile A: Advanced Fundamentals)
Fluid Mechanics and Hydraulic Engineering (mandatory)
Hydrological Dynamics and Hazards (Compulsory Elective Profile C: Advanced Fundamentals)
Supplementaries

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* a focus will be set on hydraulic structures and their application in managing water resources. We will analyze the design procedure taking engineering standards and state of the art into account.

The content of the module/course pursue the following UN Sustainable Goals:

- SDG 6 Clean Water and Sanitation
- SDG 7 Affordable and Clean Energy

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

Annotation
Further information on the course/module can be found at: https://wb.iwu.kit.edu/education.php.

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 3.7 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: Water Technologies and Urban Water Management (Compulsory Elective Profile A: Advanced Fundamentals)
Fluid Mechanics and Hydraulic Engineering (Compulsory Elective Profile B: Advanced Fundamentals)
Hydrological Dynamics and Hazards (mandatory)
Supplementaries

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

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Water Technologies and Urban Water Management (Compulsory Elective Profile A: Advanced Fundamentals)
Fluid Mechanics and Hydraulic Engineering (Compulsory Elective Profile B: Advanced Fundamentals)
Hydrological Dynamics and Hazards (mandatory)
Supplementaries

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

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

- General and Applied Hydrogeology lecture, exercise: 45 h

independent study:

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

total: 180 h

Recommendation
none

Literature
Fetter, C.W. (2018) Applied Hydrogeology. 4th Edition. Waveland Press. 598 p.

Hölting, B. & Coldewey, W.G. (2013) Einführung in die Allgemeine und Angewandte Hydrogeologie, 8. Aufl., Springer Spektrum: 438 S.

Kresic, N. (2007) Hydrogeology and Groundwater Modeling. CRC Press: 828 S.

Younger, P. (2007) Groundwater in the Environment: An Introduction. Blackwell Publishing: 318 S.

M 3.9 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: Supplementaries
Cross Cutting Methods and Competencies

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

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 3.10 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: Supplementaries
Cross Cutting Methods and Competencies

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

Responsible: PD Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries
Cross Cutting Methods and Competencies

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 3.12 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: Supplementaries
Cross Cutting Methods and Competencies

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

Mandatory			
T-BGU-106605	Geostatistics	6 CR	Mälicke, Zehe

Competence Certificate
- 'Teilleistung' T-BGU-106605 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 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 inlc. presenation of an exercise (part of the examination): 60 h
- working on a project and preparation of a report (part of the examination): 60 h

total: 180 h

Recommendation
basic knowledge in statistics

module 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

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

Responsible: PD Dr.-Ing. Uwe Ehret
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries
Cross Cutting Methods and Competencies

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

Responsible: Dr. rer. nat. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries
Cross Cutting Methods and Competencies

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

Responsible: Dr. rer. nat. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries
Cross Cutting Methods and Competencies

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

Responsible: PD Dr. Bernhard Klar
Organisation: KIT Department of Mathematics
Part of: Supplementaries
Cross Cutting Methods and Competencies

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
By the end of the course, students will

- have basic knowledge of probability theory, and be able to model simple random phenomena,
- understand the basic differences between descriptive and inferential statistics,
- know basic statistical methods, and be able to apply this knowledge to new examples.

Content
The lecture provides a concise introduction to probability theory and covers some important statistical methods. The methods covered are illustrated by many examples and exercises from environmental engineering and water management.

Key concepts:

- Random experiments, sample space, events
- probability, conditional probability, independent events
- random variables, probability distribution
- probability mass function, density function
- expected value, moments, quantiles
- error propagation
- sample mean, sample variance
- point estimate, sampling distribution
- linear regression and correlation
- confidence interval
- statistical tests

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

M 3.17 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: Supplementaries
Cross Cutting Methods and Competencies

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 3.18 Module: Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation (WSEM-CC922) [M-CIWVT-106680]

Responsible: Prof. Dr. Andrea Iris Schäfer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Supplementaries
Cross Cutting Methods and Competencies

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

Mandatory			
T-CIWVT-113433	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation	5 CR	

Competence Certificate
- 'Teilleistung' T-BGU-113433 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

Competence Goal
The goal of this course is to get an overview of current challenges in the circular economy focused on the water – energy – environment nexus. Based on individual student interest a topic will be identified and a research plan developed encompassing a thorough background research to establish the state-of-the-art, identification of a specific research problem and research questions suitable to solve this problem. Concepts of novelty and excellence will be explored in an international context. Following the individual topic choice, the research proposal will be developed individually in a tutor group (divided into water, energy, environment) while lectures on required skills will accompany this process. As an outlook beyond this course, criteria to consider when looking for research careers such as applying for funding/scholarships, considering choices in research environment and supervision, performance indicators in research and university rankings will be introduced to enable informed decisions. The proposal will be communicated in writing, as a brief presentation and as a poster, which equips students brilliantly not only for a masters thesis but also a future research publication or a PhD.

Content
In a time of limiting resources, climate change and ever increasing demand for resources the concept of a circular economy is inevitable to create a more sustainable utilization of our key resources, water, energy and ‘environment’. Concepts of zero liquid discharge, water reuse, carbon net zero, resource recovery and environmental pollution reduction are all part of this concept where where waste is returned to use. The water – energy – environment nexus is the particular focus of ths course. Global water issues, water and wastewater treatment, desalination, water reuse, micropollutants, decentralized systems, water & sanitation in international development, renewable energies, environmental pollution, climate change, resource recovery – and many more topics will inspire future research.

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

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

- Circular Economy Water Energy Environment: Research Proposal Preparation lecture: 60 h

independent study:

- development of a research proposal concept: 50 h
- preparation of the research proposal and group presentations: 40 h

total: 150 h

M 3.19 Module: Remote Sensing and Positioning (WSEM-CC931) [M-BGU-103442]

Responsible: Dr.-Ing. Michael Mayer
Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries
Cross Cutting Methods and Competencies

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 3.20 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
KIT Department of Mathematics
Part of: Supplementaries
Cross Cutting Methods and Competencies

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

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	Wursthorn
T-BGU-101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	3 CR	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
- preparation online test (examination prerequisite): 15 h
- examination preparation: 45 h

total: 180 h

Recommendation
none

M 3.21 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: Supplementaries
Cross Cutting Methods and Competencies

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 3.22 Module: Introduction to Python (WSEM-CC936) [M-BGU-106199]

Responsible: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries
Cross Cutting Methods and Competencies

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

Mandatory			
T-BGU-112598	Introduction to Python	3 CR	Cermak, Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-112598 with not graded accomplishment according to § 4 Par. 3

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
The aim of this course is providing knowledge on the basic syntax and structure of the programming language Python. Students can adapt and write basic Python code following a workflow in their individual working environment. By the end of this course students are capable implementing simple algorithms and visualizing scientific data in Python.

Content

- Setup a working environment in Python (installation, virtual environments)
- Python fundamentals (syntax, data types, control flow, functions, objects)
- Working with and visualizing scientific datasets in Python

Module grade calculation
not graded

Annotation
None

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

- lecture/exercise: 20 h

independent study:

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

total: 90 h

Recommendation
none

Base for
n.a.

M 3.23 Module: Interdisciplinary Competencies 1 (2 CP) (WSEM-CC950-1) [M-BGU-106883]

Responsible: Studiendekan:in der KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Cross Cutting Methods and Competencies

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

Election notes
Courses accepted generally by the Examination Committee are available directly as selection option in the module.

For self assignment of taken interdisciplinary qualifications of HoC or FORUM the 'Teilleistungen' with the title "Self Assignment HoC-FORUM ..." have to be selected according to the grading scale, not graded or graded (see module handbook Sect. 1.2.8). Title and CP of the taken exam are taken over by the assignment.

Interdisciplinary Competencies 1 (Election: 2 credits)			
T-BGU-113799	Self Assignment HoC-FORUM 1 not graded	2 CR	
T-BGU-113800	Self Assignment HoC-FORUM 1 graded	2 CR	

Competence Certificate
One or more learning controls, depending on the selected module, can be taken according to the announcement in the corresponding courses. Learning controls can be graded or not graded.

The registration is done directly at House of Competence (HoC), the 'General Studies. Forum Science and Society' (FORUM, formerly ZAK), the 'Sprachenzentrum', or the 'Studienkolleg für ausländische Studierende'.

For registering to other learning controls please contact Study Program Service ('Studiengangservice Bau Geo Umwelt').

Prerequisites
Only one of the following modules can be selected:

- M-BGU-106883 - Interdisciplinary Competencies 1 (2 CP)
- M-BGU-106884 - Interdisciplinary Competencies 2 (3 CP)
- M-BGU-106885 - Interdisciplinary Competencies 3 (4 CP)
- M-BGU-106886 - Interdisciplinary Competencies 4 (5 CP)
- M-BGU-106887 - Interdisciplinary Competencies 5 (6 CP)

Specific conditions for the selection of language courses:

- Language courses in the native language of the student must not be attended.
- English language courses below or at the level required for admission to the master's degree program Water Science & Engineering must not be taken. Hence, 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 gain insight into methods and technical skills of other disciplines. By this, they are able to communicate and collaborate in teams to solve interdisciplinary tasks and problems. They improve their scope of action and acquire skills in cross-cultural communication by extending their knowledge of foreign languages.

Content
The House of Competence (HoC) and the 'General Studies. Forum Science and Society' (FORUM, formerly ZAK) offer a wide range of courses on key competences, which are bundled thematically for better orientation. The contents are explained in detail in the descriptions of the courses on the internet pages of HoC and FORUM.

Further, courses from other disciplines offering interdisciplinary methods and technical skills can be taken in agreement with the mentor.

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 (in German). Students who are not native German speakers may attend German courses at Studienkolleg: www.stk.kit.edu/english/daf-stub-kurse_en.php.

Module grade calculation
not graded

Annotation
Courses on interdisciplinary qualifications, languages, etc. can be taken in the extent of 2 - 6 CPs. For the desired amount of CPs the corresponding module has to be selected. The Module Handbook provides exemplarily the description for the module 'M-BGU-106883 - Interdisciplinary Competencies 1 (2 CP)'.

The module can only be selcted within the subject 'Cross-Cutting Methods and Competencies'.

Further information about the procedure of selecting and registering to the courses is given in Sect. 1.2.8 of the module handbook.

Workload
according to taken courses; see course description of HoC, lecture descriptions of FORUM, descriptions of language courses

Recommendation
none

M 3.24 Module: Water Technology (WSEM-PA221) [M-CIWVT-103407]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Water Technologies and Urban Water Management
Supplementaries

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

Literature
Crittenden, J. C. et al. (2012): Water treatment – Principles and design. 3. edition, Wiley & Sons, Hoboken.

Jekel, M., Czekalla, C. (Hrsg.) (2016). DVGW Lehr- und Handbuch der Wasserversorgung. Deutscher Industrieverlag.

Lecture notes will be provided in ILIAS

M 3.25 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: Water Technologies and Urban Water Management
Supplementaries

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

Mandatory			
T-CIWVT-113235	Excercises: Membrane Technologies	1 CR	Horn, Saravia
T-CIWVT-113236	Membrane Technologies in Water Treatment	5 CR	Horn, Saravia

Competence Certificate
- 'Teilleistung' T-CIWVT-113235 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-CIWVT-113236 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: 45 h

independent study:

- preparation and follow-up lectures, exercises: 60 h
- preparation of excursion reports (examination prerequisite): 25 h
- examination preparation (examination): 50 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, I. A., Fane, A. G. (Eds., 2021): Nanofiltration: Principles and Applications., 2. Edition, Elsevier, Oxford.
- Staude, E., 1992. Membranen und Membranprozesse. Verlag Chemie, Weinheim.
- Vorlesungsunterlagen in ILIAS

M 3.26 Module: Practical Course in Water Technology (WSEM-PA223) [M-CIWVT-103440]

Responsible: Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Water Technologies and Urban Water Management
Supplementaries

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	Hille-Reichel, Horn
T-CIWVT-110866	Excursions: Water Supply	1 CR	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

Literature

- Harris, D. C., Lucy, C. A. (2019): . Quantitative chemical analysis, 10. edition. W. H. Freeman and Company, New York.
- Crittenden, J. C. et al. (2012): Water treatment – Principles and design. Wiley & Sons, Hoboken.
- Patnaik, P., 2017: Handbook of environmental analysis: Chemical pollutants in air, water, soil, and solid wastes. CRC Press.
- Wilderer, P. (Ed., 2011): Treatise on water science, four-volume set, 1st edition, volume 3: Aquatic chemistry and biology. Elsevier, Oxford.
- Vorlesungsskript im ILIAS
- Praktikumsskript

M 3.27 Module: Biofilm Systems (WSEM-PA224) [M-CIWVT-103441]

Responsible: Dr. Andrea Hille-Reichel
Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Water Technologies and Urban Water Management
Supplementaries

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	Hille-Reichel, Wagner

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 are able to describe the structure and function of biofilms in natural habitats and technical applications and explain the main influencing factors and processes for the formation of certain biofilms. They are familiar with methods for visualizing the structures.

Content
This lecture aims at providing an overview of biofilm systems, their development, functions, applications, and the techniques used to investigate them. Thus, topics involved will include basics of (biofilm) microbiology, natural (environmental) biofilm systems, their application in technical systems (reactors), and methods used to quantify biofilm development and performance (i.e., imaging techniques, digital image analysis).

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

M 3.28 Module: Industrial Wastewater Treatment (WSEM-PA226) [M-CIWVT-105903]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Water Technologies and Urban Water Management
Supplementaries

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

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

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Water Technologies and Urban Water Management
Supplementaries

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

Mandatory			
T-BGU-109948	Wastewater Treatment Technologies	6 CR	Azari Najaf Abad, Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-109948 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 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 visit of at least one municipal wastewater treatment plant in Germany completes the course. The course includes lab work in groups to learn about basic measuring and analytical procedures in wastewater treatment plants.

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, Chemical and Process Engineering, Geoecology* and further study programs.

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
module Urban Water Infrastructure and Management (AF301)

Literature

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

ATV-DVWK A 131 (2006): Bemessung von einstufigen Belebungsanlagen. Hennef, Germany.

Metcalf & Eddy, Abu-Orf, M., Bowden, G., Burton, F.L., Pfrang, W., Stensel, H.D., Tchobanoglous, G., Tsuchihashi, R. and AECOM (Firm), (2014). Wastewater engineering: treatment and resource recovery. McGraw Hill Education.

van Loosdrecht, M.C., Nielsen, P.H., Lopez-Vazquez, C.M. and Brdjanovic, D. eds., (2016). Experimental methods in wastewater treatment. IWA publishing.

M 3.30 Module: Stormwater Management (WSEM-PA322) [M-BGU-106112]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Water Technologies and Urban Water Management
Supplementaries

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

Mandatory			
T-BGU-112370	Stormwater Management	6 CR	Azari Najaf Abad, Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-112370 with examination of other type according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students will learn about principles, operations, and simulation of separate and combined sewer systems. Students get familiar with technical plants for stormwater treatment. They can explain operating principles of individual system components as well as assess their suitability for specific applications and apply basic dimensioning approaches.

Content
Lectures are followed by several guided site visits, descriptions, and evaluations of different stormwater treatment plants: stormwater sedimentation tanks, stormwater overflow tanks, and retention soil filters. Settlement characteristics and dimensioning approaches for the design of stormwater treatment facilities will be discussed and evaluated during the site visits. The course wraps up with group laboratory work to learn measurements for sedimentation column and sedimentation basin experiments to evaluate sedimentation characteristics and conduct relevant measurements.

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

Annotation
The attendance of the site visits and the lab work is mandatory.

The number of participants in the course is limited to 20 persons. The registration is 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, Geoecology* and further study programs.

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

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- preparation of report and presentation (examination): 60 h

total: 180 h

Recommendation
basic knowledge in sanitary engineering, module 'Urban Water Infrastructure Management' (WSE-AF301)

Literature
ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , Berlin

Gujer, W. (1997) Siedlungswasserwirtschaft, Springer, Berlin 3.Aufl.

Metcalf & Eddy, Abu-Orf, M., Bowden, G., Burton, F.L., Pfrang, W., Stensel, H.D., Tchobanoglous, G., Tsuchihashi, R. and AECOM (Firm), (2014). Wastewater engineering: treatment and resource recovery. McGraw Hill Education.

M 3.31 Module: Modeling Wastewater Treatment Processes (WSEM-PA323) [M-BGU-106113]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Water Technologies and Urban Water Management
Supplementaries

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

Mandatory			
T-BGU-112371	Modeling Wastewater Treatment Processes	6 CR	Azari Najaf Abad

Competence Certificate
- 'Teilleistung' T-BGU-112371 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
The students will be able to learn the basics of wastewater treatment modeling to develop a matrix for a biological model. Another objective is being able to work with several relevant computer software as tools for modeling wastewater treatment processes and running sensitivity analysis, calibration, and validation. At the end of this course, the students will be able to apply the theory concerning modeling practice in case studies with real datasets using one of the relevant software they learned. During the presentation, they will discuss and explain the outcome of the model.

Content
The course deals with the basis of wastewater modeling (kinetics, stoichiometry, mass balances, hydraulics, mixing, and matrix notation), an introduction of existing activated sludge models (ASM1, ASM2, ASM3, ASM2d), and a selection of computer programs (AQUASIM, SIMBA, GPS-X, and SUMO) in which the models can be built in and the protocol for the development of calibrated activated sludge models will be practiced. Different adjustments to basic ASM models for characterization of biofilm and granular sludge model, as well as anaerobic digestion models (ADM), will be also discussed. Besides the presentations, exercises form a part of the course. Finally, case studies with real datasets on modeling wastewater treatment plants will be practiced.

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

Annotation
The number of participants in the course is limited to 20 persons. The registration is 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*, *Chemical and Process Engineering, Geoecology* and further study programs.

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

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- preparation of report and presentation (examination): 60 h

total: 180 h

Recommendation
basic knowledge in sanitary engineering, module Urban Water Infrastructure and Management (WSEM-AF301)

Literature

Chen, G.H., van Loosdrecht, M.C., Ekama, G.A. and Brdjanovic, D. eds., 2020. Biological wastewater treatment: principles, modeling and design. IWA publishing.

Makinia, J. and Zaborowska, E., 2020. Mathematical modelling and computer simulation of activated sludge systems. IWA publishing.

Mannina, G. ed., 2017. Frontiers in Wastewater Treatment and Modelling: FICWTM 2017 (Vol. 4). Springer.

M 3.32 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: Water Technologies and Urban Water Management
Supplementaries

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
This course teaches the basics and methods for analyzing and planning water distribution systems using hydraulic simulation models. The modeling and application of hydraulic models for the analysis and planning of water distribution networks are learned in a project work during the semester. In the project work, a given distribution network is to be modeled and analyzed. Solutions are to be developed for any deficiencies. Furthermore, a network extension is to be planned and dimensioned. The necessary specialist knowledge (basics of water distribution, modeling and pipe network calculation as well as application of ArcGIS and EPANET, determination of water losses and water demand values, model calibration and dimensioning) is taught in individual course units. The relevant technical regulations (DIN, DVGW) are also presented.

The content of the module/course pursue the following UN Sustainable Goals:

- SDG 6 Clean Water and Sanitation
- SDG 9 Industry, Innovation and Infrastructure

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

Annotation
Further information on the course/module can be found at: https://wb.iwu.kit.edu/education.php.

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 3.33 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: Water Technologies and Urban Water Management
Supplementaries

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 3.34 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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)', 'Fluid Mechanics of Turbulent Flows (PB523)'

M 3.35 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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 3.36 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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
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 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 3.37 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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
none

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 3.38 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	2 terms	English	4	3

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

Competence Certificate
- 'Teilleistung' T-BGU-106774 with written examination according to § 4 Par. 2 No. 1
- '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
- 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, lecture notes 'Interaktion Strömung - Wasserbauwerk'

M 3.39 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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

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
none

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 through the assignment and experimental analysis, which includes:

1. hypotheses formulation,
2. experimental data acquisition, and subsequent
3. analysis of data to support derivation of own findings.

The experimental work will be conducted in a large-scale research infrastructure of the Theodor Rehbock Hydraulics Laboratory at IWU.

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: plastic, wood, sediments) in rivers,
- identify relevant sources and sinks of debris transported by rivers,
- quantify transport processes relative to river debris,
- acquire and analyze hydrodynamic data to inform on a river transport process,
- derive new, own findings based on research-based methods,
- plan monitoring campaigns based on state-of-the-art techniques,
- transfer scientific literature in river debris into practical applications.

Content
The content of the module/course pursues the following UN Sustainable Goals:

- SDG 6 Clean water and sanitation

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* considers the following topics:

- sediment transport (bed and suspended load),
- plastic and urban (cars and urban furniture) debris,
- experimental analysis of transport/retention processes for sediments or debris such as
- plastic, wood, etc.,
- woody and vegetation debris,
- bubbles and gas transfer,
- heat,
- contaminant plumes.

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

Annotation
More information about the module can be found under https://wb.iwu.kit.edu/education.php.

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 assignment in Landscape and River Morphology: 30 h
- preparation and follow-up lecture/exercises Transport Processes in Rivers: 10 h
- experimental work in Transport Processes in Rivers and preparation of report: 50 h
- preparation of final colloquium: 20 h

total: 180 h

Recommendation
basic knowledge in hydromechanics and hydraulic engineering

Literature
Chapter on Fluvial Geomorphology in Treatise in Geomorphology, 2nd edition. Elsevier.

Muste, M., Lyn, D. A., Admiraal, D., Ettema, R., Nikora, V., & García, M. H. (Eds.). (2017). Experimental Hydraulics: Methods, Instrumentation, Data Processing and Management: Volume I: Fundamentals and Methods. CRC Press.

Aberle, J., Rennie, C. D., Admiraal, D. M., & Muste, M. (2017). Experimental Hydraulics: Methods, Instrumentation, Data Processing and Management: Volume II: Instrumentation and Measurement Techniques. CRC Press.

M 3.40 Module: Experimental Hydraulics and Measurement Techniques (WSEM-PB642) [M-BGU-106114]

Responsible: Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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

Mandatory			
T-BGU-112374	Experimental Hydraulics	3 CR	Seidel
T-BGU-110411	Flow Measurement Techniques	3 CR	Gromke

Competence Certificate
- 'Teilleistung' T-BGU-112374 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
keine

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
Further information about the module can be found under https://wb.iwu.kit.edu/education.php.

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

- Flow Measurement Techniques lecture/exercise: 30 h
- Experimental Hydraulics 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: 30 h
- preparation of term paper Experimental Hydraulics (partial exam): 30 h

total: 180 h

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

M 3.41 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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
Further information on the course/module can be found at: https://wb.iwu.kit.edu/education.php.

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 3.42 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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.

The content of the module/course pursue the following UN Sustainable Goals:

- SDG 6 Clean Water and Sanitation
- SDG 7 Affordable and Clean Energy

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

Annotation
Further information on the course/module can be found at: https://wb.iwu.kit.edu/education.php.

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 3.43 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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 shipping is an important mode of transport, accounting for around 20% of inland freight transport. Around 230 million tonnes of goods are transported annually over a total length of around 7,300 km. Thanks to its high capacity and low energy requirements, inland shipping contributes to reducing transport emissions compared to other means of transport. In order to be able to secure the transport performance of inland shipping in the long term, a large number of aspects of water transport engineering must be taken into account, which will be discussed in the lecture. In addition to the necessary structural facilities, economic and ecological aspects of inland shipping are also addressed.

The contents of the module/course pursue the following UN Sustainable Goals:

- SDG 7 Affordable and Clean Energy
- SDG 9 Industry, Innovation and Infrastructure
- SDG 13 Climate Action

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

Annotation
Further information on the course/module can be found at: https://wb.iwu.kit.edu/education.php.

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 3.44 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: Fluid Mechanics and Hydraulic Engineering
Supplementaries

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
Further information on the course/module can be found at: https://wb.iwu.kit.edu/education.php.

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 'River Processes (PB634)'

M 3.45 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: Hydrological Dynamics and Hazards
Supplementaries

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 controls see at the respective '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
none

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 (not graded examination prerequisite): 30 h
- project work on River Basin Modeling (exam): 60 h

total: 180 h

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

beginning the module in summer term

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

Responsible: Dr. Ulf Mohrlok
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Hydrological Dynamics and Hazards
Supplementaries

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;

beginning the module in summer term

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

Responsible: PD Dr.-Ing. Uwe Ehret
Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Hydrological Dynamics and Hazards
Supplementaries

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
none

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 3.48 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: Hydrological Dynamics and Hazards
Supplementaries

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 3.49 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: Hydrological Dynamics and Hazards
Supplementaries

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 3.50 Module: Deep Learning in Hydrological Modeling (WSEM-PC733) [M-BGU-105994]

Responsible: Dr. rer. nat. Ralf Loritz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Hydrological Dynamics and Hazards
Supplementaries

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

Mandatory			
T-BGU-112171	Deep Learning in Hydrological Modeling	6 CR	Loritz

Competence Certificate
- 'Teilleistung' T-BGU-112171 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
The students have gained a general understanding how machine learning methods, particular artificial neural networks and derivatives, are applied in hydrology and have an overview of the current research in this field. They are able to independently setup different types of artificial neural networks in Python and do understand the core principles of these approaches. This includes that they are able to analyze these neural networks and understand their key limitations. The overall goal is that they are prepared to apply state of the art machine learning methods in the water sciences.

Content
This module is designed to deepen the understanding how machine learning is applied in hydrology. This is done along hands-on examples in combination with state of the art machine learning literature. The content is designed to strengthen the programming and scientific skills of the participating students. Topics of the class are:

- machine learning models as surrogate of environmental models with a focus on hydrological modeling
- basic concepts behind artificial neural networks and derivatives
- promises and key limitations of artificial neural network
- hybrid modelling: ideas, concepts and state of the art
- how to setup, design and validate artificial neural networks with hands-on examples in Python
- how to present scientific results in presentations and in a written form

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

Annotation
The course is limited to 12 participants. 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*, that have successful participated in 'Introduction to Environmental Data Analysis and Statistical Learning' and 'Water and Energy Cycles', 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: 60 h

independent study:

- preparation and follow-up lecture/exercises: 20 h
- preparation of presentation : 40 h
- preparation of report: 60 h

total: 180 h

Recommendation
sound knowledge in basics of hydrology;

interest in reading and reviewing scientific research papers;

good programming skills in Python, MatLab or R, preferably in Python.

successful participation in Introduction to Environmental Data Analysis and Statistical Learning (WSEM-CC774) and Water and Energy Cycles (WSEM-AF701)

M 3.51 Module: Protection and Use of Riverine Systems (WSEM-PC762) [M-BGU-103401]

Responsible: Dr. rer. nat. Charlotte Kämpf
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Hydrological Dynamics and Hazards
Supplementaries

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 3.52 Module: Karst Hydrogeology (WSEM-PC842) [M-BGU-105790]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Hydrological Dynamics and Hazards
Supplementaries

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

Mandatory			
T-BGU-111592	Karst Hydrogeology	4 CR	Goldscheider
T-BGU-110413	Field Trip Karst Hydrogeology	2 CR	Goldscheider

Competence Certificate
- 'Teilleistung' T-BGU-110413 with not graded accomplishment according to § 4 Par. 3
- 'Teilleistung' T-BGU-111592 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 are able to understand and explain the hydrogeological characteristics of karst aquifer systems and recognize them in the field.
- They are familiar with the relevant investigation methods in karst hydrogeology for scientific research and professional practice.
- They can evaluate the vulnerability of karst groundwater resources and develop concepts for their sustainable management.

Content

- Geomorphology and hydrology of karst landscapes
- Mineralogy, stratigraphy and geologic structure of karst systems
- The carbonate equilibrium, calcite dissolution, karstification and speleogenesis
- Groundwater flow in karst aquifers
- Modeling approaches in karst hydrogeology
- Vulnerability and contaminant transport in karst
- Springs, wells and other drinking water abstraction structures in karst aquifers
- Field exercises in karst hydrogeology: Impact of climate change on karst groundwater resources, drinking water abstraction in karst areas

Module grade calculation
grade of module is grade of the exam

Annotation
The practical part of this course is carried out in presence. The field courses are essential for the progress of the participants.

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

- lecture/exercise: 60 h
- field exercise: 30 h

independent study:

- preparation and follow-up lectures/exercises: 30 h
- report on feild exercise (not graded accomplishment): 30 h
- examination preparation: 30 h

total: 180 h

Recommendation
none

M 3.53 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: Hydrological Dynamics and Hazards
Supplementaries

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	2 terms	German	4	3

Mandatory			
T-BGU-102997	River and Floodplain Ecology	3 CR	Wittmann
T-BGU-112845	Wetlands	3 CR	Damm

Competence Certificate
- 'Teilleistung' T-BGU-102997 with not graded accomplishment according § 4 Par. 3
- 'Teilleistung' T-BGU-112845 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
- Wetlands 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 Wetlands: 30 h
- preparation of presentation Wetlands (examination): 30 h

total: 180 h

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

M 3.54 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: Supplementaries

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

Responsible: Dr.-Ing. Andreas Bieberstein
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Supplementaries

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 3.56 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: Supplementaries

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 3.57 Module: General Meteorology (WSEM-SM971) [M-PHYS-103732]

Responsible: apl. Prof. Dr. Michael Kunz
Organisation: KIT Department of Physics
Part of: Supplementaries

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

M 3.58 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: Supplementaries

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
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 3.59 Module: Study Project (WSEM-SP111) [M-BGU-103439]

Responsible: Dr.-Ing. Michele Trevisson
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	5	1

Mandatory			
T-BGU-106839	Study Project	15 CR	Trevisson

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.

M 3.60 Module: Module Master's Thesis (WSEM-THESIS) [M-BGU-106879]

Responsible: Studiendekan:in der KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Master's Thesis

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

Mandatory			
T-BGU-113795	Master's Thesis	30 CR	Studiendekan:in der KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften

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 and compoleted the subject 'Study Project'. 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. 1.2.7.

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 3.61 Module: Further Examinations (WSEM-ZL) [M-BGU-106855]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	pass/fail	Each term	2 terms	German/English	4	1

Further Examinations (Election: at most 30 credits)			
T-BGU-113739	GPT for Programming in Matlab and Python	1 CR	Mälicke

Prerequisites
none

M 3.62 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: Additional Examinations (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	3 terms	German	4	1

Election notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.zak.kit.edu/english/16495.php. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@zak.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

Mandatory			
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Election: at least 12 credits)			
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	3 CR	Mielke, Myglas
Mandatory			
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	0 CR	Mielke, Myglas

Competence Certificate
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.
Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.
The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at https://www.zak.kit.edu/begleitstudium-wtg.

Competence Goal
Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content
The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of two modules: the Basic Module (4 LP) and the Advanced Module (12 LP).

The Advanced Module is divided into 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Module grade calculation
The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Annotation
Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Additional credit points (supplementary achievements), up to a maximum of 12, can be earned from interdisciplinary achievements and can be included in the supplementary course. Upon request, these supplementary achievements are listed in the certificate of the accompanying course, marked as such, and recorded with their grades as specified in paragraph 9. However, these supplementary achievements are **not** included in the calculation of the overall grade for the accompanying course.
The statutes for the accompanying study programme Science, Technology and Society apply.

Workload
The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 390 hours
> Total: approx. 510 hours

In the form of supplementary services, up to approximately 390 hours of work can be added.

Recommendation
It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Learning type
- Lectures
- Seminars/Project Seminars
- Workshops

4 Courses

T 4.1 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 2024	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 4.2 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 2024	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 4.3 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation:
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

Annotation

T 4.4 Course: Biofilm Systems [T-CIWVT-106841]

Responsible: Dr. Andrea Hille-Reichel
Dr. Michael Wagner
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 2024	2233820	Biofilm Systems	2 SWS	Lecture / 🗣	Hille-Reichel, Wagner

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 20 min.

T 4.5 Course: Booklet Integrated Infrastructure Planning [T-BGU-106763]

Responsible: Dr. rer. nat. 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

Competence Certificate
booklet; DIN A5, appr. 15 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 4.6 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 24/25	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 4.7 Course: Deep Learning in Hydrological Modeling [T-BGU-112171]

Responsible: Dr. rer. nat. Ralf Loritz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105994 - Deep Learning in Hydrological Modeling

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each summer term	1 terms	1

Events					
ST 2024	6224912	Deep Learning in Hydrological Modeling	4 SWS	Lecture / Practice (/	Loritz

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
scientific presentation appr. 15 min., report appr. 10 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 4.8 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 2024	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 4.9 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 2024	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 4.10 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					
ST 2024	6251816	Embankment Dams (Advanced)	2 SWS	Lecture / Practice (/	Bieberstein
WT 24/25	6251703	Basics in Earthworks and Embankment Dams	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 4.11 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 4.12 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 4.13 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 4.14 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 24/25	2233810	Environmental Biotechnology	2 SWS	Lecture / 🗣	Tiehm

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, ca. 30 min.

Prerequisites
None

T 4.15 Course: Environmental Communication [T-BGU-101676]

Responsible: Dr. rer. nat. 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					
ST 2024	6224905	Environmental Communication	2 SWS	Seminar /	Kämpf
WT 24/25	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 4.16 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 24/25	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 4.17 Course: Examination on Turbulent Diffusion [T-PHYS-109981]

Responsible: Dr. Gholamali Hoshyaripour
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 2024	4052081	Turbulent Diffusion	2 SWS	Lecture / 🗣	Hoshyaripour, Hoose
ST 2024	4052082	Exercises to Turbulent Diffusion	1 SWS	Practice / 🗣	Hoshyaripour, Hoose, Chopra

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 4.18 Course: Examination Prerequisite Environmental Communication [T-BGU-106620]

Responsible: Dr. rer. nat. 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					
ST 2024	6224905	Environmental Communication	2 SWS	Seminar /	Kämpf
WT 24/25	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 4.19 Course: Excercises: Membrane Technologies [T-CIWVT-113235]

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 2024	2233011	Membrane Technologies in Water Treatment - Excercises	1 SWS	Practice /	Horn, Saravia, und Mitarbeitende

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Learning control is a completed coursework: Submission of exercises, membrane design and short presentation (5 minutes, group work).

Prerequisites
submission of exercises, membrane design and short presentation, 5 min., group work

T 4.20 Course: Excursions: Water Supply [T-CIWVT-110866]

Responsible: 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

T 4.21 Course: Experimental Hydraulics [T-BGU-112374]

Responsible: Dr.-Ing. Frank Seidel
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106114 - Experimental Hydraulics and Measurement Techniques

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	1

Events					
WT 24/25	6222907	Experimental Hydraulics	2 SWS	Lecture / Practice (	Seidel

Competence Certificate
term paper, appr. 10 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 4.22 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 2024	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 4.23 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 2024	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' Applied 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 4.24 Course: Field Trip Karst Hydrogeology [T-BGU-110413]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105790 - Karst Hydrogeology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	2	pass/fail	Each summer term	1

Events					
ST 2024	6339078	Field Trip Karst Hydrogeology	1 SWS	Practice / 🗣	Goldscheider

Legend: 💻 Online, 🎭 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
participation in a field exercise and submission of a field exercise report

Prerequisites
none

Recommendation
none

Annotation
The practical part of this course is carried out in presence. The field courses are essential for the progress of the participants.

T 4.25 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-106114 - Experimental Hydraulics and Measurement Techniques

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each term	1 terms	1

Events					
WT 24/25	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 4.26 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 2024	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 4.27 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	3

Events					
ST 2024	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 4.28 Course: Fundamentals of Water Quality [T-CIWVT-106838]

Responsible: Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103438 - Fundamentals of Water Quality

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2233230	Fundamentals of Water Quality	2 SWS	Lecture / 🗣	Wagner
WT 24/25	2233231	Fundamentals of Water Quality - Exercises	1 SWS	Practice / 🗣	Wagner, und Mitarbeitende

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 20 min.

Prerequisites
None.

T 4.29 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 24/25	4051011	Allgemeine Meteorologie	3 SWS	Lecture /	Kunz
WT 24/25	4051012	Übungen zur Allgemeinen Meteorologie	2 SWS	Practice /	Kunz, Schaub, Sperka, Tonn

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presenting one exercise and
test (not graded)

T 4.30 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 2024	6026204	Geodateninfrastrukturen und Webdienste	1 SWS	Lecture / 🗣	Wursthorn
ST 2024	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 4.31 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 2024	6026204	Geodateninfrastrukturen und Webdienste	1 SWS	Lecture / 🗣	Wursthorn
ST 2024	6026205	Geodateninfrastrukturen und Webdienste, Übung	2 SWS	Practice / 🗣	Wursthorn

Legend: 📱 Online, 🌀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
project work with written report, 10-20 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 4.32 Course: Geostatistics [T-BGU-106605]

Responsible: Dr. Mirko Mälicke
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
Examination of another type	6	Grade to a third	Each term	2

Events					
ST 2024	6224805	Geostatistics	4 SWS	Lecture / Practice (/	Mälicke, Zehe

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presentation of an exercise, appr. 15 min. (max. 30 points), and submission of a project report, appr. 12 pages (max. 70 points); passed with min. 60 points

Prerequisites
none

Recommendation
none

Annotation
none

T 4.33 Course: GPT for Programming in Matlab and Python [T-BGU-113739]

Responsible: Dr. Mirko Mälicke
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106855 - Further Examinations

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each winter term	1 terms	2

Events					
WT 24/25	6224909	GPT for Programming in Matlab and Python	1 SWS	Lecture /	Mälicke, Ehret, Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
task-based homework: completion of 4 programming tasks during and at the end of the lecture period, time investment appr. 3-4 h per task

Prerequisites
One of the 'Teilleistungen' Introduction to Matlab (T-BGU-106765) or Introduction to Python (T-BGU-112598) must have been started.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-BGU-106765 - Introduction to Matlab must have been started.
2. The course T-BGU-112598 - Introduction to Python must have been started.

Recommendation
none

Annotation
in addition to courses "Introduction to Matlab", 6224907, and "Introduction to Python", 6020130;

only selectable as additional accomplishment in the module Further Examinations;

participation limit: 100 students;

priority is given to students of *Water Science and Engineering* and *Remote Sensing and Geoinformatics* according to the progress of studywho are taking one of the two courses "Introduction to Matlab", 6224907, or "Introduction to Python", 6020130, in the current semester

T 4.34 Course: Groundwater Flow around Structures [T-BGU-106774]

Responsible: Dr.-Ing. Michele Trevisson
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103389 - Hydraulic Structures

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each term	2

Events					
ST 2024	6221815	Groundwater Flow around Structures	2 SWS	Lecture / Practice (/	Trevisson

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.35 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 2024	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 4.36 Course: Homework 'Introduction to Environmental Data Analysis and Statistical Learning' [T-BGU-109950]

Responsible: PD 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 24/25	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 4.37 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 2024	6222701	River Engineering	2 SWS	Lecture / Practice (/	Rodrigues Pereira da Franca
ST 2024	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 4.38 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 2024	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 4.39 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					
ST 2024	6310416	General & Applied Hydrogeology	3 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 4.40 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 2024	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 4.41 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 2024	2233020	Industrial Wastewater Treatment	2 SWS	Lecture / 🗣	Horn

Legend: 📱 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 4.42 Course: Integrated Design Project in Water Resources Management [T-BGU-111275]

Responsible: PD 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 2024	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 4.43 Course: Integrated Infrastructure Planning [T-BGU-106764]

Responsible: Dr. rer. nat. 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

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 4.44 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 24/25	6221903	Interaction Flow - Hydraulic Structures	2 SWS	Lecture / Practice (	Gebhardt

Competence Certificate
written exam, 60 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.45 Course: Introduction to Environmental Data Analysis and Statistical Learning [T-BGU-109949]

Responsible: PD 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 24/25	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 4.46 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences [T-BGU-101681]

Responsible: 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	4

Events					
WT 24/25	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
'Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite' (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 4.47 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite [T-BGU-103541]

Responsible: 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	4

Events					
WT 24/25	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
The achievement control takes place via accepted exercises.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.48 Course: Introduction to Matlab [T-BGU-106765]

Responsible: PD 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 24/25	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 4.49 Course: Introduction to Python [T-BGU-112598]

Responsible: Prof. Dr. Jan Cermak
Dr. Julia Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106199 - Introduction to Python

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework (practical)	3	pass/fail	Each winter term	1 terms	2

Events					
WT 24/25	6020130	Introduction to Python	2 SWS	Lecture / Practice (/	Cermak

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Successfully completed exercises focussing on implementation and documentation of a Python code.

Prerequisites
none

Recommendation
none

Annotation
The associated lecture is especially intended for students of the MSc Geodäsie und Geoinformatik and MSc Remote Sensing and Geoinformatics.
External students may attend the course if there is sufficient capacity. External students communicate their individual interest to participate in this lecture at the latest one week before the start of the lectures via e-mail to anja.carle@kit.edu receive positive/ negative feedback regarding the possibility of participation.

T 4.50 Course: Karst Hydrogeology [T-BGU-111592]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-105790 - Karst Hydrogeology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each winter term	1 terms	3

Events					
WT 24/25	6339076	Karsthydrogeologie	2 SWS	Lecture / Practice (	Goldscheider

Competence Certificate
written exam , 60 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.51 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 24/25	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 4.52 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation:
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Active participation, learning protocols, if applicable.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Annotation
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 4.53 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 2024	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 4.54 Course: Master's Thesis [T-BGU-113795]

Responsible: Studiendekan:in der KIT-Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106879 - Module Master's Thesis

Type	Credits	Grading scale	Recurrence	Expansion	Version
Final Thesis	30	Grade to a third	Each term	1 terms	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. 1.2.7.

T 4.55 Course: Membrane Technologies in Water Treatment [T-CIWVT-113236]

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	1

Events					
ST 2024	2233010	Membrane Technologies in Water Treatment	2 SWS	Lecture /	Horn, Saravia
ST 2024	2233011	Membrane Technologies in Water Treatment - Excercises	1 SWS	Practice /	Horn, Saravia, und Mitarbeitende

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
The Examination Prerequisite 'Excercises: Membrane Technologies' (T-CIWVT-113235) has to be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113235 - Excercises: Membrane Technologies must have been passed.

T 4.56 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 24/25	6048101	Methods of Remote Sensing, Lecture	1 SWS	Lecture / 🗣	Weidner
WT 24/25	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 4.57 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 2024	2233840	Microbiology for Engineers	2 SWS	Lecture / ✕	Schwartz

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 30 min.

T 4.58 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 24/25	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 4.59 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 24/25	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 4.60 Course: Modeling Wastewater Treatment Processes [T-BGU-112371]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106113 - Modeling Wastewater Treatment 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 2024	6223816	Modelling Wastewater Treatment Processes	4 SWS	Lecture / Practice (/	Azari Najaf Abad

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
written report, appr. 10 pages, and presentation, appr. 10 min.

Prerequisites
none

Recommendation
none

Annotation
The number of participants in the course is limited to 20 persons. The registration is 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*, *Chemical and Process Engineering, Geoecology* and further study programs.

T 4.61 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 24/25	6222903	Numerical Flow Modeling in Hydraulic 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 4.62 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 24/25	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 4.63 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 2024	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 4.64 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 24/25	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 4.65 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	4

Events					
ST 2024	0187400	Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen	2 SWS	Lecture	Weiß
ST 2024	0187500	Übungen zu Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen	1 SWS	Practice	Weiß

Competence Certificate
written exam, 120 min.

Prerequisites
None

T 4.66 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 2024	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 4.67 Course: Practical Course in Water Technology [T-CIWVT-106840]

Responsible: 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 24/25	2233032	Practical Course: Water Quality and Water Assessment	2 SWS	Practical course / 🗣	Horn, Hille-Reichel, und Mitarbeitende

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.

T 4.68 Course: Prerequisite Protection and Use of Riverine Systems [T-BGU-106790]

Responsible: Dr. rer. nat. 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 2024	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 4.69 Course: Presentation 'Urban Water Infrastructure and Management' [T-BGU-112369]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
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	Expansion	Version
Completed coursework	2	pass/fail	Each winter term	1 terms	1

Events					
WT 24/25	6223701	Urban Water Infrastructure and Management	4 SWS	Lecture / Practice (/ 🗣	Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
presentation, appr. 15 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.70 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 2024	0188100	Probability and Statistics	2 SWS	Lecture	Klar
ST 2024	0188110	Tutorial for 0188100	1 SWS	Practice	Klar

Competence Certificate
oral exam, 20 min.

T 4.71 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 24/25	6222905	Water Distribution Systems	4 SWS	Lecture / Practice (/	Oberle

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
project report, appr. 15 pages, and
presentation, appr. 15 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.72 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 24/25	6222901	Projektstudium: Wasserwirtschaftliche Planungen	4 SWS	Lecture / Practice (	Seidel

Competence Certificate
project work: term paper, appr. 15 pages, with presentation, appr. 15 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.73 Course: Protection and Use of Riverine Systems [T-BGU-106791]

Responsible: Dr. rer. nat. 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 2024	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 4.74 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each term	1

Prerequisites
In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

T 4.75 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 24/25	6048101	Methods of Remote Sensing, Lecture	1 SWS	Lecture /	Weidner
WT 24/25	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 4.76 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 24/25	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 4.77 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 24/25	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' (T-BGU-111061) 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 4.78 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 2024	6222805	Landscape and River Morphology	2 SWS	Lecture / Practice (/ 🗣	Rodrigues Pereira da Franca
ST 2024	6222807	Transport Processes in Rivers	2 SWS	Lecture / Practice (/ 🗣	Rodrigues Pereira da Franca

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
assignment on Landscape and River Morphology, max. 10 pages;
experimental work and analysis (research-based teaching) on Transport Processes in Rivers, appr. 10 pages;
final colloquium, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 4.79 Course: Self Assignment HoC-FORUM 1 graded [T-BGU-113800]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106883 - Interdisciplinary Competencies 1 (2 CP)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	2	Grade to a third	Each term	1 terms	1

Competence Certificate
according to the assignment to be credited

Prerequisites
none

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Recommendation
none

Annotation
'Not assigned grades' of HoC and FORUM (formerly ZAK) can be assigned by the students themselves; titel and CP of the grades are taken over

T 4.80 Course: Self Assignment HoC-FORUM 1 not graded [T-BGU-113799]

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106883 - Interdisciplinary Competencies 1 (2 CP)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each term	1 terms	1

Competence Certificate
according to the assignment to be credited

Prerequisites
none

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Recommendation
none

Annotation
'Not assigned grades' of HoC and FORUM (formerly ZAK) can be assigned by the students themselves; titel and CP of the grades are taken over

T 4.81 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 2024	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 4.82 Course: Stormwater Management [T-BGU-112370]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
PD Dr.-Ing. Stephan Fuchs

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

Part of: M-BGU-106112 - Stormwater Management

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each summer term	1 terms	1

Events					
ST 2024	6223815	Stormwater Management	4 SWS	Lecture / Practice (/	Azari Najaf Abad, Fuchs

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written report, appr. 10 pages, and presentation, appr. 10 min.

Prerequisites
none

Recommendation
none

Annotation
The attendance of the site visits and the lab work is mandatory.

The number of participants in the course is limited to 20 persons. The registration is 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*, *Geoecology* and further study programs.

T 4.83 Course: Study Project [T-BGU-106839]

Responsible: Dr.-Ing. Michele Trevisson
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 4.84 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 24/25	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 4.85 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 2024	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 4.86 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	3

Events					
ST 2024	4052081	Turbulent Diffusion	2 SWS	Lecture /	Hoshyaripour, Hoose
ST 2024	4052082	Exercises to Turbulent Diffusion	1 SWS	Practice /	Hoshyaripour, Hoose, Chopra

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
There are 7 exercises with 100 points in total.

To pass the prerequisite 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 4.87 Course: Urban Water Infrastructure and Management [T-BGU-106600]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
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	4	Grade to a third	Each term	3

Events					
WT 24/25	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
The not graded accomplishment Presentation 'Urban Water Infrastructure and Management' (T-BGU-112369) has to be passend.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-112369 - Presentation 'Urban Water Infrastructure and Management' must have been passed.

Recommendation
none

Annotation
none

T 4.88 Course: Wastewater Treatment Technologies [T-BGU-109948]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
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	6	Grade to a third	Each term	4

Events					
WT 24/25	6223801	Wastewater Treatment Technologies	4 SWS	Lecture / Practice (/	Fuchs, Azari Najaf Abad

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
written exam, 60 min.

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, Chemical and Process Engineering, Geoecology* and further study programs.

T 4.89 Course: Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation [T-CIWVT-113433]

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-106680 - Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	5	Grade to a third	Each summer term	1

Events					
ST 2024	2233130	Circular Economy Water Energy Environment: Research Proposal Preparation	4 SWS	Lecture / 🗣	Schäfer

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The Learning control is an examination of another type:
Research proposal of 10 pages and an oral presentation of 10 minutes (individual work). The grade will be a composite of the proposal (submission in week 13 before class) and oral & poster presentation (all day workshop with researcher participation).

Prerequisites
None

T 4.90 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	3

Events					
WT 24/25	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
none

T 4.91 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 24/25	6222905	Water Distribution Systems	4 SWS	Lecture / Practice (/	Oberle

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

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 4.92 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 24/25	2233030	Water Technology	2 SWS	Lecture / 🗣	Horn
WT 24/25	2233031	Exercises to Water Technology	1 SWS	Practice / 🗣	Horn, und Mitarbeitende

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 30 min.

T 4.93 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 2024	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 4.94 Course: Wetlands [T-BGU-112845]

Responsible: Dr. rer. nat. Christian Damm
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	Expansion	Version
Examination of another type	3	Grade to a third	Each summer term	1 terms	1

Events					
ST 2024	6111234	Wetlands	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

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

P-AF	Profile Studies - Advanced Fundamentals
P-S	Profile Studies - Specialization
PA	Profile A
PB	Profile B
PC	Profile C
CC	Cross-Cutting Methods & Competencies
Sup	Supplementaries
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 Course

L	lecture
E	exercise
S	seminar
P	practical course
F	field trip

Learning Controls

wE	written examination
oE	oral examination
EoT	examination of other type
ngA	not graded accomplishment

Example Curriculum PA - Water Technologies & Urban Water Management

1st Semester (winter semester)

Hours per week: 18; credit points: 31; exams: 5 (ungraded LC are not counted)

Subject	Module	Title	CP	HPW	Type	LC	G/E
PA-AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF201	Fundamentals of Water Quality	6	3	L/E	oE	E
	AF301	Urban Water Infrastructure and Management	6	4	L/E	wE + ngA	E
	AF701	Water and Energy Cycles	6	4	L/E	EoT	E
PA-S	PA982	Applied Microbiology - Environmental biotechnology	4	2	L	oE	E
	PA221	Water Technology	6	3	L/E	oE	E

2nd Semester (summer semester)

Hours per week: 16; credit points: 28; exams: 5

Subject	Module	Title	CP	HPW	Type	LC	G/E
PA-AF	AF801	Hydrogeology	6	3	L/E	wE	E
CC	CC371	Freshwater Ecology	6	4	L/S/E	EoT	E
Sup	PA222	Membrane Technologies in Water Treatment	6	3	L/E	wE + ngA	E
	PA323	Modeling Wastewater Treatment Processes	6	4	L/E	EoT	E
PA-S	PA982	Applied Microbiology – Microbiology for Engineers	4	2	L	oE	E

3rd Semester (winter semester)

Hours per week: 10 + Study Project (3 months); credit points: 31; exams: 3

Subject	Module	Title	CP	HPW	Type	LC	G/E
CC	CC950	Interdisciplinary Competencies	6	4	L/E	ngA	E
PA-S	PA223	Practical Course in Water Technology	4	2	L/P	EoT+ ngA	E
	PA621	Water Distribution Systems	6	4	L/E	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
PB-AF	AF401	Advanced Fluid Mechanics	6	4	L/E	wE	E
	AF601	Hydraulic Engineering	6	4	L/E	wE + ngA	E
CC	CC471	Experiments in Fluid Mechanics	6	4	L/E	EoT	E
PB-S	PB523	Fluid Mechanics of Turbulent Flows	6	4	L/E	oE	E
Sup	PB634	River Processes	6	4	L/E	EoT	E

2nd Semester (winter semester)

Hours per week: 20; credit points: 30; exams: 5

Subject	Module	Title	CP	HPW	Type	LC	G/E
PB-AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF701	Water and Energy Cycles	6	4	L/E	EoT	E
	AF501	Numerical Fluid Mechanics	6	4	L/E	wE	E
PB-S	PB524	Modeling of Turbulent Flows - RANS and LES	6	4	L/E	oE	E
	PB421	Environmental Fluid Mechanics	6	4	L/E	wE	E
	PB631	Hydraulic Structures – Interaction Flow-Hydraulic Structures	3	2	L/E	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
PB-S	PB631	Hydraulic Structures – Groundwater Flow around Structures	3	2	L/E	wE	E
Sup	PC722	Integrated Design Project in Water Resources Management	6	4	L/E	EoT	E
CC	CC371	Freshwater Ecology	6	4	L/S/E	EoT	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 – Hydrological Dynamics & Hazards

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
PC-AF	AF101	Modeling of Water and Environmental Systems	3	2	L	ngA	E
	AF201	Fundamentals of Water Quality	6	3	L/E	oE	E
	AF701	Water and Energy Cycles	6	4	L/E	EoT	E
	AF301	Urban Water Infrastructure and Management	6	4	L/E	wE + ngA	E
CC	CC774	Introduction to Environmental Data Analysis and Statistical Learning	6	4	L/E	wE + ngA	E
	CC772	Introduction to Matlab	3	2	L/E	ngA	E

2nd Semester (summer semester)

Hours per week: 21; credit points: 33; exams: 6

Subject	Module	Title	CP	HPW	Type	LC	G/E
PC-AF	AF801	Hydrogeology	6	3	L/E	wE	E
PC-S	PC561	Groundwater Management	3	2	L/E	oE	E
	PC725	Subsurface Flow and Contaminant Transport	6	4	L/E	oE	E
	PC731	Hydrological Measurements	6	4	L/P	EoT	E
	PC722	Integrated Design Project in Water Resources Management	6	4	L/E	EoT	E
Sup	CC773	Analysis of Spatial Data	6	4	L/E	EoT	E

3rd Semester (winter semester)

Hours per week: 8 + Study Project (3 months); credit points: 27; exams: 3

Subject	Module	Title	CP	HPW	Type	LC	G/E
CC	CC950	Interdisciplinary Competencies	3	2	L/E	ngA	G
PC-S	PC561	Groundwater Management	3	2	E	EoT	E
Sup	CC933	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	6	4	L/E	wE+ ngA	G
SP	SP111	Study Project	15	-	-	EoT	E

4th Semester (summer semester)

Master's thesis (6 months); credit points: 30; exams: 1