Module Handbook

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

Summer term 2023
Date: 17/03/2023

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. Advanced Fundamentals (AF), compulsory subject .............................................................................................. 9
    1.2.2. Cross-Cutting Methods & Competencies (CC), compulsory subject .................................................................. 10
    1.2.3. Profile Studies (P) .................................................................................................................................................... 11
    1.2.4. Study Project, compulsory subject ....................................................................................................................... 11
    1.2.5. Master’s Thesis/Masterarbeit ................................................................................................................................ 15
    1.2.6. Interdisciplinary Qualifications .............................................................................................................................. 15
    1.2.7. Additional accomplishments .................................................................................................................................. 15
  1.3. Module selection, individual curriculum & mentoring ................................................................................................ 16
  1.4. Exams and Learning Controls ......................................................................................................................................... 16
    1.4.1. Registration .......................................................................................................................................................... 16
    1.4.2. Cancellation .......................................................................................................................................................... 16
    1.4.3. Repetition ............................................................................................................................................................ 16
  1.5. Recognition of accomplishments .................................................................................................................................... 17
    1.5.1. Recognition of already obtained credits .................................................................................................................. 17
    1.5.2. Accomplishments obtained outside of the Higher Education System .................................................................. 17
  1.6. Calculation of grades, final grade ..................................................................................................................................... 17
  1.7. Semester abroad ................................................................................................................................................................. 18
  1.8. Special circumstances ....................................................................................................................................................... 18

2. Contact persons ................................................................................................................................................................. 18

3. Current changes .................................................................................................................................................................. 19

4. Modules ................................................................................................................................................................................. 20
  4.2. Fundamentals of Water Quality [WSEM-AF201] - M-CIWVT-103438 ................................................................. 21
  4.3. Urban Water Infrastructure and Management [WSEM-AF301] - M-BGU-103358 ................................................. 22
  4.6. Hydraulic Engineering [WSEM-AF601] - M-BGU-103376 ................................................................. 26
  4.15. Integrated Infrastructure Planning [WSEM-CC791] - M-BGU-103380 ................................................................. 42
  4.21. Introduction to GIS for Students of Natural, Engineering and Geo Sciences [WSEM-CC933] - M-BGU-101846 ................................................................. 51
  4.22. Geodata Infrastructures and Web-Services [WSEM-CC935] - M-BGU-101044 ................................................................. 52
  4.23. Introduction to Python [WSEM-CC936] - M-BGU-106199 ......................................................................................... 53
  4.27. Practical Course in Water Technology [WSEM-PA223] - M-CIWVT-103440 ................................................................. 58
  4.29. Industrial Wastewater Treatment [WSEM-PA226] - M-CIWVT-105903 ................................................................. 61
  4.32. Modeling Wastewater Treatment Processes [WSEM-PA323] - M-BGU-106113 ................................................................. 66
  4.34. Applied Microbiology [WSEM-PA982] - M-CIWVT-103436 ......................................................................................... 70

Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)
Module Handbook as of 17/03/2023
# Table Of Contents

4.35. Hydraulic Structures [WSEM-PB631] - M-BGU-103389 ................................. 76
4.40. River Processes [WSEM-PB634] - M-BGU-105927 ................................. 78
4.43. Hydro Power Engineering [WSEM-PB653] - M-BGU-100103 ................................. 83
4.44. Waterway Engineering [WSEM-PB655] - M-BGU-103392 ................................. 84
4.52. Protection and Use of Riverine Systems [WSEM-PC762] - M-BGU-103401 ................................. 97
4.54. Karnst Hydrogeology [WSEM-PC842] - M-BGU-105790 ................................. 100
4.60. General Meteorology [WSEM-SM971] - M-PHYS-103732 ................................. 108
4.62. Study Project [WSEM-SP111] - M-BGU-103439 ................................. 110
4.63. Supplementary Studies on Culture and Society - M-ZAK-106235 ................................. 111
4.64. Supplementary Studies on Sustainable Development - M-ZAK-106099 ................................. 114

5. Courses ................................. 117

5.1. Advanced Fluid Mechanics - T-BGU-106612 ................................. 117
5.2. Applied Ecology and Water Quality - T-BGU-109956 ................................. 118
5.3. Basics Module - Self Assignment BAK - T-ZAK-112653 ................................. 119
5.4. Basics Module - Self Assignment BeNe - T-ZAK-112345 ................................. 120
5.5. Biofilm Systems - T-CIWVT-106841 ................................. 121
5.6. Booklet Integrated Infrastructure Planning - T-BGU-106763 ................................. 122
5.7. Brownfield Sites - Investigation, Evaluation, Rehabilitation - T-BGU-100089 ................................. 123
5.9. Design Exercise Hydraulic Structures - T-BGU-111929 ................................. 125
5.10. Design Exercise River Engineering - T-BGU-111928 ................................. 126
5.11. Earthwork and Embankment Dams - T-BGU-106792 ................................. 127
5.12. Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe - T-ZAK-112349 ................................. 128
5.13. Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe - T-ZAK-112348 ................................. 129
5.14. Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe - T-ZAK-112350 ................................. 130
5.15. Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe - T-ZAK-112347 ................................. 131
5.16. Environmental Biotechnology - T-CIWVT-106835 ................................. 132
5.17. Environmental Communication - T-BGU-101676 ................................. 133
5.18. Environmental Fluid Mechanics - T-BGU-106767 ................................. 134
5.19. Examination on Turbulent Diffusion - T-PHYS-109981 ................................. 135
5.20. Examination Prerequisite Environmental Communication - T-BGU-106620 ................................. 136
5.21. Excursions: Membrane Technologies - T-CIWVT-110864 ................................. 137
5.23. Experimental Hydraulics - T-BGU-112374 ................................. 139
5.25. Field Training Water Quality - T-BGU-109957 ................................. 141
5.26. Field Trip Karst Hydrogeology - T-BGU-110413 ................................. 142
5.27. Flow Measurement Techniques - T-BGU-110411 ................................. 143
5.28. Fluid Mechanics of Turbulent Flows - T-BGU-110841 ................................. 144
5.29. Fundamental Numerical Algorithms for Engineers - T-BGU-109953 ................................. 145
5.30. Fundamentals of Environmental Geodesy Part B - T-BGU-109329 ................................. 146
5.31. Fundamentals of Water Quality - T-CIWVT-106838 ................................. 147
### Table Of Contents

5.32. General Meteorology - T-PHYS-101091 ................................................................. 148
5.33. Geo Data Infrastructures and Web Services - T-BGU-101756 .......................... 149
5.34. Geodata Infrastructures and Web-Services, Prerequisite - T-BGU-101757 .......... 150
5.35. Geostatistics - T-BGU-106605 ............................................................................. 151
5.36. Groundwater Flow around Structures - T-BGU-106774 ...................................... 152
5.37. Groundwater Hydraulics - T-BGU-100624 ............................................................ 153
5.38. Homework 'Introduction to Environmental Data Analysis and Statistical Learning' - T-BGU-109950 ................................................................. 154
5.39. Hydraulic Engineering - T-BGU-106759 .............................................................. 155
5.40. Hydro Power Engineering - T-BGU-100139 .......................................................... 156
5.41. Hydrogeology - T-BGU-106801 .......................................................................... 157
5.42. Hydrogeology: Field and Laboratory Methods - T-BGU-104834 ...................... 158
5.43. Hydrological Measurements in Environmental Systems - T-BGU-106599 ....... 159
5.44. In-depth Module - Doing Culture - Self Assignment BAK - T-ZAK-112655 ....... 160
5.45. In-depth Module - Global Cultures - Self Assignment BAK - T-ZAK-112658 ...... 161
5.46. In-depth Module - Media & Aesthetics - Self Assignment BAK - T-ZAK-112656 .... 162
5.47. In-depth Module - Spheres of Life - Self Assignment BAK - T-ZAK-112657 .......... 163
5.48. In-depth Module - Technology & Responsibility - Self Assignment BAK - T-ZAK-112654 ...... 164
5.49. Industrial Wastewater Treatment - T-CIJWT-111861 ........................................ 165
5.50. Instrumental Analytics - T-CIJWT-106837 ............................................................ 166
5.51. Integrated Design Project in Water Resources Management - T-BGU-111275 .... 167
5.52. Integrated Infrastructure Planning - T-BGU-106764 .............................................. 168
5.53. Interaction Flow - Hydraulic Structures - T-BGU-110404 .................................... 169
5.54. Introduction to Environmental Data Analysis and Statistical Learning - T-BGU-109949 ................................................................. 170
5.55. Introduction to GIS for Students of Natural, Engineering and Geo Sciences - T-BGU-101681 ................................................................. 171
5.56. Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite - T-BGU-103541 ................................................................. 172
5.57. Introduction to Matlab - T-BGU-106765 .............................................................. 173
5.58. Introduction to Python - T-BGU-112598 .............................................................. 174
5.59. Karst Hydrogeology - T-BGU-111592 ................................................................. 175
5.60. Landfills - T-BGU-100084 ................................................................................. 176
5.61. Mass Fluxes in River Basins - T-BGU-111061 ...................................................... 177
5.62. Master's Thesis - T-BGU-110134 ........................................................................ 178
5.63. Membrane Technologies in Water Treatment - T-CIJWT-110865 ................. 179
5.64. Methods of Remote Sensing, Prerequisite - T-BGU-101759 .............................. 180
5.65. Microbiology for Engineers - T-CIJWT-106834 ................................................. 181
5.66. Modeling of Turbulent Flows - RANS and LES - T-BGU-110842 ...................... 182
5.67. Modeling of Water and Environmental Systems - T-BGU-106757 ................. 183
5.68. Modeling Wastewater Treatment Processes - T-BGU-112371 .......................... 184
5.70. Numerical Fluid Mechanics - T-BGU-106758 ...................................................... 186
5.71. Numerical Fluid Mechanics II - T-BGU-106768 ................................................... 187
5.72. Numerical Groundwater Modeling - T-BGU-100625 ......................................... 188
5.73. Numerical Mathematics for Students of Computer Science - T-MATH-102242 .... 189
5.74. Oral Exam - Supplementary Studies on Culture and Society - T-ZAK-112659 .... 190
5.75. Oral Exam - Supplementary Studies on Sustainable Development - T-ZAK-112351 .... 191
5.76. Organic Trace Analysis of Aqueous Samples - T-CIJWT-106836 ..................... 192
5.77. Parallel Programming Techniques for Engineering - T-BGU-106769 ............... 193
5.78. Practical Course in Water Technology - T-CIJWT-106840 .................................. 194
5.79. Practice Module - T-ZAK-112660 ..................................................................... 195
5.80. Prerequisite Protection and Use of Riverine Systems - T-BGU-106790 .............. 196
5.81. Presentation 'Urban Water Infrastructure and Management' - T-BGU-112369 .......... 197
5.82. Probability and Statistics - T-MATH-106784 ...................................................... 198
5.83. Project Report Water Distribution Systems - T-BGU-108485 ............................. 199
5.84. Project Studies in Water Resources Management - T-BGU-106783 ............... 200
5.85. Protection and Use of Riverine Systems - T-BGU-106791 .................................. 201
5.86. Remote Sensing and Positioning - T-BGU-106843 .............................................. 202
5.87. River and Floodplain Ecology - T-BGU-102997 .................................................. 203
5.88. River Basin Modeling - T-BGU-106603 .............................................................. 204
5.89. River Processes - T-BGU-111390 ..................................................................... 205
5.90. Seminar Paper 'Waterway Engineering' - T-BGU-106779 .................................. 206
5.91. Specialisation Module - Self Assignment BeNe - T-ZAK-112346 ..................... 207
5.92. Stormwater Management - T-BGU-112370 ...................................................... 208
5.93. Study Project - T-BGU-106839 ............................................................... 209
<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.94. Thermal Use of Groundwater - T-BGU-106803</td>
<td></td>
<td>210</td>
</tr>
<tr>
<td>5.95. Transport and Transformation of Contaminants in Hydrological Systems - T-BGU-106598</td>
<td></td>
<td>211</td>
</tr>
<tr>
<td>5.96. Turbulent Diffusion - T-PHYS-111427</td>
<td></td>
<td>212</td>
</tr>
<tr>
<td>5.97. Urban Water Infrastructure and Management - T-BGU-106600</td>
<td></td>
<td>213</td>
</tr>
<tr>
<td>5.98. Wastewater Treatment Technologies - T-BGU-109948</td>
<td></td>
<td>214</td>
</tr>
<tr>
<td>5.100. Water Distribution Systems - T-BGU-108486</td>
<td></td>
<td>216</td>
</tr>
<tr>
<td>5.101. Water Technology - T-CIWVT-106802</td>
<td></td>
<td>217</td>
</tr>
<tr>
<td>5.102. Waterway Engineering - T-BGU-106780</td>
<td></td>
<td>218</td>
</tr>
<tr>
<td>5.103. Wetlands - T-BGU-112845</td>
<td></td>
<td>219</td>
</tr>
<tr>
<td>5.104. Wildcard 1 Language Skills 1 - T-BGU-106884</td>
<td></td>
<td>220</td>
</tr>
<tr>
<td>5.105. Wildcard 2 Language Skills - T-BGU-106885</td>
<td></td>
<td>221</td>
</tr>
</tbody>
</table>

6. Example Curricula .................................................................................................................................................................222
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. 4), which provides information on the requirements and recommendations for the modules. Details about the learning controls are described at the so-called 'Teilleistungen' (Chapt. 5). 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 as well as interdisciplinary competencies ('Cross Cutting Methods & Competencies'). Graduates are able to transform their theoretical knowledge into quantitative approaches for the balancing of systems and to solve them analytically and numerically. They can precisely describe relevant circumstances in the environment, and represent specialized solutions to both experts as well as laypersons in an understandable form. Through practical exercises in laboratories, in computer pools or field work, graduates acquire the ability to apply methods on their own in specific contexts. They have sound knowledge of the analysis of time- and space-related data, the design of experiments, and the assessment of uncertainties of measurement and model results. The methods and practices used can be reflected and adapted to changing conditions.

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

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

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

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

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

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

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Consolidation Studies</strong></td>
<td><strong>Study Project</strong></td>
<td><strong>Master's Thesis</strong></td>
<td></td>
</tr>
<tr>
<td>modules within subject Advanced Fundamentals: 27 CP</td>
<td>modules within subject Cross-Cutting Methods and Competencies: 12 CP</td>
<td>duration: 6 months completion by presentation</td>
<td></td>
</tr>
<tr>
<td><strong>Modeling of Water and Environmental Systems</strong>; in addition 4 of the 7 modules have to be taken: Fundamentals of Water Quality, Urban Water Infrastructure and Management, Advanced Fluid Mechanics, Numerical Fluid Mechanics, Hydraulic Engineering, Water and Energy Cycles, Hydrogeology</td>
<td><strong>Study Project</strong> 15 CP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Profile Studies**

- modules to be selected from the listed offer in the selected profile:
  - Water Technologies & Urban Water Cycle (A)
  - Fluid Mechanics & Hydraulic Engineering (B)
  - Environmental System Dynamics & Management (C)
  - Water Resources Engineering (D)

- to be selected freely from the entire offer of the curriculum: subject-specific modules
  - max. 12 CP

**Additional Studies**

- Additional Accomplishments: max. 30 CP
  - to be selected freely from the entire offer of KIT

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Figure 1: Structure of the master degree program Water Science & Engineering.
1.2.1 Advanced Fundamentals (AF), compulsory subject

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

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

### Table 1: Modules AF – Advanced Fundamentals

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Name</th>
<th>Module Type</th>
<th>Hours per Week</th>
<th>Language</th>
<th>Learning Control</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF101:</td>
<td>Modeling of Water and Environmental Systems</td>
<td>3</td>
<td>2</td>
<td>German</td>
<td>NgA</td>
<td>3</td>
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</tbody>
</table>

**compulsory elective modules:**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Name</th>
<th>Module Type</th>
<th>Hours per Week</th>
<th>Language</th>
<th>Learning Control</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF201:</td>
<td>Fundamentals of Water Quality</td>
<td>6</td>
<td>2/1</td>
<td>English</td>
<td>W/E</td>
<td>6</td>
</tr>
<tr>
<td>AF301:</td>
<td>Urban Water Infrastructure and Management</td>
<td>6</td>
<td>2</td>
<td>English</td>
<td>NgA 2</td>
<td>4</td>
</tr>
<tr>
<td>AF401:</td>
<td>Advanced Fluid Mechanics</td>
<td>6</td>
<td>4</td>
<td>English</td>
<td>W/E</td>
<td>6</td>
</tr>
<tr>
<td>AF501:</td>
<td>Numerical Fluid Mechanics</td>
<td>6</td>
<td>4</td>
<td>English</td>
<td>W/E</td>
<td>6</td>
</tr>
<tr>
<td>AF601:</td>
<td>Hydraulic Engineering</td>
<td>6</td>
<td>2</td>
<td>English</td>
<td>NgA 2</td>
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<tr>
<td>AF701:</td>
<td>Water and Energy Cycles</td>
<td>6</td>
<td>4</td>
<td>English</td>
<td>EoT</td>
<td>6</td>
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<td>AF801:</td>
<td>Hydrogeology 1)</td>
<td>6</td>
<td>2</td>
<td>English</td>
<td>W/E</td>
<td>6</td>
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<tr>
<td></td>
<td>Field Methods in Hydrogeology (E)</td>
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</table>

**explanations to Table 1:**

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

- **type of course:**
  - L: lecture
  - L/E: lecture and exercise, separate or integrated

- **type of learning control:**
  - W/E: written examination
  - EoT: examination of other type
  - NgA: not graded accomplishment
  - NgA 2: not graded accomplishment as examination prerequisite

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Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)
Module Handbook as of 17/03/2023
1.2.2 Cross-Cutting Methods & Competencies (CC), compulsory subject

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

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>LP</th>
<th>Name (Language)</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>Type</th>
<th>CP</th>
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<tr>
<td>CC471:</td>
<td>Experiments in Fluid Mechanics</td>
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<td>Experiments in Fluid Mechanics (E)</td>
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<td>EoT</td>
<td>6</td>
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<tr>
<td>CC773:</td>
<td>Analysis of Spatial Data</td>
<td>6</td>
<td>Geostatistics (E)</td>
<td>L/E</td>
<td>4</td>
<td>oE</td>
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<tr>
<td>CC774:</td>
<td>Introduction to Environmental Data Analysis and Statistical Learning</td>
<td>6</td>
<td>Introduction to Environmental Data Analysis and Statistical Learning (E)</td>
<td>L/E</td>
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<td>ngA</td>
<td>2</td>
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<tr>
<td>CC774:</td>
<td></td>
<td>6</td>
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<td>oE</td>
<td>4</td>
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<tr>
<td>CC371:</td>
<td>Freshwater Ecology</td>
<td>6</td>
<td>Applied Ecology and Water Quality (E)</td>
<td>L/S</td>
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<td>4</td>
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<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Organic Trace Analysis of Aqueous Samples (E)</td>
<td>P</td>
<td>2</td>
<td>ngA</td>
<td>2</td>
</tr>
<tr>
<td>CC791:</td>
<td>Integrated Infrastructure Planning</td>
<td>6</td>
<td>Infrastructure Planning – Socio-economic &amp; Ecological Aspects (E)</td>
<td>L/E</td>
<td>4</td>
<td>ngA</td>
<td>0</td>
</tr>
<tr>
<td>CC792:</td>
<td>Environmental Communication</td>
<td>6</td>
<td>Environmental Communication 1) (G)</td>
<td>S</td>
<td>2</td>
<td>ngA</td>
<td>0</td>
</tr>
<tr>
<td>CC792:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EoT</td>
<td>6</td>
</tr>
<tr>
<td>CC772:</td>
<td>Introduction to Matlab</td>
<td>3</td>
<td>Introduction to Matlab (E)</td>
<td>L/E</td>
<td>2</td>
<td>ngA</td>
<td>3</td>
</tr>
<tr>
<td>CC571:</td>
<td>Fundamental Numerical Algorithms for Engineers</td>
<td>3</td>
<td>Fundamental Numerical Algorithms for Engineers (E)</td>
<td>L</td>
<td>2</td>
<td>EoT</td>
<td>3</td>
</tr>
<tr>
<td>CC911:</td>
<td>Probability and Statistics</td>
<td>4</td>
<td>Probability and Statistics (E)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
<td>4</td>
</tr>
<tr>
<td>CC931:</td>
<td>Remote Sensing and Positioning</td>
<td>6</td>
<td>Fundamentals of Environmental Geodesy Part B (E)</td>
<td>L/E</td>
<td>1</td>
<td>ngA</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Methods of Remote Sensing (E)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC933:</td>
<td>Introduction to GIS for Students of Natural, Engineering and Geo Sciences</td>
<td>6</td>
<td>Introduction to GIS for Students of Natural, Engineering and Geo Sciences (G)</td>
<td>L/E</td>
<td>4</td>
<td>ngA</td>
<td>3</td>
</tr>
<tr>
<td>CC935:</td>
<td>Geodata Infrastructures and Web-Services</td>
<td>6</td>
<td>Geodata Infrastructures and Web-Services (G)</td>
<td>L/E</td>
<td>3</td>
<td>ngA</td>
<td>3</td>
</tr>
<tr>
<td>CC936:</td>
<td>Introduction to Python</td>
<td>3</td>
<td>Introduction to Python (E)</td>
<td>L/E</td>
<td>2</td>
<td>ngA</td>
<td>3</td>
</tr>
<tr>
<td>CC912:</td>
<td>Numerical Mathematics for Students of Computer Science and Engineering</td>
<td>6</td>
<td>Numerical Mathematics for Students of Computer Science and Engineering (G)</td>
<td>L/E</td>
<td>3</td>
<td>EoT</td>
<td>6</td>
</tr>
<tr>
<td>CC949:</td>
<td>Language Skills</td>
<td>2-6</td>
<td>Language Courses ()</td>
<td>S</td>
<td></td>
<td>ngA</td>
<td>2-6</td>
</tr>
</tbody>
</table>

explanations to Table 2:
in general:

<table>
<thead>
<tr>
<th>LC</th>
<th>CP</th>
<th>HpW / SWS</th>
<th>W / S</th>
<th>G / E</th>
<th>1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>learning control</td>
<td>credit point</td>
<td>hours per week</td>
<td>winter term / summer term</td>
<td>language German / English</td>
<td>Course is offered every semester.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>type of course:</th>
<th>type of learning control:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L lecture</td>
<td>wE written examination</td>
</tr>
<tr>
<td>L/E lecture and exercise, separate or integrated</td>
<td>oE oral examination</td>
</tr>
<tr>
<td>L/S lecture and seminar integrated</td>
<td>EoT examination of other type</td>
</tr>
<tr>
<td>E exercise</td>
<td>ngA not graded accomplishment</td>
</tr>
<tr>
<td>S seminar</td>
<td>ngA 2) not graded accomplishment as examination prerequisite</td>
</tr>
<tr>
<td>P practical course</td>
<td></td>
</tr>
</tbody>
</table>
1.2.3 Profile Studies (P)

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Course Name (Language)</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>Type</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA221:</td>
<td>Water Technology</td>
<td>Water Technology (E)</td>
<td>L/E</td>
<td>2/1</td>
<td>oE</td>
<td>6</td>
</tr>
<tr>
<td>PA222:</td>
<td>Membrane Technologies in Water</td>
<td>Membrane Technologies in Water Treatment (E)</td>
<td>L/F</td>
<td>2/1</td>
<td>ngA 2) wE</td>
<td>5</td>
</tr>
<tr>
<td>PA982:</td>
<td>Applied Microbiology</td>
<td>Microbiology for Engineers (E)</td>
<td>L</td>
<td>2</td>
<td>oE</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental Biotechnology (E)</td>
<td>L</td>
<td>2</td>
<td>oE</td>
<td>4</td>
</tr>
<tr>
<td>PA223:</td>
<td>Practical Course in Water Technology</td>
<td>Practical Course in Water Technology (E)</td>
<td>P</td>
<td>2</td>
<td>ngA 2) EoT</td>
<td>1</td>
</tr>
<tr>
<td>PA321:</td>
<td>Wastewater Treatment Technologies</td>
<td>Wastewater Treatment Technologies (E)</td>
<td>L/E</td>
<td>4</td>
<td>wE</td>
<td>6</td>
</tr>
<tr>
<td>PA322:</td>
<td>Stormwater Management 1)</td>
<td>Stormwater Management (E)</td>
<td>L/E</td>
<td>4</td>
<td>EoT</td>
<td>6</td>
</tr>
<tr>
<td>PA332:</td>
<td>Modeling Wastewater Treatment</td>
<td>Modeling Wastewater Treatment Processes (E)</td>
<td>L/E</td>
<td>4</td>
<td>EoT</td>
<td>6</td>
</tr>
<tr>
<td>PA621:</td>
<td>Water Distribution Systems</td>
<td>Water Distribution Systems (E)</td>
<td>L/E</td>
<td>4</td>
<td>ngA 2) oE</td>
<td>4</td>
</tr>
<tr>
<td>PA224:</td>
<td>Biofilm Systems</td>
<td>Biofilm Systems (E)</td>
<td>L</td>
<td>2</td>
<td>oE</td>
<td>4</td>
</tr>
<tr>
<td>PA226:</td>
<td>Industrial Wastewater Treatment</td>
<td>Industrial Wastewater Treatment (E)</td>
<td>L</td>
<td>2</td>
<td>oE</td>
<td>4</td>
</tr>
</tbody>
</table>

Explanations to Table 3:

- **LC**: LP learning control
- **CP**: credit point
- **HpW / SWS**: hours per week / winter term / summer term
- **W / S**: German / English
- **Module**: will be offered newly as from summer term 2023.

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 2)**: not graded accomplishment as examination prerequisite
Profile B: Fluid Mechanics & Hydraulic Engineering (PB), compulsory elective subject

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

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

Table 4: Modules PB - Fluid Mechanics & Hydraulic Engineering

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>LP</th>
<th>Course</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(WSEM-)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PB421:</td>
<td>Environmental Fluid Mechanics</td>
<td>6</td>
<td>Environmental Fluid Mechanics (E)</td>
<td>L/E</td>
<td>4</td>
<td>wE 6</td>
</tr>
<tr>
<td>PB524:</td>
<td>Modeling of Turbulent Flows - RANS and LES</td>
<td>6</td>
<td>Modeling of Turbulent Flows - RANS and LES (E)</td>
<td>L/E</td>
<td>4</td>
<td>oE 6</td>
</tr>
<tr>
<td>PB522:</td>
<td>Advanced Computational Fluid Dynamics</td>
<td>6</td>
<td>Numerical Fluid Mechanics II (E)</td>
<td>L/E</td>
<td>2</td>
<td>oE 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Parallel Programming Techniques for Engineering Problems (E)</td>
<td>L/E</td>
<td>2</td>
<td>oE 3</td>
</tr>
<tr>
<td>PB642:</td>
<td>Experimental Hydraulics and Measuring Techniques</td>
<td>6</td>
<td>Flow Measurement Techniques (E)</td>
<td>L/E</td>
<td>2</td>
<td>oE 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Experimental Hydraulics (E)</td>
<td>L/E</td>
<td>2</td>
<td>EoT 3</td>
</tr>
<tr>
<td>PB631:</td>
<td>Hydraulic Structures</td>
<td>6</td>
<td>Groundwater Flow around Structures (E)</td>
<td>L/E</td>
<td>2</td>
<td>oE 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Interaction Flow - Hydraulic Structures (E)</td>
<td>L/E</td>
<td>2</td>
<td>wE 3</td>
</tr>
<tr>
<td>PB653:</td>
<td>Hydro Power Engineering</td>
<td>6</td>
<td>Hydro Power Engineering (G)</td>
<td>L/E</td>
<td>4</td>
<td>oE 6</td>
</tr>
<tr>
<td>PB655:</td>
<td>Waterway Engineering</td>
<td>6</td>
<td>Waterway Engineering (G)</td>
<td>L/E</td>
<td>4</td>
<td>ngA 3)</td>
</tr>
<tr>
<td>PB634:</td>
<td>River Processes 2)</td>
<td>6</td>
<td>Landscape and River Morphology (E)</td>
<td>L/E</td>
<td>2</td>
<td>EoT 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Transport Processes in Rivers (E)</td>
<td>L/E</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PB661:</td>
<td>Project Studies in Water Resources Management</td>
<td>6</td>
<td>Project Studies in Water Resources Management (G)</td>
<td>L/E</td>
<td>4</td>
<td>EoT 6</td>
</tr>
</tbody>
</table>

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) Module must not be selected together with module WSEM-PB641 not offered anymore
2) Module must not be selected together with module WSEM-PB633 not offered anymore

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 3) not graded accomplishment as examination prerequisite
Profile C: Environmental System Dynamics & Management (PC), compulsory elective subject

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

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

Table 5: Modules PC - Environmental System Dynamics & Management

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>CP</th>
<th>Name (Language)</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>LC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC725:</td>
<td>Subsurface Flow and Contaminant Transport</td>
<td>6</td>
<td>Transport and Transformation of Contaminants in Hydrological Systems (E)</td>
<td>L/E</td>
<td>4</td>
<td>oE 6</td>
</tr>
<tr>
<td>PC732:</td>
<td>Hydrological Measurements in Environmental Systems</td>
<td>6</td>
<td>Hydrological Measurements in Environmental Systems (E)</td>
<td>PE</td>
<td>4</td>
<td>EoT 6</td>
</tr>
<tr>
<td>PC733:</td>
<td>Deep Learning in Hydrological Modeling ³)</td>
<td>6</td>
<td>Deep Learning in Hydrological Modeling (E)</td>
<td>L/E</td>
<td>4</td>
<td>EoT 6</td>
</tr>
<tr>
<td>PC821:</td>
<td>Protection and Use of Riverine Systems</td>
<td>6</td>
<td>Protection and Use of Riverine Systems (E)</td>
<td>L/S</td>
<td>4</td>
<td>ngA 4) 1</td>
</tr>
<tr>
<td>PC842:</td>
<td>Karst Hydrogeology ²)</td>
<td>6</td>
<td>Karst Hydrogeology (G)</td>
<td>L/E</td>
<td>2</td>
<td>wE 4</td>
</tr>
<tr>
<td>PC986:</td>
<td>Management of River and Wetland Ecosystems ²)</td>
<td>6</td>
<td>Ecology of Rivers and Wetlands (G)</td>
<td>L</td>
<td>2</td>
<td>ngA 3</td>
</tr>
</tbody>
</table>

Explanations to Table 5:

- 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

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

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

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

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

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

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

Table 6: Additional Supplementary Modules

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Course</th>
<th>Type</th>
<th>HpW / SWS</th>
<th>LC</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(WSEM-)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SM879</td>
<td>Thermal Use of Groundwater</td>
<td>Thermal Use of Groundwater (E)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
<td>4</td>
</tr>
<tr>
<td>SM961:</td>
<td>Earthwork and Embankment Dams</td>
<td>Basics in Earthworks and Embankment Dams (G)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Embankment Dams (Advanced) (G)</td>
<td>L/E</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SM962:</td>
<td>Environmental Geotechnics</td>
<td>Landfills (G)</td>
<td>L/E</td>
<td>2</td>
<td>oE</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brownfield Sites - Investigation, Evaluation, Rehabilitation (G)</td>
<td>L</td>
<td>2</td>
<td>oE</td>
<td>3</td>
</tr>
<tr>
<td>SM971:</td>
<td>General Meteorology</td>
<td>General Meteorology (G)</td>
<td>L/E</td>
<td>3/2</td>
<td>ngA</td>
<td>6</td>
</tr>
<tr>
<td>SM974:</td>
<td>Applied Meteorology: Turbulent Diffusion</td>
<td>Turbulent Diffusion (E)</td>
<td>L/E</td>
<td>2/1</td>
<td>ngA</td>
<td>3</td>
</tr>
</tbody>
</table>

explanations to Table 6:

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

1.2.4 Study Project, 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 ('Studiengangservice Bau-Geo-Umwelt') is handed over to the supervisor when starting the 'Study Project'.

1.2.5 Master’s Thesis/Masterarbeit

The Master's Thesis is an independent scientific study and includes the theoretical and/or experimental work on a complex problem. Students deal with the current state of research and apply the expertise and scientific methods acquired during the studies. They can document, discuss and evaluate the obtained results. Furthermore, they are able to present and defend the essential findings. The topic of the 'Master’s Thesis' depends on the subject area that is chosen for the thesis. 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. 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.

1.2.6 Interdisciplinary Qualifications

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

1.2.7 Additional accomplishments

An additional accomplishment is a voluntarily taken examination, which is not considered in the overall grade (comp. ER/SPO § 15). In total, additional accomplishments can be taken 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. Additional accomplishments available in the module Further Examinations can be selected directly. As from summer term 2023 two selectable additional modules are available for the Accompanying Studies of ZAK. If selecting one of these modules it has to be considered that the extent of possible further additional accomplishments is reduced by the extent of the selected ZAK module even if this is not completed. If the designated additional accomplishments or additional modules is not available in that list then this must be conveyed to the Study Program Service of the department ('Studiengangservice Bau-Geo-Umwelt') via e-mail. The desired selection will then be available in the campus management system enabling the online exam registration. 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 is supervised by a mentor chosen by the student at the beginning of the studies. The mentor has to be a professor of the KIT Department Civil Engineering, Geo and Environmental Sciences or of the KIT Department of Chemical and Process Engineering and has to be involved in the degree program Water Science & Engineering. Possible mentors are:

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

If modules shall be included within the compulsory and compulsory elective subjects others than listed in Tables 1 to 6 the individual curriculum need to be approved by the mentor and to be announced to the Study Advisor. Exemplary curricula can be found in the appendix.

1.4 Exams and Learning Controls

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

1.4.1 Registration

The students must register for learning controls 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 ('Studiengangservice Bau-Geo-Umwelt') 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 cancelation.

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 Examination Committee Master Civil Engineering (https://www.tmb.kit.edu/english/5583.php, in German). The respective lecturers confirm if the accomplishments are equivalent to their modules in the curriculum.

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

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

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 ('Studiengangservice Bau-Geo-Umwelt').

1.5.2 Accomplishments obtained outside of the Higher Education System

Accomplishments made outside of the higher education system, as for example vocational training, can be accredited if the acquired competences contribute to the qualification goals of the master’s program. At maximum, 50 % of the university education can be replaced. 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 (ISIO), 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; see SPO § 12 and 13 according to Satzung zur Änderung der Regelungen über den Nachteilsausgleich in den Studien- und Prüfungsordnungen, Artikel 68; 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
Institute for Hydromechanics, Bldg. 10.81, R. 132
consultation: on appointment
Phone: 0721/608-47791
Email: michele.trevisson@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
Email: studiengangservice@bgu.kit.edu
Web: https://www.bgu.kit.edu/english/studiengangservice.php

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

Major changes will be listed here as from summer term 2023. Despite the fact that this process is mapped with great care, other/minor changes may occur.

modules offered newly as from summer term 2023:
- Stormwater Management [WSEM-PA322]
- Modeling Wastewater Treatment Processes [WSEM-PA323]
- Deep Learning in Hydrological Modelling [WSEM-PC733]

changes of the courses assigned to the modules as from summer term 2023:
- Management of River and Wetland Ecosystems [WSEM-PC986]:
  - The course Wetlands (6111234), 2 HpW/SWS, replaces the course Ecosystem Management (6111234), 2 HpW/SWS.

changed examinations and not graded accomplishments as from summer term 2023:
- Management of River and Wetland Ecosystems [WSEM-PC986]:
  - The examination Wetlands, examination of other type with 3 CP, replaces the examination Ecosystem Management, examination of other type with 3 CP.
M 4.1 Module: Modeling of Water and Environmental Systems (WSEM-AF101) [M-BGU-103374]

**Responsible:** Dr. Jan Wienhöfer

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

**Part of:** Advanced Fundamentals (Version 2) (mandatory)

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<td>Duration</td>
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<td>Level</td>
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<td>Version</td>
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**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 system modeling, 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
4.2 Module: Fundamentals of Water Quality (WSEM-AF201) [M-CIWVT-103438]

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

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

Mandatory
<table>
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<tr>
<th>T-CIWVT-106838</th>
<th>Fundamentals of Water Quality</th>
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<tbody>
<tr>
<td>6 CR</td>
<td>Abbt-Braun</td>
</tr>
</tbody>
</table>

Competence Certificate
- 'Teilleistung' T-CIWVT-106838 with written examination according SPO/ER § 4 Par. 2 No. 1
- Details about learning control see at the 'Teilleistung'

Prerequisites: none

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

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

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

Workload
Contact hours (1 HpW = 1 h x 15 weeks):
- Lecture, exercise: 45 h

Independent study:
- Preparation and follow-up lectures, exercises: 65 h
- Examination preparation: 70 h

Total: 180 h

Recommendation
None

Literature
- Lecture notes in ILIAS
4.3 Module: Urban Water Infrastructure and Management (WSEM-AF301) [M-BGU-103358]

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

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

Mandatory

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<th>T-BGU-112369</th>
<th>Presentation 'Urban Water Infrastructure and Management'</th>
<th>2 CR</th>
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<td>T-BGU-106600</td>
<td>Urban Water Infrastructure and Management</td>
<td>4 CR</td>
<td>Azari Najaf Abad, Fuchs</td>
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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
keine

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

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

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<th>Recurrence</th>
<th>Duration</th>
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<th>Level</th>
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<td>Grade to a tenth</td>
<td>Each summer term</td>
<td>1 term</td>
<td>English</td>
<td>4</td>
<td>1</td>
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</table>

**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**  
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:**
- Advanced Fundamentals (Version 2) (Compulsory Elective Modules)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

**Credits** 6

**Grading scale** Grade to a tenth

**Recurrence** Each winter term

**Duration** 1 term

**Language** English

**Level** 4

**Version** 1

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**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)'

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Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)
Module Handbook as of 17/03/2023
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:**
- Advanced Fundamentals (Version 2) (Compulsory Elective Modules)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

**Credits** 6

**Grading scale** Grade to a tenth

**Recurrence** Each summer term

**Duration** 1 term

**Language** English

**Level** 4

**Version** 2

**Mandatory**

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<td>Design Exercise River Engineering</td>
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<td>T-BGU-111929</td>
<td>Design Exercise Hydraulic Structures</td>
<td>1 CR</td>
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<td>4 CR</td>
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**Competence Certificate**
- 'Teilleistung' T-BGU-111928 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-111929 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-106759 with written examination according to § 4 Par. 2 No. 1

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

**Prerequisites**
none

**Competence Goal**
Students will be able to describe and analyse basic processes linked to the hydraulics of rivers and hydraulic structures. They are able to carry the design of engineering works in rivers and the dimensioning of hydraulic structures with suitable approaches. Based on the acquired process knowledge, they are able to analyse the results of the design in a critical manner. Students are able to use and link their knowledge logically. They can work in a reflexive and self-critical manner.

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

The course River Engineering contains the following topics:

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

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

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

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

**Annotation**
none
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
4.7 Module: Water and Energy Cycles (WSEM-AF701) [M-BGU-103360]

**Responsible:** Prof. Dr.-Ing. Erwin Zehe

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

**Part of:**
- Advanced Fundamentals (Version 2) (Compulsory Elective Modules)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

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**Mandatory**

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<td>Each winter term</td>
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**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, they are 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 programming language; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab (6224907)'
Literature
Module: Hydrogeology (WSEM-AF801) [M-BGU-103406]

Responsible: Prof. Dr. Nico Goldscheider
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of:
- Advanced Fundamentals (Version 2) (Compulsory Elective Modules)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

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

Mandatory

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Competence Certificate
- ‘Teilleistung’ T-BGU-106801 with written examination according to § 4 Par. 2 No. 1
- details about the learning control see at the 'Teilleistung'

Prerequisites
none

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

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

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- General and Applied Hydrogeology lecture, exercise: 30 h
- Field Methods in Hydrogeology lecture/exercise: 15 h

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

Total: 180 h

Recommendation
none

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

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

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

Mandatory

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<td>3 CR</td>
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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 Geocology 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
Jürgen Schwörbel, Methoden der Hydrobiologie, UTB für Wissenschaft 1999
kursbegleitende Materialien
## Module: Experiments in Fluid Mechanics (WSEM-CC471) [M-BGU-103377]

### Responsible
Prof. Dr. Olivier Eiff

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

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

### Credits
6

### Grading scale
Grade to a tenth

### Recurrence
Each summer term

### Duration
1 term

### Language
English

### Level
4

### Version
1

### Mandatory

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### 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, teamwork, 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

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

**Responsible:** Prof. Dr.-Ing. Markus Uhlmann  
**Organisation:** KIT Department of Civil Engineering, Geo and Environmental Sciences

**Part of:**  
- Cross-Cutting Methods & Competencies (Usage from 4/1/2019)  
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)  
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)  
- Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2019)

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

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

**details about the learning control see at the 'Teilleistung'**

**Prerequisites**

none

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

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

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

**Annotation**

none

**Workload**
contact hours (1 HpW = 1 h x 15 weeks):
- lecture: 30 h  

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

total: 90 h

**Recommendation**
good knowledge of basic calculus, linear algebra, and differential equations and familiarity with some higher-level programming language
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:** Cross-Cutting Methods & Competencies  
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)  
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)  
- Profile Studies / Water Resources Engineering (Supplementary Modules)

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

**Responsible:** Prof. Dr.-Ing. Erwin Zehe

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

**Part of:**
- Cross-Cutting Methods & Competencies (Usage from 4/1/2019)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2021)

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**Competence Certificate**

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

Details about the learning control see at the 'Teilleistung'

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

**Module grade calculation**

Grade of the module is grade of the exam

**Annotation**

none

**Workload**

Contact hours (1 HpW = 1 h x 15 weeks):

- Lecture/exercise: 60 h
- Independent study:
  - Preparation and follow-up lecture/exercises: 60 h
  - Examination preparation: 60 h
- Total: 180 h
Recommendation
basic knowledge in statistics

module Hydrological Measurements in Environmental Systems [bauiM2S05-HY5]
knowledge of programming with Matlab; otherwise, it is strongly recommended to attend the course 'Introduction to Matlab' (6224907)

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

**Responsible:** PD Dr.-Ing. Uwe Ehret

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

**Part of:** Cross-Cutting Methods & Competencies (Usage from 4/1/2019)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 4/1/2019)

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** English

**Level:** 4

**Version:** 1

**Mandatory**

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<td>Introduction to Environmental Data Analysis and Statistical Learning</td>
<td>4 CR</td>
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**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
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: Cross-Cutting Methods & Competencies
Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
Profile Studies / Water Resources Engineering (Supplementary Modules)

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

Mandatory

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Competence Certificate
- 'Teilleistung' T-BGU-106763 with not graded accomplishment according to § 4 Par. 3 as examination 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-projekt 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
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:** Cross-Cutting Methods & Competencies
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** German

**Level:** 4

**Version:** 1

**Mandatory**

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

**Responsible:** PD Dr. Bernhard Klar

**Organisation:** KIT Department of Mathematics

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

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**Mandatory**

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

**Competence Certificate**
- 'Teilleistung' T-BGU-106784 with oral examination according to § 4 Par. 2 No. 2
- details about the learning control see at the 'Teilleistung'

**Prerequisites**
- none

**Competence Goal**
- Students acquire basic knowledge of probability theory, and are able to model simple random phenomena
- they know the basic differences between descriptive and inferential statistics
- Students learn basic statistical methods, and are able to apply this knowledge to new examples

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

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

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

**Workload**
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 45 h
independent study:
- preparation and follow-up lectures, Exercises: 45 h
- examination preparation: 30 h

total: 120 h

**Recommendation**
- none
## Module: Numerical Mathematics for Students of Computer Science and Engineering (WSEM-CC912) [M-MATH-103404]

### Responsible:
Prof. Dr. Christian Wieners

### Organisation:
KIT Department of Mathematics

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

### Credits
6

### Grading scale
Grade to a tenth

### Recurrence
Each summer term

### Duration
1 term

### Language
German

### Level
4

### Version
2

### Mandatory

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

**Responsible:** Dr. Gerald Brenner-Weiβ  
apl. Prof. Dr. Gisela Guthausen

**Organisation:** KIT Department of Chemical and Process Engineering

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

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<td>Instrumental Analytics</td>
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<td>Guthausen</td>
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<tr>
<td>T-CIWVT-106836</td>
<td>Organic Trace Analysis of Aqueous Samples</td>
<td>2 CR</td>
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**Competence Certificate**  
- 'Teilleistung' T-BGU-106836 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite  
- 'Teilleistung' T-BGU-106837 with oral examination according to § 4 Par. 2 No. 2  
details about the learning controls see at the respective ‘Teilleistung’

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

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

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

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

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

independent study:

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

total: 180 h
**Recommendation**
module 'Fundamentals of Water Quality (AF201)'
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:
- Cross-Cutting Methods & Competencies
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

Mandatory

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<td>Methods of Remote Sensing, Prerequisite</td>
<td>1 CR</td>
<td>Weidner</td>
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<tr>
<td>T-BGU-109329</td>
<td>Fundamentals of Environmental Geodesy Part B</td>
<td>1 CR</td>
<td>Kutterer, Mayer</td>
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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 exercises, 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)
### Module: Introduction to GIS for Students of Natural, Engineering and Geo Sciences (WSEM-CC933) [M-BGU-101846]

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<tr>
<th>M</th>
<th>Responsible: Dr.-Ing. Sven Wursthorn</th>
<th>Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences</th>
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<td>Each winter term</td>
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- '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
4.22 Module: Geodata Infrastructures and Web-Services (WSEM-CC935) [M-BGU-101044]

**Responsible:** Dr.-Ing. Sven Wursthorn

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

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

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<td>Geo Data Infrastructures and Web Services</td>
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### 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
4.23 Module: Introduction to Python (WSEM-CC936) [M-BGU-106199]

**Responsible:** Dr. Julia Fuchs

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

**Part of:**
- Cross-Cutting Methods & Competencies (Usage from 10/1/2022)
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 10/1/2022)

**Credits:** 3

**Grading scale:** pass/fail

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** English

**Level:** 4

**Version:** 1

### Mandatory

| T-BGU-112598 | Introduction to Python | 3 CR | 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.
4.24 Module: Language Skills 1 (2 CP) (WSEM-CC949) [M-BGU-103466]

Responsible: Dr.-Ing. Michele Trevisson
Organisation: University
Part of: Cross-Cutting Methods & Competencies

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Language Skills 1 (Election: 2 credits)

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Competence Certificate

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

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

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

Prerequisites

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

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

The same is valid for the other modules.

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

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

Competence Goal

Students acquire skills in cross-cultural communication.

Content

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

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

Module grade calculation

not graded

Annotation

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

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

Workload

corresponding to the selected language course/s

Recommendation

none
# Module: Water Technology (WSEM-PA221) [M-CIWVT-103407]

## Responsible
Prof. Dr. Harald Horn

## Organisation
KIT Department of Chemical and Process Engineering

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

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## Competence Certificate
- 'Teilleistung' T-CIWVT-106802 with oral examination according to § 4 Par. 2 No. 2
- details about learning control see at the 'Teilleistung'

## Prerequisites
none

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

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

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

## Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise: 45 h
- independent study:
  - preparation and follow-up lectures, exercises: 60 h
  - examination preparation: 75 h
- total: 180 h

## Recommendation
none

## Literature

Lecture notes will be provided in ILIAS
Module: Membrane Technologies in Water Treatment (WSEM-PA222) [M-CIWVT-105380]

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

Organisation: KIT Department of Chemical and Process Engineering

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

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

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

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

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

Prerequisites
none

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

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

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

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture, exercise (incl. excursions): 45 h

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

total: 180 h

Recommendation
module 'Water Technology (WSEM-PA221)'

Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)
Module Handbook as of 17/03/2023
Literature

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

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

Organisation: KIT Department of Chemical and Process Engineering

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

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<td>Practical Course in Water Technology</td>
<td>3 CR</td>
<td>Abbt-Braun, Hille-Reichel, Horn</td>
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<tr>
<td>T-CIWVT-110866</td>
<td>Excursions: Water Supply</td>
<td>1 CR</td>
<td>Abbt-Braun, Horn</td>
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Competence Certificate
- 'Teilleistung' T-CIWVT-110866 with not graded accomplishment according to § 4 Par. 3
- 'Teilleistung' T-CIWVT-106840 with examination of other type according to § 4 Par. 2 No. 3

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

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

Modeled Conditions
The following conditions have to be fulfilled:

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

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

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

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

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture/practical training, excursions: 36 Std.
- independent study:
  - preparation of reports on practical training (examination): 40 h
  - preparation of excursion reports (not graded accomplishment): 10 h
  - examination preparation: 34 h

total: 120 h

Recommendation
none
Literature

- Vorlesungsskript im ILIAS
- Praktikumsskript
**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:**  
Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules)  
Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)  
Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)  
Profile Studies / Water Resources Engineering (Compulsory Modules A)

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**Competence Certificate**  
- 'Teilleistung' T-CIWVT-106841 with oral examination according to § 4 Par. 2 No. 2  
details about the learning control see at the 'Teilleistung'

**Prerequisites**  
none

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

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

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

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

- lecture: 30 h

independent study:

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

total: 120 h

**Recommendation**  
none
4.29 Module: Industrial Wastewater Treatment (WSEM-PA226) [M-CIWVT-105903]

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

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

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

Competence Certificate
- 'Teilleistung' T-CIWVT-111861 with oral examination according SPO/ER § 4 Par. 2 No. 2
details about learning control see at the 'Teilleistung'

Prerequisites
none

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

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

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

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture: 30 h
independent study:
- preparation and follow-up lectures: 60 h
- examination preparation: 30 h
total: 120 h

Recommendation
none

Literature
### 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:**  
- Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 4/1/2019)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)  
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2019)  
- Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 4/1/2019)

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

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<td>Wastewater Treatment Technologies</td>
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**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 households 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 course takes place in winter term as from now.  
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, Geocology 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: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , Berlin
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:**
- Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 10/1/2022)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 10/1/2022)

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

**Mandatory**

| T-BGU-112370 | Stormwater Management | 6 CR | 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**
Module will be offered newly as from summer term 2023.
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, Geocology 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
### 4.32 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:**  
- Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 10/1/2022)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2022)  
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 10/1/2022)  
- Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 10/1/2022)

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**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**

Module will be offered newly as from summer term 2023.

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, Geoeocology 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**

Vorkenntnisse in Siedlungswasserwirtschaft, Modul Urban Water Infrastructure and Management (WSEM-AF301)
**Literature**


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

Responsible: Dr.-Ing. Peter Oberle
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of:
- Profile Studies / Water Technologies & Urban Water Cycle (Compulsory Modules) (Usage from 4/1/2018)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2018)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2018)
- Profile Studies / Water Resources Engineering (Compulsory Modules A) (Usage from 4/1/2018)

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

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

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

Prerequisites
none

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

Content
The module covers the following topics:

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

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

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

Annotation
none

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

- lecture/exercise: 60 h

independent study:

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

total: 180 h
**Recommendation**

Hydromechanics (specifically pipe hydraulics)

**Literature**


Schrifttum zur Vorlesung (auf Deutsch und Englisch)
4.34 Module: Applied Microbiology (WSEM-PA982) [M-CIWVT-103436]

**Responsible:** Prof. Dr. Thomas Schwartz  
Andreas Tiehm

**Organisation:** KIT Department of Chemical and Process Engineering

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

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

Responsible: Prof. Dr. Olivier Eiff

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

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

Mandatory

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<td>Each winter term</td>
<td>1 term</td>
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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)'
Module: Advanced Computational Fluid Dynamics (WSEM-PB522) [M-BGU-103384]

| Responsible: | Prof. Dr.-Ing. Markus Uhlmann |
| Organisation: | KIT Department of Civil Engineering, Geo and Environmental Sciences |
| Part of: | Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) |
| | Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules) |
| | Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) |
| | Profile Studies / Water Resources Engineering (Compulsory Modules B) |
| Credits | 6 |
| Grading scale | Grade to a tenth |
| Recurrence | Each summer term |
| Duration | 1 term |
| Language | English |
| Level | 4 |
| Version | 2 |

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<tr>
<td>T-BGU-106768</td>
<td>Numerical Fluid Mechanics II</td>
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<td>3 CR</td>
<td>Uhlmann</td>
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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
T.G. Mattson, B.A. Sanders, B.L. Massingill "Patterns for Parallel Programming" Addison-Wesley, 2004.
### 4.37 Module: Fluid Mechanics of Turbulent Flows (WSEM-PB523) [MBGU-105361]

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

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**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 pros and 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)'.

Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)  
Module Handbook as of 17/03/2023  
74
Module: Modeling of Turbulent Flows - RANS and LES (WSEM-PB524) [M-BGU-105362]

**Main Features**

- **Responsible:** Prof. Dr.-Ing. Markus Uhlmann
- **Organisation:** KIT Department of Civil Engineering, Geo and Environmental Sciences
- **Part of:**
  - Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2020)
  - Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules) (Usage from 4/1/2020)
  - Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 4/1/2020)
  - Profile Studies / Water Resources Engineering (Compulsory Modules B) (Usage from 4/1/2020)
- **Credits:** 6
- **Grading scale:** Grade to a tenth
- **Recurrence:** Each winter term
- **Duration:** 1 term
- **Language:** English
- **Level:** 4
- **Version:** 1

**Mandatory**

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**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 pros and 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
- 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 strongly recommended.
4.39 Module: Hydraulic Structures (WSEM-PB631) [M-BGU-103389]

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

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<td>Groundwater Flow around Structures</td>
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<tr>
<td>T-BGU-110404</td>
<td>Interaction Flow - Hydraulic Structures</td>
<td>3 CR</td>
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**Competence Certificate**
- 'Teilleistung' T-BGU-106774 with oral examination according to § 4 Par. 2 No. 2  
- 'Teilleistung' T-BGU-110404 with written examination according to § 4 Par. 2 No. 1

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

**Prerequisites**
none

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

**Content**
In this module, the following topics are discussed in depth:
- potential theory  
- groundwater flow  
- structural adjustment to groundwater flow  
- determination of hydrostatic and hydrodynamic flow forces  
- overview of sealing mechanisms: flood sluices, weirs, gates  
- flow-induced structural vibrations

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

**Annotation**
none

**Workload**
contact hours (1 HpW = 1 h x 15 weeks):
- Groundwater Flow around Structures lecture/exercise: 30 h  
- Interaction Flow - Hydraulic Structures lecture/exercise: 30 h

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

total: 180 h

**Recommendation**
none
Literature
Naudascher; E, 1991, Hydrodynamic Forces, Balkema Pub., Rotterdam
C. Lang, Skript Interaktion Strömung - Wasserbauwerk
M 4.40 Module: River Processes (WSEM-PB634) [M-BGU-105927]

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

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

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

Competence Certificate
- 'Teilleistung' T-BGU-111930 with examination of other type according to § 4 Par. 2 No. 3
details about the learning control see at the 'Teilleistung'

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

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

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

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

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

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

Transfer scientific literature in river debris into practical applications.

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

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

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

- sediment transport (bed and suspended load)
- woody and vegetation debris
- plastic and urban (cars and urban furniture) debris
- bubbles and gas transfer
- contaminant plumes
Module grade calculation
grade of the module is grade of the exam

Annotation
none

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

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

independent study:

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

total: 180 h

Recommendation
basic knowledge in hydromechanics and hydraulic engineering
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:
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Profile Modules) (Usage from 10/1/2022)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Water Resources Engineering (Compulsory Modules B) (Usage from 10/1/2022)

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

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
The module must not be selected together with the module Experimental Hydraulics and Measuring Techniques (WSEM-PB641) not offered anymore.

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

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

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

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

Annotation
none

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

- Flow Measurement Techniques lecture/exercise: 30 h
- Experimental Hydraulics 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
4.42 Module: Numerical Flow Modeling in Hydraulic Engineering (WSEM-PB651)
[M-BGU-103390]

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

**Mandatory**

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**Competence Certificate**

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

Details about the learning control see at the 'Teilleistung'

**Prerequisites**

none

**Competence Goal**

see German version

**Content**

see German version

**Module grade calculation**

Grade of the module is grade of the exam

**Annotation**

none

**Workload**

Contact hours (1 HpW = 1 h x 15 weeks):

- lecture, exercise: 60 h

Independent study:

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

Total: 180 h

**Recommendation**

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

**Literature**

lecture notes
4.43 Module: Hydro Power Engineering (WSEM-PB653) [M-BGU-100103]

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

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

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

Competence Certificate
- 'Teilleistung' T-BGU-100139 with oral examination according to § 4 Par. 2 No. 2
details about the learning control see at the 'Teilleistung'

Prerequisites
none

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

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

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

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
  • lecture, exercise: 60 h
independent study:
  • preparation and follow-up lectures, exercises: 60 h
  • examination preparation: 60 h
total: 180 h

Recommendation
course Hydraulic Engineering and Water Management (6200511)

Literature
Folienumdrucke;
Module: Waterway Engineering (WSEM-PB655) [M-BGU-103392]

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

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

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

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

Mandatory

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

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

Prerequisites
none

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

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

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

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
- lecture/exercise: 60 h

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

total: 180 h

Recommendation
course Hydraulic Engineering and Water Management (6200511)
4.45 Module: Project Studies in Water Resources Management (WSEM-PB661) [M-BGU-103394]

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

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**Mandatory**


**Competence Certificate**
- 'Teilleistung' T-BGU-106783 with examination of other type according to § 4 Par. 2 No. 3
- details about the learning control see at the 'Teilleistung'

**Prerequisites**
none

**Competence Goal**
see German version

**Content**
see German version

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

**Annotation**
none

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

- lecture, exercise: 30 h

independent study:

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

total: 180 h

**Recommendation**
module 'River Processes (PB634)'
Module: River Basin Modeling (WSEM-PC341) [M-BGU-103373]

**Responsible:** PD Dr.-Ing. Stephan Fuchs

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

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

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 2 terms

**Language:** English

**Level:** 4

**Version:** 2

**Mandatory**

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<td>Mass Fluxes in River Basins</td>
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</table>

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

details about the learning control see at the 'Teilleistung'

**Prerequisites**
none

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

**Content**
This module provides students with a broad-based understanding of the fundamentals of materials flows (N, P, pollutants) and their relevant transport pathways in river basins. Different modeling approaches for a quantitative description of the processes will be presented. Students receive a single-user version of the simulation tool MoRE (Modeling of 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 (examination prerequisite): 30 h
- project work on River Basin Modeling (examination): 60 h

total: 180 h

**Recommendation**
momules 'Urban Water Infrastructure and Management (AF301)', 'Freshwater Ecology (CC371)'
Literature
4.47 Module: Groundwater Management (WSEM-PC561) [M-BGU-100340]

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

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<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>6</td>
<td>Grade to a tenth</td>
<td>Each summer term</td>
<td>2 terms</td>
<td>English</td>
<td>4</td>
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</table>

Mandatory

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

Competence Certificate

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

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

Prerequisites

none

Competence Goal

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

Content

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

Module grade calculation

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

Annotation

none

Workload

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

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

independent study:

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

total: 185 h

Recommendation

basic knowledge in fluid mechanics, hydrology, solute transport and numerical methods
Literature
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:**  
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2021)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2021)  
- Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 4/1/2021)  
- Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 4/1/2021)

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

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**Mandatory**

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<td>T-BGU-111275</td>
<td>Integrated Design Project in Water Resources Management</td>
<td>6 CR</td>
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**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)
4.49 Module: Subsurface Flow and Contaminant Transport (WSEM-PC725) [M-BGU-103872]

**Responsible:** Prof. Dr.-Ing. Erwin Zehe

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

**Part of:**
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 4/1/2019)
- Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 4/1/2019)

**Credits**
- 6 CR

**Grading scale**
- Grade to a tenth

**Recurrence**
- Each summer term

**Duration**
- 1 term

**Language**
- English

**Level**
- 4

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

**Responsible:** Dr. Jan Wienhöfer

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

**Part of:**
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 4/1/2019)
- Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 4/1/2019)
- Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 4/1/2019)

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 1 term

**Language:** English

**Level:** 4

**Version:** 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 Geocology.

**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
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:
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 10/1/2022)
- Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 10/1/2022)

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<td>Each summer term</td>
<td>1 term</td>
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Mandatory

T-BGU-112171 Deep Learning in Hydrological Modeling

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
Module will be offered newly as from summer term 2023.
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)
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:
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Profile Modules)
- Profile Studies / Water Resources Engineering (Compulsory Modules C)

### Credits
6

### Grading scale
Grade to a tenth

### Recurrence
Each summer term

### Duration
1 term

### Language
English

### Level
4

### Version
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 environment

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

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

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

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

**Details about the learning control see at the 'Teilleistung'**

**Prerequisites**  
none

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

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

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

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

independent study:

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

total: 170 h

**Recommendation**  
module 'Hydrogeology (AF801)'

Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)  
Module Handbook as of 17/03/2023
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:**
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2022)
- Profile Studies / Environmental System Dynamics & Management (Profile Modules) (Usage from 10/1/2022)
- Profile Studies / Water Resources Engineering (Compulsory Modules C) (Usage from 10/1/2022)

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 2 terms

**Language:** German

**Level:** 4

**Version:** 2

**Mandatory**

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<td>4 CR</td>
<td>Goldscheider</td>
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<tr>
<td>T-BGU-110413</td>
<td>Field Trip Karst Hydrogeology</td>
<td>2 CR</td>
<td>Goldscheider</td>
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**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 field exercise (not graded accomplishment): 30 h
• examination preparation: 30 h

total: 180 h

Recommendation

none
Module: Sustainable Management of rivers and Floodplains (WSEM-PC986) [M-BGU-103391]

**Responsible:** Prof. Dr. Florian Wittmann

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

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

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<td>Each term</td>
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**Mandatory**

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<td>T-BGU-112845</td>
<td>Wetlands</td>
<td>3 CR</td>
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**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'
Module: Module Master's Thesis (WSE-MSC-THESIS) [M-BGU-104995]

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 (Usage from 7/1/2019)

Mandatory

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</table>

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

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

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

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

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

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

Workload

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

total: 900 h

Recommendation
All technical skills and soft skills required for working on the selected topic and the preparation of the thesis should be attained.
Module: Thermal Use of Groundwater (WSEM-SM879) [M-BGU-103408]

### Responsible
Prof. Dr. Philipp Blum

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

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

### Credits
4

### Grading scale
Grade to a tenth

### Recurrence
Each winter term

### Duration
1 term

### Language
English

### Level
4

### Version
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

Other documents such as recent publications are made available on ILIAS

Water Science and Engineering (Master of Science (M.Sc.), ER/SPO 2016)
Module Handbook as of 17/03/2023
4.58 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:**  
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)  
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)  
- Profile Studies / Water Resources Engineering (Supplementary Modules)

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<td>T-BGU-106792</td>
<td>Earthwork and Embankment Dams</td>
<td>6 CR</td>
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**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
4.59 Module: Environmental Geotechnics (WSEM-SM962) [M-BGU-100079]

**Responsible:** Dr.-Ing. Andreas Bieberstein

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

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

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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>T-BGU-100084</td>
<td>Landfills</td>
<td>3 CR</td>
<td>Bieberstein</td>
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<tr>
<td>T-BGU-100089</td>
<td>Brownfield Sites - Investigation, Evaluation, Rehabilitation</td>
<td>3 CR</td>
<td>Bieberstein</td>
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</tbody>
</table>

**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 brownfields. 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 discussed. 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
DGGE, 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
4.60 Module: General Meteorology (WSEM-SM971) [M-PHYS-103732]

Responsible: apl. Prof. Dr. Michael Kunz
Organisation: KIT Department of Physics
Part of:
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules)
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules)
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules)
- Profile Studies / Water Resources Engineering (Supplementary Modules)

Credits 6
Grading scale pass/fail
Recurrence Each winter term
Duration 1 term
Language German
Level 4
Version 1

Mandatory
T-PHYS-101091 General Meteorology 6 CR Kunz

Competence Certificate
- 'Teilleistung' T-PHYS-101091 with not graded accomplishment according to § 4 Par. 3
details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students will be able to describe basic phenomena of meteorology using adequate terminology and explain them with the help of the underlying physical processes.

Content
This lecture is designed to introduce students to the fundamental aspects of meteorology. In addition to the fundamental physical laws of the atmosphere (radiation, thermodynamics, energetics), the composition of air, basic meteorological variables, air motions, and phase transitions of water will be covered:

1) Introduction and Overview: Atmosphere, weather and climate
2) Composition of air
3) Important meteorological variables and state variables.
4) Weather elements, weather observations, and introduction to synoptic meteorology.
5) Structure of the atmosphere and basic laws
6) Radiation
7) Thermodynamic fundamentals: state variables and vertical motions
8) Condensation processes and precipitation formation
9) Dynamical fundamentals: motions and simplified balances

Module grade calculation
not graded

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

- lecture, exercise: 75 h

independent study:

- preparation and follow-up lectures, exercises: 55 h
- preparation of the exercise to present: 20 h
- test preparation: 30 h

total: 180 h

Recommendation
none
### Module: Applied Meteorology: Turbulent Diffusion (WSEM-SM974) [M-PHYS-105776]

**Responsible:** Prof. Dr. Corinna Hoose  
Dr. Gholamali Hoshyaripour  

**Organisation:** KIT Department of Physics  

**Part of:**  
- Profile Studies / Water Technologies & Urban Water Cycle (Supplementary Modules) (Usage from 10/1/2021)  
- Profile Studies / Fluid Mechanics & Hydraulic Engineering (Supplementary Modules) (Usage from 10/1/2021)  
- Profile Studies / Environmental System Dynamics & Management (Supplementary Modules) (Usage from 10/1/2021)  
- Profile Studies / Water Resources Engineering (Supplementary Modules) (Usage from 10/1/2021)

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<td>Examination on Turbulent Diffusion</td>
<td>3 CR</td>
<td>Hoose, Hoshyaripour</td>
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<tr>
<td>T-PHYS-111427</td>
<td>Turbulent Diffusion</td>
<td>3 CR</td>
<td>Hoose, Hoshyaripour</td>
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</table>

#### 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)'
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

<table>
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<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<th>Language</th>
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<td>German/English</td>
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**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.
4.63 Module: Supplementary Studies on Culture and Society [M-ZAK-106235]

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**  
Part of: Additional Examinations (Usage from 4/1/2023)

- Credits: 22  
- Grading scale: Grade to a tenth  
- Recurrence: Each term  
- Duration: 3 terms  
- Language: German  
- Level: 4  
- Version: 1

**Election notes**

With the exception of the final oral exam and the practice module, students have to self-record the achievements obtained in the Supplementary Studies on Culture and Society in their study plan. 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 ZAK homepage at https://www.zak.kit.edu/begleitstudium-bak.php. The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements both for your interdisciplinary qualifications and for the supplementary studies, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the in-depth module, achievements have to be obtained in three different areas. The areas are as follows:

- Technology & Responsibility
- Doing Culture
- Media & Aesthetics
- Spheres of Life
- Global Cultures

You have to obtain two achievements with 3 credits each and one achievement with 5 credits. To self-record achievements in the in-depth module, you first have to elect the matching partial achievement.

**Note:** If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §20 (2) of the regulations for the Supplementary Studies on Culture and Society. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

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<td>T-ZAK-112653</td>
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<td>T-ZAK-112656</td>
<td>In-depth Module - Media &amp; Aesthetics - Self Assignment BAK</td>
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<td>T-ZAK-112657</td>
<td>In-depth Module - Spheres of Life - Self Assignment BAK</td>
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<td>T-ZAK-112658</td>
<td>In-depth Module - Global Cultures - Self Assignment BAK</td>
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<td>Practice Module</td>
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<td>T-ZAK-112659</td>
<td>Oral Exam - Supplementary Studies on Culture and Society</td>
<td>4 CR</td>
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**Competence Certificate**

The monitoring is explained in the respective partial achievement.

They are composed of:

- minutes
- presentations
- a seminar paper
- an internship report
- an oral examination

After successful completion of the supplementary studies, the graduates receive a graded certificate and a KIT certificate.
**Prerequisites**
The offer is study-accompanying and does not have to be completed within a defined period of time. Enrolment or acceptance for graduation must be present when registering for the final examination.

KIT students register for the supplementary studies by selecting this module in the student portal and self-checking a performance. In addition, registration for the individual courses is necessary, which is possible shortly before the beginning of each semester.

The course catalogue, statutes (study regulations), registration form for the oral exam, and guides for preparing the various written performance requirements can be found as downloads on the ZAK homepage at www.zak.kit.edu/begleitstudium-bak.

**Competence Goal**
Graduates of the Supplementary Studies on Culture and Society demonstrate a sound basic knowledge of conditions, procedures and concepts for analysing and shaping fundamental social development tasks in connection with cultural topics. They have gained a well-founded theoretical and practical insight into various cultural studies and interdisciplinary topics in the field of tension between culture, technology and society in the sense of an expanded concept of culture.

They are able to place the contents selected from the specialization module in the basic context as well as to analyse and evaluate the contents of the selected courses independently and exemplarily and to communicate about them scientifically in written and oral form. Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective.

**Content**
The Supplementary Studies on Culture and Society can be started from the 1st semester and is not limited in time. It comprises at least 3 semesters. The supplementary studies are divided into 3 modules (basics, in-depth studies, practice). A total of 22 credit points (ECTS) are earned.

The thematic elective areas of the supplementary studies are divided into the following 5 modules and their sub-topics:

**Block 1 Technology & Responsibility**
Value change / ethics of responsibility, technology development / history of technology, general ecology, sustainability

**Block 2 Doing Culture**
Cultural studies, cultural management, creative industries, cultural institutions, cultural policy

**Block 3 Media & Aesthetics**
Media communication, cultural aesthetics

**Block 4 Spheres of Life**
Cultural sociology, cultural heritage, architecture and urban planning, industrial science

**Block 5 Global Cultures**
Multiculturalism / interculturalism / transculturalism, science and culture

**Module grade calculation**
The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

**In-depth Module**
- presentation 1 (3 ECTS)
- presentation 2 (3 ECTS)
- seminar paper incl. presentation (5 ECTS)
- oral examination (4 ECTS)

**Annotation**
With the Supplementary Studies on Culture and Society, KIT provides a multidisciplinary study offer as an additional qualification, with which the respective specialized study program is supplemented by interdisciplinary basic knowledge and interdisciplinary orientation knowledge in the field of cultural studies, which is becoming increasingly important for all professions.

Within the framework of the supplementary studies, students acquire in-depth knowledge of various cultural studies and interdisciplinary subject areas in the field of tension between culture, technology and society. In addition to high culture in the classical sense, other cultural practices, common values and norms as well as historical perspectives of cultural developments and influences are considered.

In the courses, conditions, procedures and concepts for the analysis and design of fundamental social development tasks are acquired on the basis of an expanded concept of culture. This includes everything created by humans - also opinions, ideas, religious or other beliefs. The aim is to develop a modern concept of cultural diversity. This includes the cultural dimension of education, science and communication as well as the preservation of cultural heritage. (UNESCO, 1982)

According to § 16 of the statutes, a reference and a certificate are issued by the ZAK for the supplementary studies. The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).
Workload
The workload is made up of the recommended number of hours for the individual modules:

- basic module approx. 90 h
- in-depth module approx. 340 h
- practical module approx. 120 h

total: approx. 550 h

Learning type

- lectures
- seminars
- workshops
- practical course

Literature
Recommended reading of primary and specialized literature will be determined individually by each instructor.
4.64 Module: Supplementary Studies on Sustainable Development [M-ZAK-106099]

**Responsibility:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: Additional Examinations (Usage from 4/1/2023)

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<th>Language</th>
<th>Level</th>
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**Election notes**

With the exception of the final oral exam, students have to self-record the achievements obtained in the Supplementary Studies on Sustainable Development in their study plan. 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 ZAK homepage at https://www.zak.kit.edu/begleitstudium-bene. The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements both for your interdisciplinary qualifications and for the supplementary studies, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the elective module, you need to obtain 6 credits worth of achievements in two of the four areas:

- Sustainable Cities & Neighbourhoods
- Sustainable Assessment of Technology
- Subject, Body, Individual: The Other Side of Sustainability
- Sustainability in Culture, Economy & Society

Usually, two achievements with 3 credits each have to be obtained. To self-record achievements in the elective module, you first have to elect the matching partial achievement.

**Note:** If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §19 (2) of the regulations for the Supplementary Studies on Sustainable Development. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

**Mandatory**

| T-ZAK-112345 | Basics Module - Self Assignment BeNe | 3 CR | Myglas |

**Elective Module (Election: at least 6 credits)**

| T-ZAK-112347 | Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe | 3 CR |
| T-ZAK-112348 | Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe | 3 CR |
| T-ZAK-112349 | Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe | 3 CR |
| T-ZAK-112350 | Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe | 3 CR |

**Mandatory**

| T-ZAK-112346 | Specialisation Module - Self Assignment BeNe | 6 CR | Myglas |
| T-ZAK-112351 | Oral Exam - Supplementary Studies on Sustainable Development | 4 CR |

**Competence Certificate**

The monitoring is explained in the respective partial achievement.

They are composed of:

- protocols
- a reflection report
- presentations
- presentations
- the elaboration of a project work
- an individual term paper

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by ZAK.
Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period of time. Enrolment is required for all performance assessments of the modules of 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 self-booking a performance. Registration for courses, performance assessments and examinations is regulated by § 6 of the Statutes and is usually possible shortly before the beginning of the semester.

The course catalogue, statutes (study regulations), registration form for the oral exam and guidelines for preparing the various written performance requirements can be found as downloads on the ZAK homepage at http://www.zak.kit.edu/begleitstudium-bene.

Competence Goal
Graduates of the supplementary studies in sustainable development acquire additional practical and professional competencies. Thus, the supplementary study program enables the acquisition of basics and initial experience in project management, trains teamwork skills, presentation skills and self-reflection, and also creates a fundamental understanding of sustainability that is relevant for all professional fields.

Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective. They are able to place the contents selected from the modules “Elective” and “Advanced” in the basic context as well as to independently and exemplarily analyse and evaluate the contents of the selected courses and to scientifically communicate about them in written and oral form.

Content
The supplementary study program Sustainable Development can be started from the 1st semester and is not limited in time. The wide range of courses offered by ZAK makes it possible to complete the program usually within three semesters. The supplementary studies comprise 19 credit points (LP). It consists of three modules: Basic Module, Elective Module and Advanced Module.

The thematic elective areas of the supplementary studies are divided into the following 4 modules and their subtopics in Module 2 (elective module):

Block 1: Sustainable Cities and Neighbourhoods
The courses provide an overview of the interaction of social, ecological, and economic dynamics in the microcosm of the city.

Block 2: Sustainability Assessment of Technology
Mostly based on ongoing research activities, methods and approaches of technology assessment are elaborated.

Block 3: Subject, Body, Individual: The other Side of Sustainability
Different approaches are presented to the individual perception, experience, shaping and responsibility of relationships to the environment and to oneself.

Block 4: Sustainability in Culture, Economy & Society
Courses usually have an interdisciplinary approach, but may also focus on one of the areas of culture, economics or society, both in application and in theory.

The core of the supplementary studies is a case study in the specialization area. In this project seminar, students conduct sustainability research with practical relevance themselves. The case study is supplemented by an oral examination with two topics from module 2 (elective module) and module 3 (in-depth module).

Module grade calculation
The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

Elective module
- Presentation 1 (3 ECTS)
- Presentation 2 (3 ECTS)

Advanced module
- individual term paper (6 ECTS)
- oral examination (4 ECTS)
**Annotation**
The Supplementary Studies on Sustainable Development at KIT is based on the conviction that a long-term socially and ecologically compatible coexistence in the global world is only possible if knowledge about necessary changes in science, economy and society is acquired and applied.

The interdisciplinary and transdisciplinary Studies on Sustainable Development enables diverse access to transformation knowledge as well as basic principles and application areas of sustainable development. According to the statutes § 16, a certificate is issued by the ZAK for the complementary studies.

The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).

In the specialised studies, modules and partial achievements can be recognised within the framework of the additional achievements or e.g. the interdisciplinary qualifications. This must be regulated via the respective subject study programme.

The focus is on experience- and application-oriented knowledge and competences, but theories and methods are also learned.

The aim is to be able to represent one's own actions as a student, researcher and later decision-maker as well as an individual and part of society under the aspect of sustainability.

Sustainability is understood as a guiding principle to which economic, scientific, social and individual actions should be oriented. According to this, the long-term and socially just use of natural resources and the material environment for a positive development of global society can only be addressed by means of integrative concepts. Therefore, "education for sustainable development" in the sense of the United Nations programme plays just as central a role as the goal of promoting "cultures of sustainability". For this purpose, practice-centred and research-based learning of sustainability is made possible and the broad concept of culture established at ZAK is used, which understands culture as habitual behaviour, lifestyle and changing context for social actions.

The supplementary study programme conveys the basics of project management, trains teamwork skills, presentation skills and self-reflection. Complementary to the specialised studies at KIT, it creates a fundamental understanding of sustainability, which is important for all professional fields. Integrative concepts and methods are essential: in order to use natural resources in the long term and to shape the global future in a socially just way, not only different disciplines, but also citizens, practitioners and institutions must work together.

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

- Basic module approx. 180 h
- Elective module approx. 150 h
- Consolidation module approx. 180 h

Total: approx. 510 h

**Learning type**
- lectures
- seminars
- workshops

**Literature**
Recommended reading of primary and specialist literature is determined individually by the respective lecturer.
5 Courses

5.1 Course: Advanced Fluid Mechanics [T-BGU-106612]

Responsible: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103359 - Advanced Fluid Mechanics

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<th>Version</th>
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<td>Each term</td>
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Events

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<th>Advanced Fluid Mechanics</th>
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<th>Lecture / Practice ( /</th>
<th>Eiff</th>
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Legend: 🖥 Online, 🦄 Blended (On-Site/Online), 🗯 On-Site, ✗ Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none
5.2 Course: Applied Ecology and Water Quality [T-BGU-109956]

**Responsible:** PD Dr.-Ing. Stephan Fuchs  
Dr.-Ing. Stephan Hilgert

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

**Part of:** M-BGU-104922 - Freshwater Ecology

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**Events**

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<th>Applied Ecology and Water Quality</th>
<th>2 SWS</th>
<th>Seminar / 🗣</th>
<th>Hilgert, Fuchs</th>
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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 Geocology 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.
5.3 Course: Basics Module - Self Assignment BAK [T-ZAK-112653]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
- Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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</table>

**Competence Certificate**
The monitoring in this module includes a course credit according to § 5 section 4 in the form of minutes of which two are to be handed in freely chosen topics of the lecture series "Introduction to Applied Studies on Culture and Society". Length: approx. 6,000 characters each (incl. spaces).

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**

**Annotation**
The Basic Module consists of the lecture “Introduction to Supplementary Studies on Culture and Society”, which is offered only in the winter semester. It is therefore recommended that students start their studies in the winter semester and complete them before module 2.
5.4 Course: Basics Module - Self Assignment BeNe [T-ZAK-112345]

Responsible: Christine Myglas
Organisation: Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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Competence Certificate
The monitoring in this module includes a course credit according to § 5 section 4:
Introduction to Sustainable Development in the form of minutes of which two are to be handed in freely chosen topics of the lecture series "Introduction to Sustainable Development". Length: approx. 6,000 characters each (incl. spaces).
or
Sustainability Spring Days at KIT in the form of a reflection report on all components of the project days "Sustainability Spring Days at KIT". Length approx. 12,000 characters (incl. spaces).

Prerequisites
None

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

Annotation
Module Basics consists of the lecture "Introduction to Sustainable Development", which is only offered in the summer semester or alternatively of the project days "Sustainability Spring Days at KIT", which is only offered in the winter semester. It is recommended to complete the course before Elective Module an Specialisation Module.

In exceptional cases, Elective Module or Specialisation Module can also be completed simultaneously with Basics Module. However, the prior completion of the advanced modules Elective and Specialisation should be avoided.
5.5 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

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**Events**

| ST 2023 | 22617 | Biofilm Systems     | 2 SWS | Lecture / 🗣 | Hille-Reichel, Wagner |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**
oral exam, appr. 20 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
### 5.6 Course: Booklet Integrated Infrastructure Planning [T-BGU-106763]

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<th>Recurrence</th>
<th>Each winter term</th>
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**Events**

| WT 22/23              | 6224910               | Infrastructure Planning – Socio-economic & Ecological Aspects | Lecture / Practice | Kämpf, Walz |

**Competence Certificate**

booklet; DIN A5, appr. 15 pages

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
## 5.7 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

<table>
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### Events

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<td>Brownfield Sites - Investigation, Evaluation, Rehabilitation</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Bieberstein, Eiche, Würdemann, Mohrlok</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

**Competence Certificate**  
oral exam, appr. 20 min.

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.8 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

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<td>Each summer term</td>
<td>1 terms</td>
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**Competence Certificate**
scientific presentation appr. 15 min., report appr. 10 pages

**Prerequisites**
none

**Recommendation**
none

**Annotation**
course will not be offered until summer term 2023
5.9 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

<table>
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<td>Each summer term</td>
<td>1 terms</td>
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**Events**

| ST 2023 | 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
### 5.10 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

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<th>Each summer term</th>
<th>Expansion</th>
<th>1 terms</th>
<th>Version</th>
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| Events | ST 2023 | 6222701 | River Engineering | 2 SWS | Lecture / Practice ( / Rodrigues Pereira da Franca |

**Competence Certificate**  
1 design exercise, report about 10 pages

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.11 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

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**Events**

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<td>Lecture / Practice ( / )</td>
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<td>Embankment Dams (Advanced)</td>
<td>Lecture / Practice ( / )</td>
<td>2 SWS</td>
<td>Bieberstein</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
oral exam, appr. 40 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
Course: Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe [T-ZAK-112349]

5.12 Course: Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe [T-ZAK-112349]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

<table>
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Competence Certificate
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
The content of the Basics Module is helpful.
5.13 Course: Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe [T-ZAK-112348]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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<td>Grade to a third</td>
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**Competence Certificate**
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
The content of the Basics Module is helpful.
## 5.14 Course: Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe [T-ZAK-112350]

**Organisation:**
- **Part of:** M-ZAK-106099 - Supplementary Studies on Sustainable Development

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**Competence Certificate**
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

**Prerequisites**
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
The content of the Basics Module is helpful.
### 5.15 Course: Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe [T-ZAK-112347]

**Organisation:** University

**Part of:** M-ZAK-106099 - Supplementary Studies on Sustainable Development

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<td>Examination of another type</td>
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**Competence Certificate**
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

**Prerequisites**
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
The content of the Basics Module is helpful.
5.16 Course: Environmental Biotechnology [T-CIWVT-106835]

**Responsible:** Andreas Tiehm

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-CIWVT-103436 - Applied Microbiology

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<td>Each winter term</td>
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**Events**

| WT 22/23 | 22614 | Environmental Biotechnology | 2 SWS | Lecture / Tiehm |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☒ Cancelled

**Competence Certificate**

oral exam, ca. 30 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.17 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

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<td>Seminar / 🗣️</td>
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</table>

**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
5.18 Course: Environmental Fluid Mechanics [T-BGU-106767]

<table>
<thead>
<tr>
<th>Responsible</th>
<th>Prof. Dr. Olivier Eiff</th>
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<tr>
<td>Organisation</td>
<td>KIT Department of Civil Engineering, Geo and Environmental Sciences</td>
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<td>Part of</td>
<td>M-BGU-103383 - Environmental Fluid Mechanics</td>
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Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

Competence Certificate
written exam, 90 min.

Prerequisites
none

Recommendation
none

Annotation
none
5.19 Course: Examination on Turbulent Diffusion [T-PHYS-109981]

Responsible: Dr. Gholamali Hoshayripour
apl. Prof. Dr. Michael Kunz

Organisation: KIT Department of Physics

Part of: M-PHYS-105776 - Applied Meteorology: Turbulent Diffusion

Type: Oral examination
Credits: 3
Grading scale: Grade to a third
Recurrence: Each summer term
Version: 3

Events

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<tr>
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<td>Exercises to Turbulent Diffusion 1 SWS Practice / 🗣 Hoshayripour, Hoose, Chopra</td>
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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
5.20 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

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**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**
one

**Recommendation**
one

**Annotation**
one
5.21 Course: Excursions: Membrane Technologies [T-CIWVT-110864]

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-CIWVT-105380 - Membrane Technologies in Water Treatment

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<th>Practice</th>
<th>Horn, Saravia, und Mitarbeiter</th>
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</table>

**Competence Certificate**

attendance at two excursions, delivery of excursion reports

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.22 Course: Excursions: Water Supply [T-CIWVT-110866]

**Responsible:** Dr. Gudrun Abbt-Braun
Prof. Dr. Harald Horn

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-CIWVT-103440 - Practical Course in Water Technology

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**Competence Certificate**
attendance at two excursions, delivery of excursion reports

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
### 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

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**Competence Certificate**
term paper, appr. 10 pages

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
5.24 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

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**Events**

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<td>Lecture / Practice /</td>
<td>Eiff, Mitarbeiter/innen</td>
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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
5.25 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

<table>
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Legend: 🖥 Online, 🥏 Blended (On-Site/Online), 🗣 On-Site, ✗ Canceled

**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 Geocology 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.
### 5.26 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

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗿 Cancelled

**Annotation**
The practical part of this course is carried out in presence. The field courses are essential for the progress of the participants.
5.27 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

<table>
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<td>Each term</td>
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**Events**

| WT 22/23 | 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
## 5.28 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

<table>
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<td>Lecture / Practice</td>
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**Legend:** 📱 Online, 🧩 Blended (On-Site/Online), 🗼 On-Site, ✗ Cancelled

**Competence Certificate**  
oral exam, appr. 45 min.

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.29 Course: Fundamental Numerical Algorithms for Engineers [T-BGU-109953]

**Responsible:** Prof. Dr.-Ing. Markus Uhlmann

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

**Part of:** M-BGU-104920 - Fundamental Numerical Algorithms for Engineers

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**Prerequisites**

none

**Recommendation**

none

**Annotation**

none

**Competence Certificate**

written exam, 60 min.
### 5.30 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

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**Events**

| ST 2023 | 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
### Course: Fundamentals of Water Quality [T-CIWVT-106838]

**Responsible:** Dr. Gudrun Abbt-Braun  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103438 - Fundamentals of Water Quality

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**Legend:** 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
written exam, 90 min.

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.32 Course: General Meteorology [T-PHYS-101091]

Responsible: apl. Prof. Dr. Michael Kunz
Organisation: KIT Department of Physics
Part of: M-PHYS-103732 - General Meteorology

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Legend: 🌐 Online, 🌐 Blended (On-Line/Online), 🗣 On-Site, 🗑 Cancelled

Competence Certificate
presenting one exercise and test (not graded)

Prerequisites
none

Recommendation
none

Annotation
none
5.33 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:** Oral examination
- **Credits:** 1
- **Grading scale:** Grade to a third
- **Recurrence:** Each summer term
- **Version:** 2

**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
### 5.34 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

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**Competence Certificate**  
working on exercises

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.35 Course: Geostatistics [T-BGU-106605]

Responsible: Prof. Dr.-Ing. Erwin Zehe
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103762 - Analysis of Spatial Data

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<td>Each term</td>
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Events

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Legend: 🖥 Online, 🟢 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none
5 COURSES

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

5.36 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 |

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none
### 5.37 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

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<td>Lecture / Practice ( /</td>
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**Competence Certificate**
oral exam, appr. 20 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
5.38 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

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<th>Type</th>
<th>Credits</th>
<th>Grade</th>
<th>Lecture / Practice</th>
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Legend: Online, Blended (On-Site/Online), On-Site, X Cancelled

Competence Certificate
course associated assignments, short reports appr. 1 page each

Prerequisites
none

Recommendation
none

Annotation
none
### 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
Written examination

#### Credits
4

#### Grading scale
Grade to a third

#### Recurrence
Each term

#### Version
2

### Events

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<td>Design of Hydraulic Structures</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

### Competence Certificate
written exam, 75 min.

### Prerequisites
The not graded accomplishments 'Design Exercise River Engineering', T-BGU-111928, and 'Design Exercise Hydraulic Structures', T-BGU-111929, have to be passed.

### Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-111928 - Design Exercise River Engineering must have been passed.
2. The course T-BGU-111929 - Design Exercise Hydraulic Structures must have been passed.

### Recommendation
none

### Annotation
none
T 5.40 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

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Competence Certificate
oral exam, appr. 20 min.

Prerequisites
none

Recommendation
none

Annotation
none

Type
Oral examination

Credits
6

Grading scale
Grade to a third

Recurrence
Each term

Version
1
### 5.41 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

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**Events**

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<th>Lecturer</th>
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<tr>
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<td>Field Methods in Hydrogeology</td>
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<td>Lecture / Practice ( / 🧬)</td>
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<td>General &amp; Applied Hydrogeology</td>
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Legend: 🖥 Online, 🧬 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled

**Competence Certificate**

written exam, 90 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.42 Course: Hydrogeology: Field and Laboratory Methods [T-BGU-104834]

Responsible: Dr. rer. nat. Nadine Göppert
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-102441 - Hydrogeology: Field and Laboratory Methods

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Events

| ST 2023 | 6310412 | Field and Laboratory Exercises | 2 SWS | Practice / 🗣 | Göppert |
| ST 2023 | 6310414 | Preparatory Workshop            | 1 SWS | Seminar / 🗣  | Göppert |

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

Competence Certificate
presentation within the "Preparatory Seminar" and
term paper on the results of the "Field and Laboratory Exercises"

Prerequisites
none

Recommendation
none

Annotation
none
5.43 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

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**Events**

| ST2023   | 6224807   | Hydrological Measurements in Environmental Systems | 4 SWS / | Wienhöfer, Mitarbeiter/innen |

**Competition 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.
5.44 Course: In-depth Module - Doing Culture - Self Assignment BAK [T-ZAK-112655]

Responsibilities: Dr. Christine Mielke
Christine Myglas

Organisation:
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

<table>
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Competence Certificate
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation
The content of the Basic Module is helpful.
5.45 Course: In-depth Module - Global Cultures - Self Assignment BAK [T-ZAK-112658]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**
The content of the Basic Module is helpful.
5.46 Course: In-depth Module - Media & Aesthetics - Self Assignment BAK [T-ZAK-112656]

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**  
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**  
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT). In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken. The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**  
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**  
The content of the Basic Modul is helpful.
5.47 Course: In-depth Module - Spheres of Life - Self Assignment BAK [T-ZAK-112657]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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Competence Certificate
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation
The content of the Basic Modul is helpful.
5.48 Course: In-depth Module - Technology & Responsibility - Self Assignment
BAK [T-ZAK-112654]

Responsible:  Dr. Christine Mielke
            Christine Myglas

Organisation:
  Part of:    M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary stdues**
This course can be used for self service assignment of grade aquired from the following study providers:
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**
The content of the Basic Modul is helpful.
5.49 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

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**Events**

| ST 2023 | 22619 | Industrial Wastewater Treatment | 2 SWS | Lecture / 🗣 Horn |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⌚ Cancelled

**Competence Certificate**
oral exam appr. 20 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
5.50 Course: Instrumental Analytics [T-CIWVT-106837]

**Responsible:** apl. Prof. Dr. Gisela Guthausen

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-CIWVT-103437 - Instrumental Analysis

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 2

### Events

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**
oral exam, 30 min.

**Prerequisites**
The accomplishment 'Organic Trace Analysis of Aqueous Samples' (T-CIWVT-106836) has to be passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-CIWVT-106836 - Organic Trace Analysis of Aqueous Samples must have been passed.

**Recommendation**
none

**Annotation**
none
5.51 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

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<th>Recurrence</th>
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<td>Each term</td>
<td>1 terms</td>
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**Events**

| ST 2023 | 6224801 | Integrated Design Project in Water Resources Management | 4 SWS | Lecture / Practice ( / ) | Ehret, Seidel |

**Competence Certificate**
project work, report approx. 15 pages with presentation approx. 15 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
5.52 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

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<td>Grade to a third</td>
<td>Each winter term</td>
<td>1</td>
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Events

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<th>Type</th>
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<td>Infrastructure Planning – Socio-economic &amp; Ecological Aspects</td>
<td>Lecture / Practice</td>
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</table>

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
## 5.53 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

<table>
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<td>Each term</td>
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### Events

| WT 22/23 | 6221903 | Interaction Flow - Hydraulic Structures | 2 SWS | Lecture / Practice | Gebhardt |

**Competence Certificate**

written exam, 60 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.54 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

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<td>4 SWS Lecture / Practice ( /</td>
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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 passed.

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
**5.55 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences [T-BGU-101681]**

**Responsible:** Dr.-Ing. Norbert Rösch  
Dr.-Ing. Sven Wursthorn  

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

**Part of:** M-BGU-101846 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences  

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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
written exam, 90 min.

**Prerequisites**
online test 'Introduction to GIS for Students of Natural, Engineering and Geo Sciences' (T-BGU-103541) has to be passed

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-BGU-103541 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite must have been passed.

**Recommendation**
none

**Annotation**
none
## 5.56 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite [T-BGU-103541]

**Responsible:** Dr.-Ing. Norbert Rösch  
Dr.-Ing. Sven Wursthorn

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

**Part of:** M-BGU-101846 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences

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**Events**

| WT 22/23 | 6071101 | Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen, V/Ü | 4 SWS | Lecture / Practice ( / Wursthorn |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

online test

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
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

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<th>Lecture / Practice ( /</th>
<th>Ehret, Wienhöfer</th>
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**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.
5 COURSES

Course: Introduction to Python [T-BGU-112598]

5.58 Course: Introduction to Python [T-BGU-112598]

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

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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
none
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

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**Events**

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**Competence Certificate**

written exam, 60 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.60 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

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**Events**

| WT 22/23 | 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
5.61 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

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<td>Each summer term</td>
<td>1 terms</td>
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Events

| ST 2023 | 6223812 | Mass Fluxes in River Basins | 2 SWS | Lecture / Online | 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
5.62 Course: Master's Thesis [T-BGU-110134]

**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-104995 - Module Master's Thesis

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<td>Each term</td>
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**Competence Certificate**
- duration appr. 6 months
- presentation within one month after submission of the thesis

**Prerequisites**
- defined for the module Master Thesis

**Final Thesis**
This course represents a final thesis. The following periods have been supplied:

- **Submission deadline** 6 months
- **Maximum extension period** 3 months
- **Correction period** 8 weeks

This thesis requires confirmation by the examination office.

**Recommendation**
see module

**Annotation**
Information about the procedure regarding admission and registration of the Master Thesis see chap. 1.2.5.
5.63 Course: Membrane Technologies in Water Treatment [T-CIWVT-110865]

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-CIWVT-105380 - Membrane Technologies in Water Treatment

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<td>Each summer term</td>
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**Events**

| ST 2023 | 22605 | Membrane Technologies in Water Treatment | 2 SWS | Lecture / 🗣 | Horn, Saravia |
| ST 2023 | 22606 | Membrane Technologies in Water Treatment - Exercises | 1 SWS | Practice / 🖥 | Horn, Saravia, und Mitarbeiter |

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

**Competence Certificate**
written exam, 90 min.

**Prerequisites**
excursion reports has to be graded as passed

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-CIWVT-110864 - Excursions: Membrane Technologies must have been passed.

**Recommendation**
none

**Annotation**
none
### 5.64 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

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<td>Lecture / 🗣</td>
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*Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled*

**Competence Certificate**

Successfully completed exercises

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.65 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

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**Events**

| ST 2023 | 22633 | Microbiology for Engineers | 2 SWS | Lecture / 🗣 | Schwartz |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**
oral exam, appr. 30 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
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**Competence Certificate**
oral exam, appr. 45 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
5.67 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

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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
5.68 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

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**Events**

| ST 2023 | 6223816 | Modelling Wastewater Treatment Processes | 1 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**

Course will not be offered until summer term 2023.

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.
### 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

<table>
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<td>Each term</td>
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#### Events

| WT 22/23 | 6222903 | Numerische Strömungsmodellierung im Wasserbau | 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
### 5.70 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

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<th>Recurrence</th>
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<tr>
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<td>6221702</td>
<td>Numerical Fluid Mechanics I</td>
<td>4 SWS</td>
<td>Lecture / Practice</td>
<td>6</td>
<td>Written examination</td>
<td>Grade to a third</td>
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</table>

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled

**Competence Certificate**  
written exam, 90 min.

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.71 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

<table>
<thead>
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<th>Credits</th>
<th>Grading scale</th>
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<td>Grade to a third</td>
<td>Each term</td>
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</table>

**Events**

| ST 2023 | 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
5.72 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

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<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

**Events**

| WT 22/23 | 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
5.73 Course: Numerical Mathematics for Students of Computer Science [T-MATH-102242]

**Responsible:** Prof. Dr. Andreas Rieder  
Dr. Daniel Weiβ  
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-103404 - Numerical Mathematics for Students of Computer Science and Engineering

<table>
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<td>Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Wieners</td>
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<td>1 SWS</td>
<td>Practice</td>
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**Competence Certificate**  
written exam, 120 min.

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
5.74 Course: Oral Exam - Supplementary Studies on Culture and Society [T-ZAK-112659]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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<td>1</td>
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</table>

**Competence Certificate**
An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from In-depth Module.

**Prerequisites**
Prerequisite for the ‘Oral Examination’ is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.
5.75 Course: Oral Exam - Supplementary Studies on Sustainable Development [T-ZAK-112351]

**Organisation:**

- **Part of:** M-ZAK-106099 - Supplementary Studies on Sustainable Development

**Type**

- Oral examination

**Credits**

- 4

**Grading scale**

- Grade to a third

**Version**

- 1

**Competence Certificate**

An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from Elective Module.

**Prerequisites**

A requirement for the Supplementary Course: Oral examination is the successful completion of the modules Basics Module and Specialisation Module and the required electives of Elective Module.
## 5.76 Course: Organic Trace Analysis of Aqueous Samples [T-CIWVT-106836]

**Responsible:** Dr. Gerald Brenner-Weiß  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103437 - Instrumental Analysis

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<th>Recurrence</th>
<th>Each summer term</th>
<th>Version</th>
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**Events**

| ST 2023 | 22629 | Organic Trace Analysis of Aqueous Samples | 2 SWS | Practical course / | Brenner-Weiß |

**Competence Certificate**
written report on the analyses of laboratory data, maximum 5 pages

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
5.77 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

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**Events**

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<th>Type</th>
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<td>2 SWS</td>
<td>Parallel Programming Techniques for Engineering Problems</td>
<td>Lecture / Practice ( / )</td>
<td>Uhlmann</td>
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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
5.78 Course: Practical Course in Water Technology [T-CIWVT-106840]

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** M-CIWVT-103440 - Practical Course in Water Technology

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**Events**

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<th>Credits</th>
<th>Prerequisite</th>
<th>Notes</th>
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<td>WT 22/23 22664</td>
<td>2 SWS</td>
<td>Practical Course: Water Quality and Water Assessment</td>
<td>Practical course / Horn, Abbt-Braun</td>
</tr>
</tbody>
</table>

**Competence Certificate**

The grade of the examination of other type is determined as follows:

In total 150 points can be achieved:

- maximum 60 points for 6 experiments incl. entrance test and report (10 points each),
- maximum 15 points for the presentation about one experiment,
- maximum 75 points for the final certificate.

At least 80 points must be achieved in order to pass the examination of other type.

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.
2. The course T-CIWVT-110866 - Excursions: Water Supply must have been passed.

**Recommendation**

none

**Annotation**

none
5.79 Course: Practice Module [T-ZAK-112660]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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<td>Completed coursework</td>
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<td>pass/fail</td>
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**Competence Certificate**
Internship (3 ECT)
Report within the framework of the practical training (Length approx. 18,000 characters (incl. spaces)) (1 ECT)

**Prerequisites**
none

**Annotation**
Knowledge from the Basic Module and the Elective Module is helpful.
5.80 Course: Prerequisite Protection and Use of Riverine Systems [T-BGU-106790]

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<td>Each summer term</td>
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</table>

**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

<table>
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<th>Recurrence</th>
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<td>6220801</td>
<td>2 SWS</td>
<td>Lecture / 📞</td>
<td>Kämpf, Rodrigues Pereira da Franca, Kron</td>
</tr>
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</table>

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
### 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

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<td>pass/fail</td>
<td>Each winter term</td>
<td>1 terms</td>
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<td>4 SWS</td>
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**Legend:** 🖥 Online, 🧬 Blended (On-Site/Online), 🗣 On-Site, ⌚ Cancelled

**Competence Certificate**
- Presentation, appr. 15 min.

**Prerequisites**
- none

**Recommendation**
- none

**Annotation**
- none
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

<table>
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<td>Each summer term</td>
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Events

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<th>2 SWS</th>
<th>Lecture</th>
<th>Klar</th>
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<tbody>
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<td>0188110</td>
<td>Tutorial for 0188100</td>
<td>1 SWS</td>
<td>Practice</td>
<td>Klar</td>
</tr>
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</table>

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Recommendation
none

Annotation
none
### 5.83 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

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<tr>
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<th>pass/fail</th>
<th>Recurrence</th>
<th>Each winter term</th>
<th>Version</th>
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**Events**

| WT 22/23 | 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
**5.84 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

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**Events**

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<th>Credits</th>
<th>Grading scale</th>
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<tr>
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<td>Projektstudium: Wasserwirtschaftliche Planungen</td>
<td>Lecture / Practice</td>
<td>4 SWS</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>Dr.-Ing. Frank Seidel</td>
</tr>
</tbody>
</table>

**Competence Certificate**

Project work: term paper, appr. 15 pages, with presentation

**Prerequisites**

None

**Recommendation**

None

**Annotation**

None
5.85 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

<table>
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<td>Each summer term</td>
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</table>

**Events**

| ST 2023 | 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

manuscript, 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
5.86 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

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Events

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<td>Weidner</td>
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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
### 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

<table>
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<tr>
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<td>Wittmann</td>
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**Legend:**  
🖥 Online,  
🧩 Blended (On-Site/Online),  
🗣 On-Site,  
🗙 Cancelled

**Competence Certificate**  
not graded written test with 60 min.

**Prerequisites**  
None

**Recommendation**  
None

**Annotation**  
None
# 5.88 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

<table>
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<td>Grade to a third</td>
<td>Each winter term</td>
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**Events**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ✗ Cancelled

**Competence Certificate**
project report, appr. 10 pages, and presentation, appr. 15 min.

**Prerequisites**
The not graded accomplishment 'Mass Fluxes in River Basins' has to be passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-BGU-111061 - Mass Fluxes in River Basins must have been passed.

**Recommendation**
none

**Annotation**
none
5 COURSES

5.89 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

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**Competence Certificate**

report about student project on Landscape and River Morphology, appr. 10 pages;
report about student project on Transport Processes in Rivers, appr. 10 pages;
final colloquium, appr. 20 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.90 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

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| ST 2023 | 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
Competence Certificate
The monitoring occurs in the form of several supplementary courses, which usually comprise a presentation of the (group) project, a written elaboration of the (group) project as well as an individual term paper, if necessary with appendices (examination performances of other kind according to statutes § 5 section 3 No. 3 or § 7 section 7).

The presentation is usually with the accompanying practice partners, as well as the written paper.

Prerequisites
Active participation in all three mandatory components.

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

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
Knowledge from 'Basic Module ' and 'Elective Module ' is helpful.
5.92 Course: Stormwater Management [T-BGU-112370]

**Responsible:** PD Dr.-Ing. Stephan Fuchs

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

**Part of:** M-BGU-106112 - Stormwater Management

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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**

Course will not be offered until summer term 2023.

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, Geocology and further study programs.
5.93 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

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**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
**5.94 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

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**Events**

| WT 22/23 | 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
5.95 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

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**Events**

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Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

oral exam, appr. 30 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.96 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

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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
5.97 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

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**Events**

| WT 22/23 | 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 passed.

**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
5.98 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

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**Legend:** 🔄 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
written exam, 60 min.

**Prerequisites**
one

**Recommendation**
one

**Annotation**
The course takes place in winter term as from now.
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, Geocology and further study programs.
### 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

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**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
5.100 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

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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
5.101 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

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ☠️ Cancelled

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none
5.102 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

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**Events**

| ST 2023 | 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
5.103 Course: Wetlands [T-BGU-112845]

**Responsible:** Dr. rer. nat. Christian Damm  
Prof. Dr. Florian Wittmann

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

**Part of:** M-BGU-103391 - Sustainable Management of rivers and Floodplains

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Legend: 📧 Online, ⏯ Blended (On-Site/Online), ⚪ On-Site, ❌ Cancelled

**Competence Certificate**

presentation, appr. 20-30 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
5.104 Course: Wildcard 1 Language Skills 1 [T-BGU-106884]

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5.105 Course: Wildcard 2 Language Skills [T-BGU-106885]

**Organisation:** University

**Part of:** M-BGU-103466 - Language Skills 1 (2 CP)

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Example Curricula

This section contains example curricula for each of the four profiles. Please note that these are only one out of many other possible combinations. The students can ask the mentors for advice on the selection of modules.

Abbreviations

Subjects

AF  Advanced Fundamentals
CC  Cross-Cutting Methods & Competencies
P   Profile Studies
PA  Profile A
PB  Profile B
PC  Profile C
PD  Profile D
P/SM Profile Studies/Supplementary Modules
SP  Study Project
MT  Master's Thesis

General Information

CP  credit points
HPW class hours per week
LC  learning control
G   German
E   English
G/E teaching language: German/documents: English

Type of 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 Cycle

## 1st Semester (winter semester)

Hours per week: 18; credit points: 31; exams: 5 (not graded accomplishments)

<table>
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<th>Module</th>
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<th>CP</th>
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## 2nd Semester (summer semester)

Hours per week: 19; credit points: 30; exams: 4

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## 3rd Semester (winter semester)

Hours per week: 7 + Study Project (3 months); credit points: 29; exams: 4

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## 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)

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2nd Semester (winter semester)

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

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3rd Semester (summer semester)

Hours per week: 10 + Study Project (3 months); credit points: 30; exams: 4

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4th Semester (winter semester)

Master’s thesis (6 months); credit points: 30; exams: 1
### Example Curriculum PC - Environmental System Dynamics & Management

#### 1st Semester (winter semester)

Hours per week: 19; credit points: 30; exams: 4 (ungraded LC are not counted)

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#### 2nd Semester (summer semester)

Hours per week: 22; credit points: 32; exams: 5

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#### 3rd Semester (winter semester)

Hours per week: 7 + Study Project (3 months); credit points: 28; exams: 4

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#### 4th Semester (summer semester)

Master’s thesis (6 months); credit points: 30; exams: 1
### Example Curriculum PD - Water Resources Engineering

#### 1st Semester (winter semester)

Hours per week: 18; credit points: 30; exams: 4 (ungraded LC are not counted)

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#### 2nd Semester (summer semester)

Hours per week: 19; credit points: 30; exams: 5

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#### 3rd Semester (winter semester)

Hours per week: 10 + Study Project (3 months); credit points: 30; exams: 4

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#### 4th Semester (summer semester)

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