### Soil and Groundwater Resources

**Relevance for ResEngin curriculum**
- compulsory

**Administration**
- ResEngin Office

**Contact**
- res.eng@bgu.uka.de

**Term(s) offered**
- 2nd term (Summer term Apr–Sep)

**Duration | Cycle**
- 1 term; every other year

**Language of instruction**
- English / German

**Prerequisites**
- Bachelor

**Module coordinator**
- MOHRLOK, PD Dr.rer.nat. Ulf; IfH
  [Modulverantwortlicher]

**Learning outcomes**
- Description see p. 2.

**Literature / Course materials**
- Reference list see p. 3.

**Basis for module(s)**
- M 7 Integrated Projects
- M MSc Masterarbeit

**Intersection with module(s)**
- M1 Hydraulic & Environmental Engineering; M7 Integrated Projects
- MT2b Sub-surface Transport & Transformation
- MT2c Fresh Water Quality Assessment

<table>
<thead>
<tr>
<th>Lecture courses</th>
<th>(training mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19624</td>
<td>Groundwater Management (lecture)</td>
</tr>
<tr>
<td>19625</td>
<td>Soil Environment (lecture)</td>
</tr>
<tr>
<td>19626</td>
<td>Agricultural Soil Use (lecture, demonstration)</td>
</tr>
<tr>
<td><strong>SUM</strong></td>
<td>**9.0 CP</td>
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</tbody>
</table>

**Workload specification**
- (30 work hours → 1 CP acc. to ECTS) 9 x 30 h 270 h

**Lecture Phase:**
- Contact hours 63 h
- Self instruction hours 126 h

**Exam Phase:**
- Self instruction hours 81 h

**Module examination(s)**
- (mode | scope | weighting)
  - “Soil and Groundwater” written | 60 min | 6.0/9.0 CP
  - “Agricultural Soil Use” oral | 20 min | 3.0/9.0 CP

**Lecturers**
- MOHRLOK, PD Dr.rer.nat. Ulf; IfH
- HABER, Dr.sc.agr. Norbert; LTZ
- NORRA, PD Dr.rer.nat. Stefan; IfGG

**Individual lecture courses**
- Descriptions + Recommended background knowledge see pp. 4.
Module 4: “Soil and groundwater Resources” (cont.)

Module topic

Development of soils and their importance for living organisms and sustainable environmental protection; this includes major aspects of chemical, physical and biological processes in soils, development of soils from rock, classification systems and ecosystem-services they provide. Quantitative and qualitative groundwater development; the interaction of flow and transport processes in the heterogeneous subsurface environment; reliability and uncertainty of measured data; and finally the interdependence of plant growth, soil und water.

Learning outcomes

**Disciplinary knowledge**

- **concepts, theories & definitions**
  Hydrogeology and hydraulics principles and definitions; flow and transport processes.
  Soil genesis, physical and chemical soil properties, soils as environment for living organisms, world wide distribution of soils, substance fluxes and transformation processes in soils, ecosystem-services of soils, sustainable development.
  Soil fertility; utilization of soil water, nutrients and fertilizers.

- **subject matter (factual data, examples)**
  One- and two-dimensional flow examples; pumping tests; tracer tests; groundwater recharge, irrigation; groundwater remediation, salt water intrusion.
  Soil assessment, soil protection, soil management.
  Soil erosion; plant pathology and plant protection; energy plants.

- **methods & procedures**
  Balance approaches; tools for management.
  Methods of soil analyses and assessment, soil classification and mapping.
  Irrigation; use of organic fertilizers.

**Professional skills**

- To gain expertise in analytical methods for assessments and planning in groundwater management. To apply the above listed disciplinary knowledge.

- Soil determination, soil classification, soil assessment, understanding the role of soils within the environment and ecosystems.

- To analyze the possibilities of a given location for agricultural use (soil, water and other resources). To handle founding concepts of agriculture under restricted conditions regarding resources of water, fertilizers, pesticides. To select a suited agricultural practice to use the given resources most efficiently to establish sustainable agriculture.

**Personal competence**

- Being able to discuss the role of soils and their value to society and the environment.
Module 4: “Soil and groundwater Resources” (cont.)

Literature/ Course material


Sparks, D.L. (2003); Environmental Soil Chemistry. Amsterdam, NL: Academic Press.


Lecture notes

# Module 4

## Soil and Groundwater Resources

### Course

## Groundwater Management

<table>
<thead>
<tr>
<th>KIT Lecture ID</th>
<th>19624</th>
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<tbody>
<tr>
<td><strong>Relevance</strong></td>
<td>compulsory</td>
</tr>
<tr>
<td><strong>Prerequisites</strong></td>
<td>Bachelor</td>
</tr>
<tr>
<td><strong>Term(s)</strong></td>
<td>2(^{nd}) term (summer)</td>
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<tr>
<td><strong>Language</strong></td>
<td>English</td>
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<tr>
<td><strong>Training mode</strong></td>
<td>Lecture, 2 WCH *</td>
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<tr>
<td><strong>Workload</strong></td>
<td>3 CP ⇒ 90.0 h</td>
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### Workload specification

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<tr>
<th><strong>Lecture Phase</strong></th>
<th>Contact (based on 2 WCH) 21.0 h</th>
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<tr>
<td></td>
<td>Self instruction 42.0 h</td>
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<tr>
<td><strong>Exam Phase</strong></td>
<td>Self instruction 27.0 h</td>
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### Contact

ulf.mohrlok@kit.edu

### Lecturer(s)

MOHRLOK, PD Dr.rer.nat. Ulf; IfH

### Course topic

Quantitative and qualitative groundwater development; the interaction of flow and transport processes in the heterogeneous subsurface environment; the reliability and uncertainty in measured data.

### Recommended background knowledge

Fundamentals of hydraulics, hydrogeology.

### Learning outcomes

**Disciplinary knowledge**

- **concepts, theories & definitions**
  - hydrogeology and hydraulics principles and definitions;
  - flow and transport processes.

- **subject matter (factual data, examples)**
  - one- and two-dimensional flow examples; pumping tests; tracer tests;
  - groundwater recharge, irrigation; groundwater remediation, salt water intrusion.

- **methods & procedures**
  - balance approaches; tools for management.

**Professional skills**

To gain expertise in analytical methods for assessments and planning in groundwater management. To apply the above listed disciplinary knowledge.

**Personal competence**

n.a.

### Assessment specification

- **written** 60 min = partial module exam "Soil and Groundwater" together with LV Soil Environment
- **oral** ---
- **other** ---

* WCH = Weekly Contact Hours
Module 4

Soil and Groundwater Resources

Course

Soil Environment

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</tbody>
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**Workload specification**

**LECTURE PHASE**
- Contact (based on 2 WCH) 21.0 h
- Self instruction 42.0 h

**EXAM PHASE**
- Self instruction 27.0 h

**Contact**
- stefan.norra@kit.edu

**Lecturer(s)**
- NORRA, PD Dr.rer.nat. Stefan; IfGG

**Course topic**
- Ecosystem-services of soils and their importance for living organisms, sustainable environmental protection.

**Recommended background knowledge**
- Fundamentals of physics, chemistry and biology.

**Learning outcomes**

**Disciplinary knowledge**
- **concepts, theories & definitions**
  - soil genesis, physical and chemical soil properties, soils as environment for living organisms, world wide distribution of soils, substance fluxes and transformation processes in soils, ecosystem-services of soils, sustainable development.
- **subject matter (factual data, examples)**
  - soil assessment, soil protection, soil management.
- **methods & procedures**
  - methods of soil analyses and assessment, soil classification and mapping.

**Professional skills**
- Soil determination, soil classification, soil assessment, understanding the role of soils within the environment and ecosystems.

**Personal competence**
- Being able to discuss the role of soils and their value to the society and the environment.

**Assessment specification**
- **written** 60 min = partial module exam “Soil and Groundwater” together with LV Groundwater Management
- **oral** ---
- **other** ---

* WCH = Weekly Contact Hours
Module 4

Soil and Groundwater Resources

Course

Agricultural Soil Use

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<th>Module 4</th>
<th>Soil and Groundwater Resources</th>
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**Course**

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<th>Workload specification</th>
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<td>19626</td>
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- **Relevance**: compulsory
- **Prerequisites**: Bachelor
- **Term(s)**: 2nd term (summer)
- **Language**: German / English
- **Training mode**: Lecture, 2 WCH *
- **Workload**: 3 CP \(\Rightarrow\) 90.0 h

**LECTURE PHASE**
- Contact (based on 2 WCH) 21.0 h
- Self instruction 42.0 h

**EXAM PHASE**
- Self instruction 27.0 h

**Contact**
res.eng@kit.edu

**Lecturer(s)**

HABER, Dr.sc.agr. Norbert; LTZ

**Course topic**

The interdependence of plant growth, soil and water.

**Recommended background knowledge**

Fundamentals of soil science and biology of plants.

**Learning outcomes**

**Disciplinary knowledge**
- **concepts, theories & definitions**
  - contribution of physical and chemical properties of soils to soil fertility; utilization of soil water, nutrients and fertilizers by different plant species (C3, C4).
- **subject matter (factual data, examples)**
  - soil erosion: importance and possibilities to reduce it; plant pathology and plant protection; cultivation of energy plants.
- **methods & procedures**
  - irrigation: technical equipment, management, effectiveness; use of municipal waste, feces and manure from livestock as organic fertilizers.

**Professional skills**

To analyze the possibilities of a given location for agricultural use (soil, water and other resources). To handle founding concepts of agriculture under restricted conditions regarding resources of water, fertilizers, pesticides. To select a suited agricultural practice to use the given resources most efficiently to establish sustainable agriculture.

**Personal competence**

n.a.

**Assessment specification**

- written ---
- oral 20 min = partial module exam “Agricultural Soil Use”
- other ---

* WCH = Weekly Contact Hours