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### Module Name:
**Mine Water II - Dewatering, Technical Devices, Projects**

### Responsible:
Drebenstedt, Carsten / Prof. Dr.
Hoth, Nils / Dr.

### Lecturer(s):
Hoth, Nils / Dr.

### Institute(s):
Institute of Mining and Special Civil Engineering

### Duration:
1 Semester(s)

### Competencies:
The students will gain knowledge about inflowing waters to open cast, open pits. They are able to deal with water balances and to characterise the status of slope stabilities in relation to pore pressures. They have an understanding how the dewatering system (pumps etc.) has to be chosen in relation to the site specific situation. Furthermore they are able to build up a site specific strategy to investigate, characterise, trace the inflowing waters to open pits or underground mines hydrogeochemically.

### Contents:
**Lecture:**
- Water balances of open casts
- Dewatering aspects under consideration of pit development
- Pore pressures and slope stability and slope failures
- Examples of water handling systems at different mine sites
- Detailed explanation of investigation strategies/ results of different projects
- Water inflow balances for test sites - how to deal with data shortage
- Operational cost differences related to dewatering systems
- Open pit or underground mine inflow systems - hydrogeochemical investigations (trace metals, REE, isotopes, Tracers ...)

**Exercises:**
- Calculate surface run-off
- Water related problems - influence to mining operation/ Impact to operational costs
- Open Pit under extreme climate - groundwater and surface water inflow
- Rough dewatering estimation by easy analytical solutions

### Literature:
Beale & Read (2013) Evaluating water in pit slope stability

### Types of Teaching:
S1 (WS): Lectures (2 SWS)
S1 (WS): Exercises (1 SWS)

### Pre-requisites:
**Recommendations:**
*Mine Water I - Formation and Treatment, 2018-07-04*

### Frequency:
yearly in the winter semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA [90 min]
- PVL: Exercises and homework
- PVL have to be satisfied before the examination.

### Credit Points: 4

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
- KA [w: 1]

### Workload:
The workload is 120h. It is the result of 45h attendance and 75h self-studies. (75 h are spent on preparation for the classes, homework and
Module Name: **Hydrogeology III**

(English):

**Responsible:** Drebenstedt, Carsten / Prof. Dr.

**Lecturer(s):** Hoth, Nils / Dr.

**Institute(s):** Institute of Mining and Special Civil Engineering

**Duration:** 1 Semester(s)

**Competencies:** The students gain profound knowledge in karsthydrogeology and karst research. Furthermore their skills with respect to handling of data, multiple statistical evaluation will be enhanced to enable them solving hydrogeological problems on their own. Additional their team competencies and time management skills will be enforced.

**Contents:**

1. Lecture karst hydrogeology: hydrogeological relevant karts features, rocks prone to karstification, karst indicators, karst processes (mixing corrosion, kinetics), modeling karstification, flow and transport in karst systems, storage, tracer, contaminations, protection, karst water exploration and exploitation, regional examples of different karst systems.

2. Short course integrated data evaluation: data mining, handling and evaluation (database principles, t-test, anova, parameter free tests, correlation- and regression analysis, Factor and cluster-analysis, time series analysis, geo-statistics).

3. Hydrogeological field exercises: working on a defined task with different techniques (sampling, measurements, data evaluation by means of statistics, GIS, models). Writing a report and presenting the results.

**Literature:**


**Types of Teaching:**

S1 (SS): karst hydrogeology / Lectures (1 SWS)

S1 (SS): Integrated data evaluation - short course / Lectures (4 d)

S1 (SS): field exercises / Practical Application (8 d)

**Pre-requisites:**

**Recommendations:**

* Datenanalyse/Statistik, 2011-07-27
* Grundlagen der Hydrogeologie, 2009-08-11

Basic skill in Hydrogeology, statistics, and data management.

**Frequency:** yearly in the summer semester

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam.

The module exam contains:

KA [90 min]

AP: ca. 6 reports from short course

AP: ca. 20 pages report from field work

**Credit Points:** 4

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):

KA [w: 1]

AP: ca. 6 reports from short course [w: 1]

AP: ca. 20 pages report from field work [w: 2]

**Workload:** The workload is 120h. It is the result of 111h attendance and 9h self-studies.
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<th>Data: BODBEWB. BA. Nr. 646</th>
<th>Version: 05.12.2018</th>
<th>Start Year: SoSe 2020</th>
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**Module Name:** Special Topics Geokinematics  
(English):

**Responsible:** Benndorf, Jörg / Prof. Dr.-Ing.  
**Lecturer(s):** Benndorf, Jörg / Prof. Dr.-Ing.  
John, André / Dr.-Ing.

**Institute(s):** Institute for Mine Surveying and Geodesy

**Duration:** 1 Semester(s)

**Competencies:** After successful completion of the course, students are able to:
- solve topical problems related to predicting and monitoring mining induced ground movements,
- utilize methods of inverse modelling to estimate parameters of prediction models based on monitoring data and
- apply methods of machine learning to analyse highly dimensional data and identify relations between independent and dependent variables.

**Contents:**
- review of methods for predicting mining induced ground movements on topical examples
- applied inverse modelling and geostatistics for parameter estimation in the context of ground movement prediction
- introduction to supervised and unsupervised learning (Machine Learning) in the context of resource extraction monitoring and prediction
- case studies of machine learning in the context of mining induced ground movement modelling and exploration
- case studies for ground movement prediction and parameter estimation

**Literature:**
Journals: Markscheidewesen, Geotechnik, Mathematical Geosciences, Computer and Geosciences, Journal of Mining Sciences

**Types of Teaching:**
S1 (SS): Special Topics Geokinematics - Lectures / Lectures (2 SWS)  
S1 (SS): Special Topics Geokinematics - Practical work in groups / Practical Application (2 SWS)

**Pre-requisites:**
- Höhere Mathematik für Ingenieure 1, 2015-03-12  
- Höhere Mathematik für Ingenieure 2, 2015-03-12  
- Allgemeine Grundlagen der Bergschadenlehre, 2017-01-24  
- Datenanalyse/Statistik, 2011-07-27  
- Geomodelling – Geostatistics for Natural Resource Modelling, 2018-12-05  
- Ausgleichungsrechnung, 2017-12-21

**Frequency:** yearly in the summer semester

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:
MP: Oral examination [20 to 30 min]
PVL: Set of assignments  
PVL have to be satisfied before the examination.

<table>
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| Grade:         | The Grade is generated from the examination result(s) with the following weights (w):  
|                | MP: Oral examination [w: 2]  
|                | PVL: Set of assignments [w: 1] |

| Workload:      | The workload is 120h. It consists of 60h presence time (lectures and practical), and 60 hours independent work including group work, practical, self-study and preparation for examination |
### Module Name:

**Groundwater Chemistry I**

### Responsible:

Drebenstedt, Carsten / Prof. Dr.

### Lecturer(s):

Hoth, Nils / Dr.

### Institute(s):

Institute of Mining and Special Civil Engineering

### Duration:

1 Semester(s)

### Competencies:

The students are widening their chemical know how in the field of hydrochemical aspects in particular with respect to groundwater. They will be able to solve basic but as well complex water quality problems by means of geochemical modeling on their own.

### Contents:

**Lecture groundwater chemistry:**

- basis of thermodynamics (ionic strength, calculating activity, saturation index)
- water as universal solvent
- solution and precipitation of minerals
- redox reactions
- ion exchange
- sorption
- solubility of gases in water
- balance between lime and carbonic acid
- basis of the chemistry of the elements Silicium, Aluminum, Sodium, Potassium, Carbon, Calcium, Magnesium, Halogens, Sulfur, Iron, Manganese, Nitrogen, Phosphorus, and the following trace elements: Pb, Cd, As, Hg, Zn, Cu, Ni, Cr, Mo, Co, Se in groundwater
- radioactivity
- Uranium and gases in groundwater
- microbiology and organic constituents in water

**Practical training:**

- chemical thermodynamics by means of PHREEQC
- complex formation
- species distribution
- saturation index
- mixing of waters
- balance between lime and carbonic acid
- gases in water
- weathering of rocks
- evaporation
- reaction pass modeling

### Literature:


APPELO & POSTMA (1993): Geochemistry, groundwater and pollution, Balkema.


### Types of Teaching:

S1 (WS): Lectures (2 SWS)
**S1 (WS): Exercises (2 SWS)**

**Pre-requisites:**
- Recommendations:
  - *Allgemeine, Anorganische und Organische Chemie, 2009-09-02*
  - *Grundlagen der Hydrogeologie, 2009-08-11*
- Basic knowledge of chemistry and hydrogeology

**Frequency:**
- Yearly in the winter semester

**Requirements for Credit Points:**
- For the award of credit points it is necessary to pass the module exam.
  - The module exam contains:
    - KA [90 min]
    - AP: 7 exercises with PHREEQC
    - AP: web-based quiz along the lecture

**Credit Points:**
- 4

**Grade:**
- The Grade is generated from the examination result(s) with the following weights (w):
  - KA [w: 2]
  - AP: 7 exercises with PHREEQC [w: 1]
  - AP: web-based quiz along the lecture [w: 1]

**Workload:**
- The workload is 120h. It is the result of 60h attendance and 60h self-studies.
### Module Name:
**Seismic Sequence Stratigraphy**

(English): Seismic Sequence Stratigraphy

**Responsible:** Buske, Stefan / Prof. Dr.

**Lecturer(s):** Fischer, Klaus

**Institute(s):**
- Wintershall Holding GmbH
- Institute of Geophysics and Geoinformatics

**Duration:** 1 Semester(s)

**Competencies:**
The course objective is to communicate sequence stratigraphic principles and demonstrate their relevance to seismic interpretation. The basic workflow will be presented for seismic stratigraphic interpretation and basin evolution analysis, using case histories and field examples worldwide. Based on seismic examples and some "hands on" interpretation exercises from different geological settings, attendees learn how to identify different depositional environments from seismic data, predict facies and gross lithological units (reservoir and seal pairs), estimate paleo water depths, and evaluate subsidence trends and baselevel changes.

**Contents:**
**Course Outline:**
- Introduction
- Principles of sequence stratigraphy, sequence stratigraphic models
- Principles of seismic stratigraphy, recognition of seismic sequence boundaries and other surfaces of importance, delineation of systems tracts, sea-level variations
- Seismic facies analysis: reflection geometries and other seismic facies characteristics with a detailed description of geological facies models and their use for lithology / depositional environment prediction
- 3D visualisation and attribute analysis
- Illustration of standard workflows for seismic reservoir characterisation

The examination prerequisite is a project which will be processed in groups of 2 or 3 students with the software Petrel. Before the beginning of the project, students will receive a short Petrel introduction (around 4 hours).

**Literature:**

**Types of Teaching:**
S1 (WS): Intensive course (including Petrel project work) / Lectures (3 d)

**Pre-requisites:**

**Frequency:** yearly in the winter semester

**Requirements for Credit Points:**
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- PVL: Petrel project work
- KA [90 min]

PVL have to be satisfied before the examination.

**Credit Points:**
3

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):
- KA [w: 1]

**Workload:** The workload is 90h. It is the result of 24h attendance and 66h self-studies.
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<td>Module Name:</td>
<td><strong>Geomatics for Resource and Reserve Management</strong></td>
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<td>(English):</td>
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<tr>
<td>Responsible:</td>
<td>Benndorf, Jörg / Prof. Dr.-Ing.</td>
<td>Lecture(s):</td>
<td>Benndorf, Jörg / Prof. Dr.-Ing.</td>
</tr>
<tr>
<td>Institute(s):</td>
<td>Institute for Mine Surveying and Geodesy</td>
<td>Duration:</td>
<td>1 Semester(s)</td>
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</table>
| Competencies: | After successful completion of the course, students are able to create case specific work flows and apply methods that support a safe, economical end environmental responsible exploitation of mineral deposits. The particular focus of this module is on:  
- exploration of the resource and geo-mechanical aspects including tectonics,  
- evaluation of mineral resources and reserves according international standards,  
- monitoring of operational accessible reserves (in-pit reserves),  
- grade control and reconciliation,  
- operational production and safety monitoring and  
- aspects related to optimization of mine design. |
| Contents: |  
- methods and phases of resource exploration  
- resource/reserve estimation and international standards for reporting  
- operational production and safety monitoring  
- grade control and reconciliation  
- tectonic structures and its visualization in mine maps (folding structures and discontinuities)  
- geotechnical design aspects  
- applied operations resource for optimized mine design |
Michaely, H., Blasgude H.G.: Rissmusteratlas- Bergmännisches Risswerk. FABERG-Normenausschuss Bergbau im DIN Deutsches Institut für Normung e.V.  
| Types of Teaching: | S1 (SS): Geomatics for Resource and Reserve Management - Lectures / Lectures (2 SWS)  
S1 (SS): Geomatics for Resource and Reserve Management - Exercises and practical work in groups / Practical Application (2 SWS) |
| Pre-requisites: |  |
| Recommendations: | Risstechnik, CAD und Geodatenbanken, 2017-11-14 |
| Frequency: | yearly in the summer semester |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains:  
MP [30 min]  
PVL: Excursion report, set of assignments incl. presentation  
PVL have to be satisfied before the examination. |
| Credit Points: | 6 |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w):  
MP [w: 1] |
| Workload: | The workload is 180h. It consists of 60h presence time (lectures and practical work) and 120h self-study. |
underground surveying practical), and 120 hours independent work including group work, practical, self-study and preparation for examination.
| Data: GSC. MA. Nr. 3630 / Examination number: 31724 | Version: 04.07.2018 | Start Year: SoSe 2019 |
| --- |
| Module Name: **Geo-scientific Communication** |
| Responsible: Drebenstedt, Carsten / Prof. Dr. Hoth, Nils / Dr. |
| Lecturer(s): Jacob, Mark / Dr. Hoth, Nils / Dr. |
| Institute(s): Institute of Mining and Special Civil Engineering |
| Duration: 1 Semester(s) |
| Competencies: The course intends to give students the knowledge and the ability to perform scientific database research. Furthermore they will be able to structure and document their scientific work and results. Also they learn more about scientific writing (of a paper), as well as to present and defend their results (oral talk). This is very important before writing their MSc-thesis. |
| Contents: - dealing with scientific literature - Detailed database research, - citation of publications, - aspects about writing technical or review papers - structure your practical work in relation to the Master thesis (deal with sub-aspects) - Main ideas how to structure the written MSc-thesis in comparison to technical reports - dealing with the resources of the university library - search papers, therefore searching strategies Oral communication (language of describing graphs, charts and diagrams) Argumentation line of talks Written communication - Language to link points and ideas, language of comparing and contrasting Major goals are learning and applying strategies of transporting scientific informations using different techniques and analogue and digital sources. AP main work working on a scientific topic for a defined time, prepare a paper (around 12 pages) in relation to a ground water, mine water or mining/geoscience based topic. Students have to present their topic, argumentation line and basic literature (2 to 5 scientific papers) in before they start to write the paper. Afterwards, when they have handed in the paper, they have to give a presentation/ defence talk about this topic/ paper. |
| Literature: Cargill, M. [2013] : 2013 Writing scientific research articles and internal material |
| Types of Teaching: S1 (SS): Lectures (1 SWS) S1 (SS): Exercises (2 d) |
| Pre-requisites: **Recommendations:** basics in hydrogeology, groundwater chemistry and mine water |
| Frequency: yearly in the summer semester |
| Requirements for Credit Points: For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: writing a scientific research paper AP*: presentation and defence of the paper |
* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.

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<th>Credit Points:</th>
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</table>
| Grade:         | The Grade is generated from the examination result(s) with the following weights (w):
|                | AP*: writing a scientific research paper [w: 2]
|                | AP*: presentation and defence of the paper [w: 1] |

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.

| Workload:      | The workload is 120h. It is the result of 31h attendance and 89h self-studies. (89 h are spent on preparation of the paper and preparing the presentation as well as self study). |
**Module Name:** Project and Contract Management  

**Responsible:** Drebenstedt, Carsten / Prof. Dr. Bongaerts, Jan C. / Prof. Dr.  

**Lecturer(s):** Bongaerts, Jan C. / Prof. Dr.  

**Institute(s):** Professor of Environmental & Resource Management  
Institute of Mining and Special Civil Engineering  

**Duration:** 1 Semester(s)  

**Competencies:** The objectives of the module are to convey principal elements of project and contract management.  

**Project Management:** The student will be able to identify, analyze and structure the issues involved in a large scale environmental remediation project. On the basis of this skill, the student will be in a position to set up, organise, and control a project and its components including the procurement of outside services. He/she will be capable of managing the tendering of contracts, identifying critical paths, setting up financial controlling, initiating technical controlling as well as establishing quality assurance and control.  

**Contract Management:** The student will be able to identify the various types of contracts required to manage large scale environmental remediation projects. In particular, he/she will be in a position to compile information required to generate contracts, formulate draft contracts, expedite the execution of contracts, and to establish the organizational structures to facilitate the storage and retrieval of crucial information by project personnel. Presentation of small group projects and case studies forms an essential part of the module in order to train communication skills.  

**Contents:** Project management is a set of principles, practices, and techniques applied to lead project teams and control project schedule, cost, and performance risks. The basic elements are  

- Project integration including the establishment of life cycle phases ending in milestones, producing a set of project documents and preparing a project management plan,  
- Project scope definition including the definition of requirements, breaking down the work into single components, establishing cost and schedule baselines,  
- Time management using automated scheduling systems, conducting critical path analysis,  
- Cost management covering the preparation of cost estimates, tracking costs at the work package level,  
- Quality management by defining goals and stating methods to achieve quality assurance, implementing quality measurement and continuous quality improvement,  
- Risk management composed of risk analysis and implementing measures for risk avoidance and mitigation  
- Human Resources management entailing the establishment of clear goals, maintaining channels of communication, and instruments to resolve conflicts,  
- Communications, including internal project team communication and external public relations,  
- Procurement.
Contract management covers aspects that are part of project management such as Procurement. Although contract management is an integral part of project management it deserves particular attention due to its legal implication during the execution of a project and the potential to preserve knowledge in spite of long-term staff attrition. Therefore, it is focused on further by discussing:

- Life Cycle of contracts, contract types, e.g. expert opinions, services, supplies and contract structures
- Parties involved in designing contracts
- Contract elements, e.g. risks, occupational health and safety, conflicts of interest, ownership and tights to the use of intellectual property, dispute resolution, regulatory controls)
- Contract negotiations and elements of contract administration
- Cost and price analysis

The subjects will be presented using summary texts, graphs, software demonstration and case studies. Students shall participate in the presentation to solicit ideas as well as individual situations experienced and integrate these in the structured presentation. Where appropriate, real-life situations will be simulated.

**Literature:**
Johanna Rothman, Successful Project Management, The Pragmatic Programmers, 2007;

**Types of Teaching:**
S1 (WS): Lectures (6 d)
S1 (WS): Seminar (9 d)

**Pre-requisites:**
**Recommendations:**
No previous knowledge of management is required.

**Frequency:**
yearly in the winter semester

**Requirements for Credit Points:**
For the award of credit points it is necessary to pass the module exam.
The module exam contains:
KA [120 min]
PVL: Presentation of results of practical training
PVL have to be satisfied before the examination.

**Credit Points:**
6

**Grade:**
The Grade is generated from the examination result(s) with the following weights (w):
KA [w: 1]

**Workload:**
The workload is 180h. It is the result of 120h attendance and 60h self-studies.
### Module Name:
**Borehole Seismics and Acoustics**

### Responsible:
Buske, Stefan / Prof. Dr.

### Lecturer(s):
Geerits, Tim / Dr.

### Institute(s):
Institute of Geophysics and Geoinformatics

### Duration:
1 Semester(s)

### Competencies:
At the end of the module students are able to
- explain the principles of borehole seismic methods
- apply and practice borehole seismic methods
- explain relevant terms in English.

### Contents:
The course consists of two parts. Both parts include international literature and relevant terms in English.

The *first part* (*Borehole Acoustics*) comprises the theoretical basics of wave propagation in boreholes and the analysis to characterize the direct vicinity of the borehole. This includes *borehole acoustic tools* (wireline, logging-while-drilling), *slowness analysis* (slowness-time/frequency-coherency, dispersion corrections) and wave propagation in and around fluid-filled borehole and *imaging away from the borehole* (data in CSG/CRG domain).

The *second part* comprises the principles of *Borehole Seismics* presented with the help of synthetic and real data and examples. This includes *Basic VSP theory*, *VSP geometries/acquisition/planning/QC*, *checkshot processing*, *acoustic log calibration & synthetic seismograms*, *zero-offset VSP processing*, *VSP imaging*, *case study inversion test* and *VSP multiples*, *VSP anisotropy/AVO*.

### Literature:

### Types of Teaching:
S1 (WS): 1 week intensive course / Lectures (1 Wo)

### Pre-requisites:
yearly in the winter semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
KA [90 min]

### Credit Points:
3

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
KA [w: 1]

### Workload:
The workload is 90h. It is the result of 40h attendance and 50h self-studies.
Module Name: **Applied Remote Sensing in Geosciences**

(English):

**Responsible:** Benndorf, Jörg / Prof. Dr.-Ing.

**Lecturer(s):** John, André / Dr.-Ing.

**Institute(s):** Institute for Mine Surveying and Geodesy

**Duration:** 1 Semester(s)

**Competencies:** After successful completion of the course students will be able to apply methods of remote sensing in the context of analysis of spatio-temporal processes in geosciences. This includes in particular,

- the ability to choose suitable sensor technology based on knowledge about available sensors and related physical principles
- processing of remote sensing data using typical software
- application of multi-variate statistical methods to infer relevant information from sensor data, relevant to specific case studies
- application of spatial modelling techniques for prediction of attributes at not samples location or times.
- integration of before mentioned aspects in an efficient work flow.

**Contents:** This module covers the introduction to and working on selected applications of remote sensing in geosciences by the means of selected case studies. Topics covered include

- review of theoretical foundation of remote sensing
- data acquisition techniques (terrestrial, airborne, spaceborne)
- spatio-temporal analysis of data
- geoscientific background related to the case studies.

Practical exercises will be conducted applying multi-spectral and radar data for change detection of ground properties and ground deformations. Students will conduct individual project assignments and present their results.

**Literature:**

- Richards and Jia, Remote Sensing Digital Image Analysis, Springer

**Types of Teaching:**

- S1 (WS): Applied Remote Sensing in Geosciences / Lectures (1 SWS)
- S1 (WS): Applied Remote Sensing in Geosciences / Practical Application (3 SWS)

**Pre-requisites:**

**Recommendations:**

- Datenanalyse/Statistik, 2011-07-27
- Grundlagen der Geowissenschaften für Nebenhörer, 2014-02-03
- Grundlagen der Geofernerkundung, 2017-12-19

**Frequency:** yearly in the winter semester

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:

- AP: Project assignment and presentation

**Credit Points:** 6

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):

- AP: Project assignment and presentation [w: 1]

**Workload:** The workload is 180h. It consists of 60h supervised lecture and practical
time and 120h independent work including group work, practical, self-study and preparation for examination.
Module Name: **Ground Water Chemistry for GW-Management - Basics**

(English):

**Responsible:** Drebenstedt, Carsten / Prof. Dr. Hoth, Nils / Dr.

**Lecturer(s):** Hoth, Nils / Dr.

**Institute(s):** Institute of Mining and Special Civil Engineering

**Duration:** 1 Semester(s)

**Competencies:**

The student is widening his chemical know how in the field of hydrochemical aspects in particular with respect to groundwater. He will be able to understand and solve basic as well as more complex water quality problems. He gains an understanding of basic practical lab work for analysis.

**Contents:**

- water as universal solvent
- drinking water standards / disease aspects
- basics of thermodynamics in relation to Ground waters (ionic strength,
  - activity versus concentration, saturation index)
- species interactions, solubility of gases in water
- redox reactions - stability diagrams
- solution/ precipitation of mineral phases – equilibria to the fluid phase
- hydrochemical milieu measurements (background)
- Acidity, alkalinity - Kb,Ks values - and titration in general
- Carbonic acid - Carbonate phases interaction
- Ground Water Sampling (hydraulic and chemical criteria)
- Field handling of Water Samples (Filtration, Conservation)

**Literature:**

APPELO & POSTMA (1996) or (2005): Geochemistry, groundwater and pollution, Balkema.

**Types of Teaching:**

S1 (WS): Basics of GW chemistry / Lectures (2 SWS)
S1 (WS): practical lab courses - Basic hydrochemical lab work, basics of titration, photometry etc. / Practical Application (2 SWS)

**Pre-requisites:**

**Recommendations:**

Basic knowledge of chemistry and hydrogeology

**Frequency:**

yearly in the winter semester

**Requirements for Credit Points:**

For the award of credit points it is necessary to pass the module exam. The module exam contains:

KA*: written exam to GW-chemistry [90 min]

AP*: reports of lab practical work

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.

**Credit Points:**

6

**Grade:**

The Grade is generated from the examination result(s) with the following weights (w):

KA*: written exam to GW-chemistry [w: 2]

AP*: reports of lab practical work [w: 1]

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.

**Workload:**

The workload is 180h. It is the result of 60h attendance and 120h self-studies. (120 h are spent on preparation, writing the lab course reports and self study)
<table>
<thead>
<tr>
<th>Data:</th>
<th>FTMGWM. MA. Nr. 3635 / Examination number: 31729</th>
<th>Version: 04.07.2018</th>
<th>Start Year: WiSe 2018</th>
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</thead>
<tbody>
<tr>
<td>Module Name:</td>
<td><strong>Hydrogeological Flow and Transport Modelling for GW-Management</strong> (English):</td>
<td></td>
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</tr>
<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr. Hoth, Nils / Dr.</td>
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<tr>
<td>Lecturer(s):</td>
<td>Berrios Amador, Danilo Hoth, Nils / Dr. Shao, Haibing / Junior-Prof.</td>
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<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering Institute of Geotechnics</td>
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<td></td>
</tr>
<tr>
<td>Duration:</td>
<td>1 Semester(s)</td>
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<tr>
<td>Competencies:</td>
<td>Modelling of flow, transport and chemical reactions for ground water systems. The student will be able to analyse a given situation, to choose an appropriate algorithm and software package to solve a given task. He is able to interpret complex results of the different models in relation to the practical, site related questions.</td>
<td></td>
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</tbody>
</table>
| Contents: | - Basics of hydogeological flow modelling - numerical (FDM, FEM) and analytical solutions  
- Importance of the conceptual model  
- Boundary conditions, local grid refinements  
- Parameterisation aspects  
- Basics of non-reactive transport modelling  
- Transport modelling of organic contaminants - application of knowledge from GW-chemistry (use of isotherme concepts)  
- Boundary conditions for transport equation, stability criteria for numerical solution techniques  
- Reactive transport modelling - 1D with PHREEQC - concept, basic understanding (with mineral phase interactions and cation exchange)  
- Conceptual understanding for the modelling of column flow/ transport experiments  
- Short introduction to Multiphase flow and density driven flow | | |
| Practical exercises: | computer- training block courses  
in relation to FDM Modelling - MODFLOW  
FEM- Modelling  
1D-reactive transport with PHREEQC | | |
| Literature: | Rausch et al. (2005): Solute transport modelling  
APPELO & POSTMA (2005): Geochemistry, groundwater and pollution | | |
| Types of Teaching: | S1 (WS): Lectures (2 SWS)  
S1 (WS): computer exercises / Exercises (2 SWS) | | |
| Pre-requisites: | **Recommendations:**  
Hydrogeology for GW-Management - Basics and Advanced | | |
| Frequency: | yearly in the winter semester | | |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam.  
The module exam contains:  
KA* [90 min]  
AP*: Exercises - homework computer courses  
* In modules requiring more than one exam, this exam has to be passed | | |
### Credit Points:

6

### Grade:

The Grade is generated from the examination result(s) with the following weights (w):

- KA*: [w: 2]
- AP*: Exercises - homework computer courses [w: 1]

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4.0), respectively.

### Workload:

The workload is 180h. It is the result of 60h attendance and 120h self-studies. (120 h are spent on preparation, to prepare reports and homework in relation to the exercises and self study)
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<th><strong>Start Year:</strong> WiSe 2014</th>
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<tr>
<td><strong>Module Name:</strong></td>
<td>Research Seminar: Plate Tectonics and Orogenic Processes (English):</td>
<td></td>
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<tr>
<td><strong>Responsible:</strong></td>
<td>Ratschbacher, Lothar / Prof. Dr.</td>
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<tr>
<td><strong>Lecturer(s):</strong></td>
<td>Stanek, Klaus / Prof. Dr. Kroner, Uwe / PD Dr. Jonckheere, Raymond / Dr. Pfänder, Jörg / PD Dr. Ratschbacher, Lothar / Prof. Dr. Schneider, Susanne / Dr.</td>
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<tr>
<td><strong>Institute(s):</strong></td>
<td>Institute of Geology</td>
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<tr>
<td><strong>Duration:</strong></td>
<td>2 Semester(s)</td>
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<tr>
<td><strong>Competencies:</strong></td>
<td>Understanding and interpreting of research literature, defining problems in tectonics, and developing own research strategies. Focus is variable: defined by the research projects and interests of the working group.</td>
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<tr>
<td><strong>Contents:</strong></td>
<td>Analysis of orogeny</td>
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<tr>
<td><strong>Literature:</strong></td>
<td>Publications in international journals</td>
<td></td>
<td></td>
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<tr>
<td><strong>Types of Teaching:</strong></td>
<td>S1 (WS): Lectures (1 SWS) S1 (WS): Exercises (1 SWS) S2 (SS): Lectures (1 SWS) S2 (SS): Exercises (1 SWS)</td>
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<td><strong>Pre-requisites:</strong></td>
<td>Recommendations: Bachelor Geoscience</td>
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<tr>
<td><strong>Frequency:</strong></td>
<td>yearly in the winter semester</td>
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<tr>
<td><strong>Requirements for Credit Points:</strong></td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Active participation in the seminars</td>
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<tr>
<td><strong>Credit Points:</strong></td>
<td>5</td>
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</tr>
<tr>
<td><strong>Grade:</strong></td>
<td>The Grade is generated from the examination result(s) with the following weights (w): AP: Active participation in the seminars [w: 1]</td>
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<tr>
<td><strong>Workload:</strong></td>
<td>The workload is 150h. It is the result of 60h attendance and 90h self-studies.</td>
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</table>
Module Name: **Geomonitoring**

(English):

**Responsible:** Benndorf, Jörg / Prof. Dr.-Ing.

**Lecturer(s):** Benndorf, Jörg / Prof. Dr.-Ing.
John, André / Dr.-Ing.

**Institute(s):** Institute for Mine Surveying and Geodesy

**Duration:** 1 Semester(s)

**Competencies:**
Students are able to build on their knowledge about geodetic and geotechnical measurement methods on the one hand and their understanding about the geogenic/antropogenic process to monitor on the other hand to generate reliable and effective monitoring concepts for spatial, temporal and spatio-temporal processes.

Students are able to critically analyze monitoring concepts and interpret monitoring results.

**Contents:**
The lecture introduces to applications and to the methodological approach of geomonitoring. Starting on the basis of measurement and data acquisition techniques it discusses monitoring design aspects and statistical and model based inference strategies. The aim is to infer an understanding of geo-processes and their relevant spatio-temporal dynamics, including change detection.

Topical application in the context of resource extraction impact- and environmental impact monitoring on different scales in time and space will be discussed and analyzed.

**Literature:**

**Types of Teaching:**
S1 (WS): Geomonitoring - Lecture / Lectures (2 SWS)
S1 (WS): Geomonitoring - Practical exercises / Practical Application (2 SWS)

**Pre-requisites:**
**Recommendations:**
Geomodellierung, 2018-01-11
Grundlagen der Geoinformationssysteme, 2014-06-16
Allgemeine Grundlagen der Vermessungs- und Instrumententechnik, 2015-06-01
Ingenieurgeodäsie, 2017-09-13
Grundlagen der Geofernerkundung, 2017-12-19
Ingenieurvermessung

**Frequency:**
yearly in the winter semester

**Requirements for Credit Points:**
For the award of credit points it is necessary to pass the module exam.
The module exam contains:
MP [30 min]
PVL: Project report
PVL have to be satisfied before the examination.

**Credit Points:**
5

**Grade:**
The Grade is generated from the examination result(s) with the following weights (w):
| Workload: | The workload is 150h. It consists of 60h supervised lecture and practical time and 90h independent work including group work, practical, self-study and preparation for examination. |
**Module Name:** Groundwater Management

**Responsible:** Drebenstedt, Carsten / Prof. Dr.

**Lecturer(s):** Hoth, Nils / Dr.

**Institute(s):** Institute of Mining and Special Civil Engineering

**Duration:** 1 Semester(s)

**Competencies:** The students will gain confidence and experience in navigation Geo Information Systems (GIS) software and applying his geo-scientific knowledge by means of GIS. Furthermore they will learn how to develop a project, calculate costs, writing tenders and quotes, and manage a project with respect to costs, time, and project goals.

**Contents:** Practical project management is a lecture with home works addressing aspects like designing contracts, billing and accounting, HOAI (Scale of Fees for Services by Architects and Engineers), tender, VOL, VOB, engineering contracts, project-management, development and controlling.

Short course GIS Applications in Hydrogeology: Display and edit of raster, vector and CAD objects as well as handling of databases. Determination of subsurface and groundwater catchments based on a DTM. Utilization of slope, aspect, and shading. Groundwater exploration by means of remote sensing, compilation of land use maps. Raster-based calculation of evapotranspiration and groundwater recharge. Creating and managing well head protection zones for potable water withdrawal.

**Literature:**
- Drury (1993): Image interpretation in geology

**Types of Teaching:**
- S1 (WS): with homeworks / Lectures (1 SWS)
- S1 (WS): short course / Lectures (4 d)

**Pre-requisites:**
- Basic knowledge Hydrogeology and GIS

**Frequency:** yearly in the winter semester

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:
  - AP: 7 reports
  - AP: Compiling an digital atlas with concent form the GIS class

**Credit Points:** 3

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):
  - AP: 7 reports [w: 1]
  - AP: Compiling an digital atlas with concent form the GIS class [w: 1]

**Workload:** The workload is 90h. It is the result of 47h attendance and 43h self-studies.
### Module Name:

**Introduction to Meteorology and Climatology**

### Responsible:

Matschullat, Jörg / Prof. Dr.

### Lecturer(s):

Matschullat, Jörg / Prof. Dr.

Zimmermann, Frank / Dr.

### Institute(s):

Institute of Mineralogy

### Duration:

1 Semester(s)

### Competencies:

Successful participants know the basics of Meteorology and Climatology. Understanding the most important parameters and processes and being able to interpret related results.

### Contents:

Atmospheric dynamics, radiation budget, global energy balance, meteorological parameters, global, regional, local climates and their dynamics, paleoclimatology, climate change.

### Literature:


### Types of Teaching:

S1 (WS): Lectures (2 SWS)

S1 (WS): Exercises (2 SWS)

### Pre-requisites:

**Recommendations:**

- Höhere Mathematik I für naturwissenschaftliche Studiengänge, 2014-06-01
- Höhere Mathematik II für naturwissenschaftliche Studiengänge, 2014-06-01
- Physik für Naturwissenschaftler I, 2012-05-10
- Physik für Naturwissenschaftler II, 2012-05-10

### Frequency:

yearly in the winter semester

### Requirements for Credit Points:

For the award of credit points it is necessary to pass the module exam. The module exam contains:

KA [90 min]

### Credit Points:

4

### Grade:

The Grade is generated from the examination result(s) with the following weights (w):

KA [w: 1]

### Workload:

The workload is 120h. It is the result of 60h attendance and 60h self-studies. The latter comprises preparatory work and repetitions of the lectures and exercises and exam preparations.
Module Name: **Introduction to Quaternary Geology**

(English): Breitkreuz, Christoph / Prof. Dr.

Institute(s): Institute of Geology

Duration: 1 Semester(s)

Competencies: Students will gain knowledge and the ability to understand the basic processes and techniques in the field of Quaternary Geology, and in particular in the field of paleoclimatic variation.

Contents: Proxies for paleoclimatic variation in the last 2.5 Million years; chronostratigraphic and other tools for stratigraphic correlation of the Quaternary; important archives: lake- and marine sediments, ice cores; glacial and periglacial processes and glacial sedimentology

Literature: 

Types of Teaching: S1 (SS): Lectures (2 SWS)  
S1 (SS): Field trip / Practical Application (1 d)

Pre-requisites: **Recommendations:**  
Grundlagen der Geowissenschaften für Nebenhörer, 2014-02-03  
Grundlagen der Geowissenschaften I, 2014-09-10  
Principles of Geoscience (Secondary Subject) or equivalent modules; for example one of the both above

Frequency: yearly in the summer semester

Requirements for Credit Points: For the award of credit points it is necessary to pass the module exam. The module exam contains:  
KA [90 min]  
PVL: Successful participation in the field trip  
PVL have to be satisfied before the examination.

Credit Points: 3

Grade: The Grade is generated from the examination result(s) with the following weights (w):  
KA [w: 1]

Workload: The workload is 90h. It is the result of 38h attendance and 52h self-studies. Self-studies include assignments, preparation and wrapping up of lectures as well as preparation of examinations.
### Module Name:
**Innovation Project Geomatics**

### Responsible:
Benndorf, Jörg / Prof. Dr.-Ing.

### Lecturer(s):
John, André / Dr.-Ing.

### Institute(s):
Institute for Mine Surveying and Geodesy

### Duration:
1 Semester(s)

### Competencies:
After successful completion of the module, students are able to:
- create innovative solutions for a complex challenge in the context of geomatics for mineral resource management as a result of a team effort,
- apply their project management and interpersonal communication skills to achieve innovative solutions,
- develop a concept for the scenario of a market entry for the created innovative solutions and
- present and defend the solution in front of an expert panel.

### Contents:
A detailed challenge will be provided inspired by topics of current interest in the larger community of geomatics in mineral resource management. For the team-project, teams will be defined by the supervisor. The teams will conduct independent work supported by regularly scheduled audits, selected expert lectures and also the possibility of consulting experts. Teams have to manage their project work including tasks, schedules and team roles independently. A solution to the challenge has to be created by applying their knowledge gained in all modules taken before, extended by individual focused auto-didactical investigations. Given a scenario that the solution should be brought to the national and/or international market, a market entry plan has to be generated. The innovative solution and the market entry plan have to be presented in a consistent report and be defended in front of an expert panel assembled by the course coordinator.

### Literature:
Typical literature will be recommended by expert lecturers and/or has to be investigated independently.

### Types of Teaching:
S1 (WS): Innovation Seminar - Expert lectures, audits, consulting hours, independent group work / Seminar (2 SWS)

### Pre-requisites:
**Mandatory:**
Abschluss von Modulen des Studiengangs im Umfang von mindestens 50 LP (Proof of the successful conclusion of at least 50 LPs/ECTS of mandatory, optional and free elective modules as defined in the study documents for the MSc in Geomatics for Mineral Resource Management.)

### Frequency:
yearly in the winter semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- AP*: Report on the innovation project
- AP*: Oral defense of the innovation project

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.

### Credit Points:
10

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
- AP*: Report on the innovation project [w: 2]
**AP**: Oral defense of the innovation project

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4.0), respectively.

| Workload: | The workload is 300h. It consists of 30 hours audits, lectures and consulting hours, and 270 hours independent group work, report writing and preparation for examination. |
**Module Name:** Advanced Borehole Geophysics  

**Responsible:** Buske, Stefan / Prof. Dr.  
**Lecturer(s):** Geerits, Tim / Dr.  
**Institute(s):** Institute of Geophysics and Geoinformatics  
**Duration:** 1 Semester(s)  
**Competencies:** The aim of this course is to learn the principles and the applications of advanced borehole geophysics methods with focus on seismic techniques and to describe relevant terms in English.

**Contents:** Beside an introduction to the most important methods in borehole geophysics (*Formation Evaluation Tool*, e.g. resistivity, NMR, *formation pressure testing and sampling, and their standard deliverables*), this course comprises the following topics: Logging While drilling (LWD) multipole borehole acoustic array tools and their measurement principles; Borehole wave types (head waves and guided waves, e.g. Stoneley waves, flexural waves, etc.); Intrinsic azimuthal anisotropy (HTI) from cross-dipole wireline shear wave measurements; Shear wave imaging away from the wellbore using cross-dipole wireline measurements; International literature and relevant terms in English.


**Types of Teaching:** S1 (SS): 1 week intensive course / Lectures (1 Wo)  

**Pre-requisites:** yearly in the summer semester  

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min]

**Credit Points:** 3  
**Grade:** The Grade is generated from the examination result(s) with the following weights (w):  
KA [w: 1]

**Workload:** The workload is 90h. It is the result of 40h attendance and 50h self-studies.
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<tbody>
<tr>
<td>Module Name:</td>
<td>Industry Internship Geomatics</td>
<td>(English):</td>
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<tr>
<td>Responsible:</td>
<td>Benndorf, Jörg / Prof. Dr.-Ing.</td>
<td>Lecturer(s):</td>
<td></td>
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<tr>
<td>Institute(s):</td>
<td>Institute for Mine Surveying and Geodesy</td>
<td>Duration:</td>
<td>1 Semester(s)</td>
</tr>
<tr>
<td>Competencies:</td>
<td>Students will apply their gained knowledge in practical tasks during an industry internship in a geomatic-oriented enterprise, consultant company, public authority or similar institutions institution. Students will deepen their understanding of the business context of their subject, and develop cross-disciplinary and interpersonal skills.</td>
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<tr>
<td>Contents:</td>
<td>The internship contains of:</td>
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<td></td>
<td>• 20 days practical work in a company or related institution,</td>
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<td>• regular consultations with the university supervisor,</td>
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<td>• a short and consistent internship report,</td>
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<td>• an evaluation talk with the supervisor.</td>
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<tr>
<td>Literature:</td>
<td>n.a.</td>
<td></td>
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<tr>
<td>Types of Teaching:</td>
<td>S1: Practical work in an enterprise, consulting company, public authority or similar institution (20 days) / project</td>
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<tr>
<td>Pre-requisites:</td>
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<tr>
<td>Frequency:</td>
<td>constantly</td>
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<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written report and evaluation discussion No grading.</td>
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<td>* In modules requiring more than one exam, this exam has to be passed or completed with at least &quot;ausreichend&quot; (4,0), respectively.</td>
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<tr>
<td>Credit Points:</td>
<td>5</td>
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<tr>
<td>Grade:</td>
<td>The examination results are not rated. The credits are given when the exams are passed successfully.</td>
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<tr>
<td>Workload:</td>
<td>The workload is 150h. (20 working days)</td>
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<tr>
<td>Start Year:</td>
<td>WiSe 2016</td>
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</table>

**Module Name:** Mineral Liberation Analysis (MLA) of Mineral Resources

**Responsible:** Schulz, Bernhard / Prof. Dr.

**Lecturer(s):**

**Institute(s):** Institute of Mineralogy

**Duration:** 1 Semester(s)

**Competencies:**
- Bewertung von Erzen und Aufbereitungsprodukten aus der automatisierten Liberierungsanalyse (Mineral Liberation Analysis, MLA) mit Rasterelektronenmikroskop (REM). Aufsetzen und Spezifizierung von automatisierten Messungen mit REM. Numerische und graphische Auswertung von Datenbank-Files der automatisierten Analysen mit REM.

- Evaluation of metal ores and processed metal ores by automated mineral liberation analysis (MLA) by Scanning Electron Microscope (SEM). Set-up and speciation of automated measurements by SEM. Numerical and graphical assessment of databas files produced from automated SEM measurements.

**Contents:**
- Methodik der automatisierten REM-Analyse, Auswerte-Programme, Daten-Extraktion, Interpretation, Verfassen von Berichten an Aufbereitungsingenieure.

- Methods of automated SEM analysis, evaluation software, data extraction, interpretation, writing of reports for mineral processing engineers.

**Literature:**

**Types of Teaching:**

**Pre-requisites:**

**Recommendations:**
- Knowledge of analytical methods based on electron beam instruments

**Frequency:**
- yearly in the winter semester

**Requirements for Credit Points:**
- For the award of credit points it is necessary to pass the module exam. The module exam contains:
  - AP: Report with protocol on the evaluation of a Mineral Liberation Analysis by Scanning Electron Microscope (SEM)

**Credit Points:**
- 3

**Grade:**
- The Grade is generated from the examination result(s) with the following weights (w):
  - AP: Report with protocol on the evaluation of a Mineral Liberation Analysis by Scanning Electron Microscope (SEM) [w: 1]

**Workload:**
- The workload is 90h. It is the result of 30h attendance and 60h self-studies. Der Zeitaufwand beträgt 60 h und setzt sich zusammen aus 30 h Präsenzzeit und 30 h Selbststudium. Letzteres umfasst die Anfertigung
Expenditure of time is 60 hrs. This is composed of 30 hrs presence in class and 30 hrs homework, including preparation of report with protocol.
Module Name: **Geo-fluid Modelling**

(English):

**Responsible:** Amro, Mohd / Prof. Dr.

**Lecturer(s):** Shao, Haibing / Junior-Prof.

**Institute(s):**
- Institute of Geotechnics
- Institute of Drilling Engineering and Fluid Mining

**Duration:** 1 Semester(s)

**Competencies:**

The idea of this module is to teach basic concepts behind the numerical modelling of fluid flow processes in the subsurface. It is designed to give the students hands-on experience of setting up and running numerical models. With this module, the students should be able to conduct numerical analysis on geo-fluid related processes.

**Contents:**

The lecture will introduce the physical processes of fluid flow, mass and heat transport in the subsurface. Their underlying governing equations will be explained in details. Particular focus will be the numerical solution of these partial differential equations, with finite element method.

With help from the lecturer, the students will be asked to work in small groups and conduct 3 case studies on computer (Computerpraktikum). These studies need to be completed by constructing and simulating numerical models with the open-source software OpenGeoSys. The students are expected to analyze the modelling results and summarize them in written reports.

The modelling skills learned in this module can be applied in Soil protection and agriculture (Fluid flow in the subsurface); Mining operation (Groundwater drainage); Geotechnics; Groundwater management; Exploitation of geothermal energy; Oil and gas reservoir engineering.

**Literature:**


**Types of Teaching:**

S1 (WS): Lectures (1 SWS)

S1 (WS): Computerpraktikum / Practical Application (1 SWS)

S1 (WS): Exercises (1 SWS)

**Pre-requisites:**

**Recommendations:**

Allgemeine Hydrogeologie, 2016-08-22
Partielle Differentialgleichungen für Ingenieure und Naturwissenschaftler, 2009-05-27
Grundkenntnisse der Geohydraulik, PC-Grundkenntnisse

**Frequency:** yearly in the winter semester

**Requirements for Credit Points:**

For the award of credit points it is necessary to pass the module exam. The module exam contains:

- KA [90 min]
- AP: Assignment
- AP: Practical assignment

**Credit Points:** 4

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):

- KA [w: 1]
| Workload:          | The workload is 120h. It is the result of 45h attendance and 75h self-studies. Self-study includes preparation and follow-up work in class instruction as well as preparation for and completion of the assignments as well as the written exam, i.e. “Klausurarbeit”. |
### Module Name:
**Introduction to Geochemistry**

### Responsible:
Matschullat, Jörg / Prof. Dr.

### Lecturer(s):
Pleßow, Alexander / Dr.
Matschullat, Jörg / Prof. Dr.
Kleeberg, Reinhard / Dr.

### Institute(s):
Institute of Mineralogy

### Duration:
1 Semester(s)

### Competencies:
Basic understanding of the chemistry of planet Earth and other celestial bodies. From sampling via sample preparation and analysis - following the selection of appropriate methods - the accompanying short lectures and practical training units deliver the necessary technical-analytical knowledge.

### Contents:
Starting with nucleosynthesis and the formation of solar systems, the periodic system of the elements is being introduced and the chemical differentiation of our planet discussed. Thereafter, all Earth spheres (atmo-, hydro-, pedosphere, oceans and marine geochemistry, sediments and sedimentary rocks) are being introduced and discussed.

In parallel, a solid base is being laid for an understanding of modern inorganic analytics and resulting demands for sampling and sample preparation, the selection of appropriate analytical methods as well as quality control and quality assurance.

### Literature:

### Types of Teaching:
- S1 (SS): Introduction to Geochemistry / Lectures (2 SWS)
- S1 (SS): Methoden der geochemisch-mineralogischen Analytik / Lectures (1 SWS)

### Pre-requisites:
**Mandatory:**
- Einführung in die Mineralogie, 2009-10-14
- Grundlagen der Geowissenschaften I, 2014-09-10

### Frequency:
yearly in the summer semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA [90 min]

### Credit Points:
4

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
- KA [w: 1]

### Workload:
The workload is 120h. It is the result of 45h attendance and 75h self-studies. This encompasses the preparation for lectures and tests as well as post-lecture work.
<table>
<thead>
<tr>
<th>Data:</th>
<th>Module Name: <strong>Mine Water: Hydrogeology and Modeling</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Name:</td>
<td>Mine Water: Hydrogeology and Modeling</td>
</tr>
<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
</tr>
<tr>
<td>Lecturer(s):</td>
<td>Hoth, Nils / Dr.</td>
</tr>
<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering</td>
</tr>
<tr>
<td>Duration:</td>
<td>1 Semester(s)</td>
</tr>
<tr>
<td>Competencies:</td>
<td>The students will improve their knowledge on Hydrogeology and in particular in the field of groundwater flow and transport with special emphasis on mining and rehabilitation and remediation of mining related problems. They will be able to understand basic and complex mining related groundwater problems and to evaluate numerical groundwater models.</td>
</tr>
</tbody>
</table>
| Contents: | • Basic of hydraulic subsurface flow in granular and fractured rocks  
• Basic of transport of contaminants in seepage and groundwater  
• Basic of water balance in particular in mining environments  
• Analytical and numerical modeling  
• Pros and cons of FD and FE models  
• Setting up a 3d steady state flow and transport model, discretization, parameterization, defining boundary conditions, defining sinks and sources  
• Manual and inverse calibration, sensivity analysis  
• Special aspects of dewatering open pit and deep mines, groundwater recovery and mine flooding |
| Literature: | Domenico & Schwartz (1996): Physical and Chemical Hydrogeology, Wiley & Sons  
| Types of Teaching: | S1 (WS): block course / Lectures (3 SWS)  
S1 (WS): block course / Practical Application (2 SWS) |
| Pre-requisites: | Basic knowledge of physics, geology and hydrogeology. |
| Frequency: | each semester |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains:  
KA [90 min]  
AP: Report related to the practials  
PVL: Home assignment  
PVL have to be satisfied before the examination. |
| Credit Points: | 6 |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w):  
KA [w: 3]  
AP: Report related to the practials [w: 1] |
| Workload: | The workload is 180h. It is the result of 75h attendance and 105h self-studies. The latter comprises time for preparation and homework as well as preparation for exams. |
## Module Name:
**Field Exercise**

### (English):
- **Responsible:** Stanek, Klaus / Prof. Dr.
- **Lecturer(s):** Gloaguen, Richard / Dr., Stanek, Klaus / Prof. Dr., Kroner, Uwe / PD Dr., Tichomirowa, Marion / Prof. Dr., Schulz, Bernhard / Prof. Dr., Ratschbacher, Lothar / Prof. Dr.
- **Institute(s):** Institute of Geology, Institute of Mineralogy
- **Duration:** 1 Semester(s)
- **Competencies:** Analyzing orogenic deformation in the field.
- **Contents:** Interdisciplinary data acquisition (e.g. in the fields of structural geology, sedimentology, petrology, remote sensing, paleontology, geomorphology) in the field in the framework of ongoing projects in orogenic belts.
- **Literature:** Publications in international journals Depending on the orogenic belt and work focus
- **Types of Teaching:** S1 (WS): Fieldwork with applications of various methods in tectonics, literature and remote sensing preparation, sampling, field report preparation / Practical Application (8 SWS)
- **Pre-requisites:** **Recommendations:** Bachelor-level field exercises
- **Frequency:** yearly in the winter semester
- **Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:
  - AP: Written report
- **Credit Points:** 5
- **Grade:** The Grade is generated from the examination result(s) with the following weights (w):
  - AP: Written report [w: 1]
- **Workload:** The workload is 150h. It is the result of 120h attendance and 30h self-studies. The latter is spend on preparation and self study.
**Module Name:** Geochronology and Isotope Geochemistry

**Responsible:** Tichomirowa, Marion / Prof. Dr.

**Lecturer(s):** Tichomirowa, Marion / Prof. Dr. Jonckheere, Raymond / Dr. Pfänder, Jörg / PD Dr. Ratschbacher, Lothar / Prof. Dr.

**Institute(s):** Institute of Mineralogy Institute of Geology

**Duration:** 2 Semester(s)

**Competencies:** Acquisation of theoretical and practical skills in geo-thermochronology and isotope geochemical analysis.

**Contents:** Variable, for example: geo-thermochronological techniques (in particular: U-Pb, Ar-Ar, Rb-Sr, particle track), application of geo-thermochronology and isotopic geochemical analysis for the understanding of the evolution of young orogenic belts.


**Types of Teaching:**
- S1 (SS): Lectures (4 SWS)
- S1 (SS): Exercises
- S1 (SS): Practical Application
- S2 (WS): Practical Application (10 d)

**Pre-requisites:** Bachelor course in structural geology

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA [90 min]
- PVL: Seminar and exercises
PVL have to be satisfied before the examination.

**Credit Points:** 9

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):
- KA [w: 1]

**Workload:** The workload is 270h. It is the result of 140h attendance and 130h self-studies.
**Module Name:** Radioactivity  

**Responsible:** Mischo, Helmut / Prof. Dr.-Ing.  
Lecturer(s): Mischo, Helmut / Prof. Dr.-Ing.  
Weyer, Jürgen / Dr.-Ing.  

**Institute(s):** Institute of Mining and Special Civil Engineering  

**Duration:** 1 Semester(s)  

**Competencies:** Basic knowledge of radioactive decay, measurement of radiation, units, technique of sampling, decontamination techniques, ventilation  

**Contents:**  
- Radioactive decay  
- Special consideration of Rn222 and Radon decay  
- Products  
- ICRP principles  
- Protection against radiation  
- Measurement and sampling  
- Pathways  
- Risk analysis  
- Optimal remedial procedures  
- Decontamination techniques  
- Ventilation systems  
- Gases  
- Airway resistance  

**Literature:** ICRP publications, especially ICRP 43 and 65, conference proceedings  

**Types of Teaching:**  
**S1 (SS):** 45 hours / Lectures (3 SWS)  
**S1 (SS):** seminars and practical training, excursions to rehabilitation sites - 45 hours / Practical Application (3 SWS)  

**Pre-requisites:** Recommendations: Fundamentals in engineering and natural science  

**Frequency:** yearly in the summer semester  

**Requirements for Credit Points:**  
For the award of credit points it is necessary to pass the module exam.  
The module exam contains:  
MP/KA (KA if 15 students or more) [MP minimum 30 min / KA 120 min]  
PVL: Project report  
PVL have to be satisfied before the examination.  

**Credit Points:** 6  

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):  
MP/KA [w: 1]  

**Workload:** The workload is 180h. It is the result of 90h attendance and 90h self-studies. The latter includes industrial placement.
### Module Name:
**Geomodelling - Geostatistics for Natural Resource Modelling**

### Responsible:
Benndorf, Jörg / Prof. Dr.-Ing.

### Lecturer(s):

### Institute(s):
Institute for Mine Surveying and Geodesy

### Duration:
1 Semester(s)

### Competencies:
- explain the theoretical foundation of spatial data analysis, geostatistical model building and estimation,
- apply geostatistical methods in the context of estimating natural resources/reserves,
- critically evaluate model assumptions of different estimation and simulation methods and choose suitable methods for specific applications,
- discuss the critical character of the SMU-size to recoverable reserves,
- conduct a resource/reserve estimation in a simple case study.

### Contents:

### Literature:
- M. Armstrong: “Basic Linear Geostatistics”, Springer Verlag;
- H. Akin, H. Siemes: „Praktische Geostatistik“, Springer Verlag;
- T. Schafmeister: “Geostatistik für die hydrogeologische Praxis“, Springer Verlag

### Types of Teaching:
- S1 (WS): Geomodelling – Geostatistics for natural resource modelling - Lecture / Lectures (2 SWS)
- S1 (WS): Geomodelling – Geostatistics for natural resource modelling - Practical work in the computer lab / Practical Application (2 SWS)

### Pre-requisites:
**Recommendations:**
Angewandte Statistik, 2009-05-25
Infinitesimalrechnung, An introductory course in statistics.

### Frequency:
yearly in the winter semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
KA* [90 min]
<table>
<thead>
<tr>
<th>Credit Points:</th>
<th>5</th>
</tr>
</thead>
</table>
| Grade:         | The Grade is generated from the examination result(s) with the following weights (w):
|                | KA*: [w: 2]
|                | AP*: Set of assignments [w: 1]
|                | * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4.0), respectively. |
| Workload:      | The workload is 150h. It consists of 60h presence time (lectures and practical), and 90 hours independent work including group work, practical, self-study and preparation for examination. |
**Module Name:** Hydrogeology IV  
(English):  
**Responsible:** Drebenstedt, Carsten / Prof. Dr.  
**Lecturer(s):** Hoth, Nils / Dr.  
**Institute(s):** Institute of Mining and Special Civil Engineering  
**Duration:** 1 Semester(s)  

**Competencies:** Modeling of aquatic systems including flow, transport and chemical reactions. The students will be able to analyze a given situation, to choose an appropriate algorithm and software package to solve the given problem. Additional they will gain skill concerning geophysical methods that are important for groundwater issues.

**Contents:**  
**Lecture Hydrogeological modeling:**  
- basics of flow and transport modeling (analytical and numerical solutions, FDM, FEM, AEM), boundary conditions  
- numerical stability criteria  
- density driven flow  
- fracture flow  
- multi-phase flow  
- reactive transport modeling  
- impact of stress on pore volume  
- balancing and plausibility test  
- sensitivity analysis  

Hydrogeological seminar: actually relevant research projects, literature research and presenting a talk.

**Practical exercise groundwater modeling:**  
- conceptual model  
- importing a map  
- discretization  
- defining boundary conditions and properties  
- calibration  
- wells and monitoring wells  
- particle tracking  
- modeling a contamination  
- 2d and 3d Model  
- simple transport modeling example  

**Practical exercise reactive transport modeling:**  
- kinetically modeling within PHREEQC  
- 1d reactive transport for the unsaturated and saturated zone taking into account dilution and dual porosity.

**Literature:**  

**Types of Teaching:** S1 (WS): Lectures (2 SWS)
<table>
<thead>
<tr>
<th>Pre-requisites:</th>
<th><strong>Recommendations:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Allgemeine Geophysik 1, 2009-06-03</em></td>
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<tr>
<td></td>
<td><em>Grundlagen der Hydrogeologie, 2009-08-11</em></td>
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<tr>
<td></td>
<td><em>Groundwater Chemistry I, 2009-09-28</em></td>
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<tr>
<td></td>
<td><em>Hydrogeology II, 2011-07-07</em></td>
</tr>
<tr>
<td></td>
<td><em>Hydrogeology III, 2009-08-16</em></td>
</tr>
</tbody>
</table>

| Frequency: | yearly in the winter semester |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains: |
| Credit Points: | 9 |

| Grade: | The Grade is generated from the examination result(s) with the following weights (w): |
| Workload: | The workload is 270h. It is the result of 120h attendance and 150h self-studies. |
|          | KA [w: 1] |
|          | AP: seminar report or equivalent [w: 1] |
|          | AP: reports from groundwater-flow modeling course [w: 1] |
|          | AP: reports from reactive transport modeling course [w: 1] |
Module Name: **Ground Water Chemistry for GW-Management - Advanced**

(English):

**Responsible:** Drebenstedt, Carsten / Prof. Dr. Hoth, Nils / Dr.

**Lecturer(s):** Hoth, Nils / Dr. Klamerth, Nikolaus / Dr. rer. nat.

**Institute(s):** Institute of Mining and Special Civil Engineering  
Institute of Geology

**Duration:** 1 Semester(s)

**Competencies:** Students will gain confidence and experience in sampling, sample handling (conservation, storage) as well as measuring field parameters. Furthermore they enhance their knowledge about analytical techniques for groundwater. He gets a general understanding with respect to the use of isotopes to trace flow and reactive systems in the subsurface (within aquifers). In general they practice and deepen their knowledge about handling of photometry and other analytical techniques.

**Contents:**

- different analytical techniques  
  wet chemistry (gravimetry, volumetry), spectroscopy, chromatography, electro-analysis  
- in detail: acid-base titration, UV-VIS and IR-spectroscopy  
- AAS, AES (MP-AES), hXRF  
Part of hydrogeochemical modelling - with PHREEQC  
speciation of a water sample, ionic balance error, saturation index equilibrium to mineral phases, interaction with a gas phase, cation exchange etc.

Lecture groundwater chemistry (sampling and analytical techniques) combined with laboratory exercises  
Determination of limit of detection and limit of quantification. Using photometry for different species now again, in more detail

Lecture isotope hydrology: Basics of isotope measurements in context to trace subsurface flow systems.  
Stable (H, O, C, N, S) isotopes in aquatic systems. Explanation of investigations on different test sites (field examples) – study and interpretation of flow and reactive systems.

**Literature:**  
Stumm & Morgan (1996): Aquatic Chemistry. John, Wiley & Sons;  
APPELO & POSTMA (1996) or (2005): Geochemistry, groundwater and pollution, Balkema.  

**Types of Teaching:**  
S1 (SS): GW chemistry - analytical techniques / Lectures (2 SWS)  
S1 (SS): Stable Isotope hydrology - trace flow and reactions / Lectures (1 SWS)  
S1 (SS): groundwater chemistry - advanced practica / Practical Application (1 SWS)

**Pre-requisites:**

**Recommendations:**  
Ground Water Chemistry for GW-Management - Basics, 2018-07-04

**Frequency:** yearly in the summer semester

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:  
KA*: GW chemistry - analytical techniques [90 min]
<table>
<thead>
<tr>
<th>Credit Points:</th>
<th>6</th>
</tr>
</thead>
</table>
| Grade:         | The Grade is generated from the examination result(s) with the following weights (w):  
|                | KA*: GW chemistry - analytical techniques [w: 1]  
|                | KA*: Isotope hydrology - trace flow and reaction [w: 1]  
|                | AP*: practical lab reports [w: 1]  
<p>|                | * In modules requiring more than one exam, this exam has to be passed or completed with at least &quot;ausreichend&quot; (4,0), respectively. |
| Workload:      | The workload is 180h. It is the result of 60h attendance and 120h self-studies. (120 h are spent on preparation, preparing the reports for the lab classes and self study) |</p>
<table>
<thead>
<tr>
<th>Data:</th>
<th>EARTHSY. BA. Nr. 748 / Examination number: 31014</th>
<th>Version: 03.05.2011</th>
<th>Start Year: SoSe 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Name:</td>
<td><strong>Introduction Earth System Science</strong></td>
<td>(English):</td>
<td></td>
</tr>
<tr>
<td>Responsible:</td>
<td>Matschullat, Jörg / Prof. Dr.</td>
<td>Lecturer(s):</td>
<td>Matschullat, Jörg / Prof. Dr.</td>
</tr>
<tr>
<td>Institute(s):</td>
<td>Institute of Mineralogy</td>
<td>Duration:</td>
<td>1 Semester(s)</td>
</tr>
<tr>
<td>Competencies:</td>
<td>Successful participants obtain an understanding for the complexity of environmental challenges, and for the individual parts of the geosphere and their interactions – the prerequisite for any responsible work in many environmental fields. In addition, the module assists in learning how to write short scientific communications.</td>
<td></td>
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<tr>
<td>Contents:</td>
<td>The lecture covers the theoretical background of many typical tasks in environmental research and practice. Examples from all environmental compartments are being discussed from the initial concept via sampling to the interpretation of results. A complimentary seminar trains the participants to write scientific texts on lecture topics.</td>
<td></td>
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<tr>
<td>Types of Teaching:</td>
<td>S1 (SS): Lectures (2 SWS) S1 (SS): Incl. Excursion / Exercises (1 SWS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-requisites:</td>
<td><strong>Recommendations:</strong></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Frequency:</td>
<td>yearly in the summer semester</td>
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<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] AP: Written Essay AP: Written Essay</td>
<td></td>
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<tr>
<td>Credit Points:</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade:</td>
<td>The Grade is generated from the examination result(s) with the following weights (w): KA [w: 2] AP: Written Essay [w: 2] AP: Written Essay [w: 1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workload:</td>
<td>The workload is 90h. It is the result of 45h attendance and 45h self-studies.</td>
<td></td>
<td></td>
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</tbody>
</table>
Data: MINING. MA. Nr. 2914 / Examination number: 31703  
Version: 28.04.2010  
Start Year: WiSe 2010

<table>
<thead>
<tr>
<th>Module Name:</th>
<th>Introduction to Mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
</tr>
<tr>
<td>Lecturer(s):</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
</tr>
<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering</td>
</tr>
<tr>
<td>Duration:</td>
<td>1 Semester(s)</td>
</tr>
<tr>
<td>Competencies:</td>
<td>Basic knowledge in role of mining and mining engineering processes and relationship to other disciplines; Understanding of sustainable development in mining industry: balance between mining production, social development and environment protection.</td>
</tr>
<tr>
<td>Contents:</td>
<td>Mining is one of the oldest and most important sectors in our civilisation building the backbone of many further industries. Developed economies highly dependent on mineral and energy imports. The world knows many wars about reserves and resources. Mining production employs million of workers worldwide and is especially in developing countries an important source of income. On other side mining has a great influence to the environment and social sphere. Mining is today a modern industry with high standard in working safety and environment protection. The largest machines the world knows are operating in open pit mines. The lecture introduces this interesting and important world of mining and gives an understanding for economic, social and technical processes. Case studies will illustrate the practical side of knowledge application.</td>
</tr>
</tbody>
</table>
Hustrulid, Kuchta: Open pit mine planning and design, Balkema, latest edition |
| Types of Teaching: | S1 (WS): Lectures (1 SWS)  
S1 (WS): Exercises (1 SWS) |
| Pre-requisites: | Recommendations:  
No requirements. |
| Frequency: | yearly in the winter semester |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] |
| Credit Points: | 3 |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1] |
| Workload: | The workload is 90h. It is the result of 30h attendance and 60h self-studies. |
Module Name: **Applied Engineering Geology and Brownfield Revitalisation**

(English):

**Duration:** 1 Semester(s)

**Competencies:** Participants get the qualification to gain knowledge of the scientific field of engineering geology, including methods to evaluate soil and groundwater contaminated sites, learn to apply an interdisciplinary approach focussing on technique, economy, ecology and environmental law. The additional goal is to acquire the specific knowledge of a Brownfield Manager.

**Contents:**

The basis of Engineering Geology:

- Aims, Development
- Materials and Mass Fabric
- Environmental Factors

Investigating the ground:

- Geological materials, sediments, rock materials, fluids and gases
- Description of materials, properties and their measurement
- Geological masses
- Maps
- Recovery of samples
- Field tests and measurements

Ground behaviour:

- Ground response to engineering and natural processes
- Withdrawal of support by surface and underground excavations
- Static loading of the ground
- Dynamic loading of the ground
- Ground reaction to changes of fluid and gas pressures

Technology of disposal sites and tailings:

- Geotechnical aspects related to the construction of disposal sites and tailings
- site survey, investigations and characteristics
- transport mechanisms of contaminants in the underground

Contaminated sites - investigation assessment and reusing (Lifecycle):

- Environmental legislation relevant to contaminated sites
- Quality control of sampling on contaminated sites, analytics of site contaminations, reclamation process and monitoring
- Assessment of water, soil and air pollution level (risk assessment)
- Overview of reclamation methods and geotechnical securing measures
- Safety of operation in dealing with contaminated sites
- Aspects and concepts of site revitalisation (innercity areas/landscaping)

**Cost-benefit considerations, case studies:**

- Comparing various remediation strategies and selecting best option

**Developing and assessing successful after-use scenarios:**

- Risk assessment, marketing studies, cost benefit analysis

<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td>Franzius V.; Altenbockum M.; Gerhold T. (Herausgeber): Handbuch: Altlastensanierung und Flächenmanagement, Verlag C.F. Müller</td>
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<td></td>
<td>TA Abfall/ Siedlungsabfall</td>
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<td></td>
<td>Arbeitshilfen Altlasten</td>
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<td></td>
<td>Sustainable Brownfield Regeneration: CABERNET Network Report</td>
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<td></td>
<td>Proceedings ECI Conferences „Green Brownfields“</td>
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<table>
<thead>
<tr>
<th>Types of Teaching:</th>
<th>S1 (WS): Lectures (4 SWS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S1 (WS): Practical Application (2 SWS)</td>
</tr>
</tbody>
</table>

**Pre-requisites:**

**Recommendations:**

- B.Sc. in Geosciences or Geo-Engineering; Basic Knowledge of Geosystems

**Frequency:**

- each semester

**Requirements for Credit Points:**

For the award of credit points it is necessary to pass the module exam. The module exam contains:

- MP/KA: Technology of disposal sites and tailings, Contaminated sites - investigation assessment and reusing (KA if 15 students or more) [MP minimum 30 min / KA 90 min]

- AP: Project report: Cost-benefit considerations, Developing and assessing successful after-use scenarios

**Credit Points:**

- 6

**Grade:**

The Grade is generated from the examination result(s) with the following weights (w):

- MP/KA: Technology of disposal sites and tailings, Contaminated sites - investigation assessment and reusing [w: 2]

- AP: Project report: Cost-benefit considerations, Developing and assessing successful after-use scenarios [w: 1]

**Workload:**

- The workload is 180h. It is the result of 90h attendance and 90h self-studies. Latter includes the preparation and review of the taught materials and exam preparation.
### Module Name: Licensing, Stakeholder Involvement and Expectation Management

**Responsible:** Drebenstedt, Carsten / Prof. Dr. Bongaerts, Jan C. / Prof. Dr.

**Lecturer(s):** Bongaerts, Jan C. / Prof. Dr.

**Institute(s):** Professor of Environmental & Resource Management
Institute of Mining and Special Civil Engineering

**Duration:** 1 Month(s)

**Competencies:**

Upon completion of industrial activity at a given site (e.g., mining, chemical production), liabilities must be investigated, assessed, and removed/remediated with respect to safe usage in the future. This is an iterative decision process involving many parties, often with conflicting interests and different ways to influence the outcome of this decision process. This module addresses the need to handle public inquiries, concerns, or conflicts on environmental and remediation issues. It shows environmental managers, regulators and public servants in this field, and consultants at industrial facilities how to identify the causes of environmental issues and concerns, create community relations programs to address issues or establish a proactive dialogue to prevent or minimise future environmental conflicts, and handle technical and risk communication in a highly efficient manner.

The aspects which have to be observed within such a complex process include (but are not restricted to):

- legal requirements,
- economic conditions,
- environmental objectives and regional political aims,
- communication, information management and negotiation methods.

The subjects will be presented using overview texts and summary texts, graphs, and case studies. Discussions among students and between tutors and students will be facilitated by electronic means of communication such as email and a web-based discussion platform. Special emphasis will be laid on presentation of selected cases and discussion of critical parameters like timing cost, communication problems, information handling. Students will be trained in groups and individually. This module will also feature checklists, forms and worksheets as tools for further reference in the daily work.

**Contents:**

Expectations by the various stakeholders are identified as driving forces within a remediation project. The management of expectations of all involved stakeholders as well as transparent assessment and decision procedures are a core ingredient of this module, and will be discussed using case studies from a great variety of real-world projects and experiences. Students will be encouraged to contribute their personal and professional experiences to the module in order to both focus the content to the specific needs of the audience and to demonstrate the great cultural variety of negotiation and management styles.

**Literature:**


Warren Richard Plunkett, Raymond F. Attner, Gemmy Allen:
| Types of Teaching: | S1 (SS): Lectures (4 d)  
|                  | S1 (SS): Seminar (1 d) |
| Pre-requisites:  | **Recommendations:**  
|                  | No previous knowledge of management is required. |
| Frequency:       | yearly in the summer semester |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains:  
|                  | KA [120 min]  
|                  | PVL: Preparation and presentation of a project on a practical case  
|                  | PVL have to be satisfied before the examination. |
| Credit Points:   | 6 |
| Grade:           | The Grade is generated from the examination result(s) with the following weights (w):  
|                  | KA [w: 1] |
| Workload:        | The workload is 180h. It is the result of 40h attendance and 140h self-studies. |
**Module Name:** Limnology  

**Responsible:** Matschullat, Jörg / Prof. Dr.  

**Lecturer(s):** Pleßow, Alexander / Dr.  
Herklotz, Kurt / Dipl.-Chem.  
Matschullat, Jörg / Prof. Dr.  

**Institute(s):** Institute of Mineralogy  
Institute of Biosciences  

**Duration:** 1 Semester(s)  

**Competencies:** Limnology as the historical base of modern ecology offers a tightly knit dissemination of physical-chemical-biological fundamentals in theory and practical applications. Successful participants perceive limnological challenges and are capable of tackling elated problems independently. They are qualified to work in respective professional applications.  

**Contents:** Fundamentals and applications of Limnology. Physical and chemical processes (Light, heat, movement, element cycles). Organisms and their interaction (plankton, food webs, (partial) ecosystems. Applied Limnology (Methods and case studies in theory and practice applications, e.g., eutrophication, acidification, litoral damages)  

**Literature:**  
Aktuelle Literatur für Seminarreferat  

**Types of Teaching:**  
S1 (SS): Lectures (2 SWS)  
S1 (SS): Excursion (5 d)  

**Pre-requisites:**  
Einführung in die Prinzipien der Biologie und Ökologie, 2014-03-11  
Physik für Naturwissenschaftler II, 2014-06-02  
Physik für Naturwissenschaftler I, 2014-06-02  
Allgemeine, Anorganische und Organische Chemie, 2016-04-20  

**Frequency:** yearly in the summer semester  

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:  
KA [90 min]  
PVL: Report (field work)  
PVL have to be satisfied before the examination.  

**Credit Points:** 5  

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):  
KA [w: 1]  

**Workload:** The workload is 150h. It is the result of 70h attendance and 80h self-studies. These self studies include preparation for lectures and field work.
Data: | SUSGMF. MA. Nr. 083 /  | Version: 01.01.2014  | Start Year: WiSe 2014 |
---|---|---|---|
Module Name: | Management and Finance of Mining Operations along the Life Cycle (English): |
Responsible: | Drebenstedt, Carsten / Prof. Dr. Bongaerts, Jan C. / Prof. Dr. |
Lecturer(s): | Bongaerts, Jan C. / Prof. Dr. |
Institute(s): | Professor of Environmental & Resource Management Institute of Mining and Special Civil Engineering |
Duration: | 1 Month(s) |
Competencies: | Environmental remediation projects require careful financial planning and control since their time frame can be often quite long and uncertain and considerable financial means are required from different sources. Public funding institutions and private/corporate sources require that a remediation project be carried out at minimal cost in minimal time. Strong financial skills are absolutely essential for a successful future career of this course’s participants. Students will, therefore, be equipped with a sound knowledge and broad overview of general management concepts with special emphasis on project finance, financial control and accounting, cost estimating and forecasting/simulation techniques as well as funding mechanisms. Students will also familiarise themselves with concepts how to handle uncertainty and risk. |
Contents: | According to the objectives, the module is structured into two separate but closely linked parts: Part A: General management |
| | • Management and strategic thinking |
| | • Project and team structures, management styles |
| | • Introduction to structural models of corporations and project teams |
| | • Fundamentals of human resources management: choosing the right people and structures |
| | Part B: Financial management |
| | • Fundamentals of finance, basic concepts: balance sheets, profit/loss statements, cash-flow reports, ratio analysis |
| | • Using conceptual models for financial planning: fundamentals and practical use of software tools |
| | • Cost-estimating techniques for large-scale remediation projects |
| | • Cash-flow planning in remediation projects |
| | • Dealing with uncertainties in financial forecasts |
| | • Cost control and reporting |
| | • Sources of finance: public, corporate, foundations. Their role and specific expectations/requirements to spending money and reporting |
| | • Incorporating the potential after-use and redevelopment scenarios of remediated site into the planning and evaluation of remediation projects |
| | • Communication of financial information at different levels |

The subjects will be presented using overview texts and summary texts, and graphs. The students will receive numerous handouts that not only...
contain the content of the lectures and case studies but will also serve for future reference. Students will be encouraged to participate actively in the presentation to solicit ideas as well as individual situations experienced and integrate these in the structured presentation. Where appropriate real-life situations will be simulated.
A wide range of software tools for simulation of financial processes will be presented in the context of case studies to demonstrate their application to practical situations.
Presentation of small group projects and case studies forms an essential part of the module in order to train communication skills.

Literature:
- Rudolf Volkart: Corporate Finance

Types of Teaching:
- S1 (WS): Lectures (4 d)
- S1 (WS): Exercises (4 d)

Pre-requisites: Recommendations: No previous knowledge of management is required.

Frequency: yearly in the winter semester

Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA [120 min]
- PVL: Home assignment
PVL have to be satisfied before the examination.

Credit Points: 6

Grade: The Grade is generated from the examination result(s) with the following weights (w):
- KA [w: 1]

Workload: The workload is 180h. It is the result of 64h attendance and 116h self-studies.
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<tbody>
<tr>
<td>Module Name:</td>
<td><strong>Mine Water: Chemistry and Treatment</strong></td>
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<tr>
<td>(English):</td>
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<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
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<tr>
<td>Lecturer(s):</td>
<td>Hoth, Nils / Dr.</td>
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<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering</td>
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<tr>
<td>Duration:</td>
<td>1 Semester(s)</td>
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<tr>
<td>Competencies:</td>
<td>Participants will improve their knowledge about the reasons and processes of mine water generation. Furthermore they will improve their basic chemical understanding of weathering, buffering and precipitation reactions. So they are able to understand the strategy of different water treatment technologies.</td>
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<tr>
<td>Contents:</td>
<td>Basics of mine water generation – Acid Mine Drainage / Acid Rock Drainage Most important Buffer systems, Acid-Base-balance for forefield materials Basics of chemical thermodynamics (ionic strength, law of mass action, calculation of activity, saturation index) Water flow systems of large scale open cast mines – chemical analyses as tracer to understand the flow-fields Basics of water treatment: precipitation, biological techniques, membrane and ion exchange methods</td>
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<tr>
<td>Types of Teaching:</td>
<td>S1 (WS): block course / Lectures (3 SWS) S1 (WS): block course / Practical Application (2 SWS)</td>
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<tr>
<td>Pre-requisites:</td>
<td>Recommendations: Basic knowledge on chemistry, hydrogeology and process engineering</td>
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<td>Frequency:</td>
<td>yearly in the winter semester</td>
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<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] AP: Report 1 related to the practicals PVL: Home assignment AP: Report 2 related to the practicals PVL have to be satisfied before the examination.</td>
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<tr>
<td>Credit Points:</td>
<td>6</td>
<td></td>
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<tr>
<td>Grade:</td>
<td>The Grade is generated from the examination result(s) with the following weights (w): KA [w: 6] AP: Report 1 related to the practicals [w: 1] AP: Report 2 related to the practicals [w: 1]</td>
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<tr>
<td>Workload:</td>
<td>The workload is 180h. It is the result of 75h attendance and 105h self-studies. The latter comprises time for preparation and homework as well as preparation for exams.</td>
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### Module Name:
**Master-Seminar Sustainable Mining and Remediation Management with Colloquium**

<table>
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<th>Data:</th>
<th>SEMSMRM. MA. Nr. 2092 / Examination number: -</th>
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<tr>
<td>Version:</td>
<td>02.05.2014</td>
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<td>Start Year:</td>
<td>WiSe 2014</td>
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<tr>
<th>Module Name:</th>
<th>Master-Seminar Sustainable Mining and Remediation Management with Colloquium</th>
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<tbody>
<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
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<tr>
<td>Lecturer(s):</td>
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<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering</td>
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<tr>
<td>Duration:</td>
<td>1 Month(s)</td>
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<tr>
<td>Competencies:</td>
<td>Experiences with own scientific work, written and oral summary and presentation of the results</td>
</tr>
<tr>
<td>Contents:</td>
<td>The students will get a specific topic for their work as well as hints for the literature study. The students have to familiarize with this topic and they have to prepare an oral 30 min presentation. A written copy of the presentation has to be prepared as well. The students should improve their ability to communicate and to speak free in front of a greater audience. They should learn how to prepare a presentation (Selection of literature, material, time schedule) and they should gain experience how to prepare scientific papers. Seminar lecture to specific topics with guest-lecturers from the industry complete the module.</td>
</tr>
<tr>
<td>Literature:</td>
<td>Will be specified according to the topic of the work</td>
</tr>
<tr>
<td>Types of Teaching:</td>
<td>S1 (WS): Colloquia (lecture with discussion, 8 hours) / Seminar (1 d) S1 (WS): Seminar (1 d)</td>
</tr>
<tr>
<td>Pre-requisites:</td>
<td>Recommendations: Knowledge and abilities form the 1. and 2. semester of the study course Sustainable Mining and Remediation Management. (see study order)</td>
</tr>
<tr>
<td>Frequency:</td>
<td>yearly in the winter semester</td>
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<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written paper AP*: Oral presentation [30 min] * In modules requiring more than one exam, this exam has to be passed or completed with at least &quot;ausreichend&quot; (4,0), respectively.</td>
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<tr>
<td>Credit Points:</td>
<td>4</td>
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<tr>
<td>Grade:</td>
<td>The Grade is generated from the examination result(s) with the following weights (w): AP*: Written paper [w: 1] AP*: Oral presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least &quot;ausreichend&quot; (4,0), respectively.</td>
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<tr>
<td>Workload:</td>
<td>The workload is 120h. It is the result of 16h attendance and 104h self-studies. The self study includes the preparation of the presentation, the written copy of the presentation and consultations.</td>
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</table>
### Module Name:

**Applied Spatial Data Analysis and Modelling - Case Study**

### Responsible:

Benndorf, Jörg / Prof. Dr.-Ing.

### Lecturer(s):

Löbel, Karl-Heinz / Dr. Ing.

Benndorf, Jörg / Prof. Dr.-Ing.

### Institute(s):

Institute for Mine Surveying and Geodesy

### Duration:

1 Semester(s)

### Competencies:

After successful completion of the course, students are able to:

- independently create solutions for complex practical problems in mining and geoengineering applying knowledge about mine surveying, mining engineering, geotechnical engineering and engineering geology, utilizing modern methods in geospatial data analysis, geo-modelling and GIS,
- critically assess and interpreted results of the analysis and provide recommendations related to expected impact of mining activities during active and post-mining phase,
- coordinate team work, create project plans and manage the work progress,
- present results in a report and/or a presentation to a panel of independent experts,
- conduct auto-didactical education related to detailed handling of typical software.

### Contents:

- project work on a case study related to after mine care
- supporting acquisition of georeferenced data
- impact analysis on environment and safety
- data base structures suited to map the problem on hand
- GIS project management
- interpolation, 2½- and 3D model building
- geospatial data analysis
- network analysis
- client/server concepts
- GIS and internet
- presentation of results in thematic maps and presentations

### Literature:

David Maguire, Michael Batty, Michael Goodchild: GIS, Spatial Analysis, and Modeling. ISBN: 1-58948-130-5;

### Types of Teaching:

S1 (SS): Applied Spatial Data Analysis and Modelling for After Mine Care - Case Study - Lectures / Lectures (1 SWS)
S1 (SS): Applied Spatial Data Analysis and Modelling for After Mine Care
### Pre-requisites:
**Recommendations:**
- Allgemeine Grundlagen im Markscheidewesen, 2018-01-11
- Grundlagen der Geoinformationssysteme, 2014-06-16

### Frequency:
Yearly in the summer semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- MP*: Oral examination [30 min]
- AP*: Report on project

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4.0), respectively.

### Credit Points:
5

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
- MP*: Oral examination [w: 2]
- AP*: Report on project [w: 3]

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4.0), respectively.

### Workload:
The workload is 150h. It consists of 45h lectures 105h independent work including group work, practical, self-study and preparation for examination.
**Module Name:** Groundwater Chemistry II  
(English):  

**Responsible:**  
Drebenstedt, Carsten / Prof. Dr.  
Hoth, Nils / Dr.  

**Institute(s):** Institute of Mining and Special Civil Engineering  

**Duration:** 1 Semester(s)  

**Competencies:** The Students will gain confidence and experience in sampling, sample treatment, sample storage as well as measuring field parameters and basic and advanced analytical techniques for ground water investigations and with respect to environmental isotopes in water.

**Contents:** Lecture groundwater chemistry (sampling and analytical techniques) combined with laboratory exercises: sampling (DIN/ISO and low flow sampling), impact of construction material of monitoring well, filtration and stabilization in the field, reading field parameters (pH, eH, temperature, EC, O$_2$). Determination of limit of detection and limit of quantification. Using photometry for different species (e.g. Fe(II), Fe(III), NO$_2$, NO$_3$, NH$_4$), titration to determine balance between lime and carbonic acid and Ks and Kb in comparison to the determination of TIC. Ion selective electrodes (activity versus concentration), Ion chromatography for anions and cations, HPLC for inorganic and organic compounds (evaluation of chromatograms), ICP-MS and coupling IC with ICP-MS, GC with FID, ECD, NPD, PID, MS. Elisa and toxicity tests. Lecture isotope hydrology: stable (H, O, C, N, S, and Sr) and radioactive isotopes (H, C, Sr, Cs, Ra, U, J, Rn, Ar, Kr, Cl) in aquatic systems.

**Literature:**  
Schwedt (1996): Taschenatlas der Analytik, WILEY-VCH;  
Sigg & Stumm (1994): Aquatische Chemie, Teubner Verlag;  
Stumm & Morgan (1996): Aquatic Chemistry. John, Wiley & Sons;  

**Types of Teaching:**  
S1 (SS): Analytics / Lectures (1 SWS)  
S1 (SS): Analytics / Exercises (3 SWS)  
S1 (SS): Isotopes / Lectures (2 SWS)  

**Pre-requisites:** **Recommendations:**  
Allgemeine, Anorganische und Organische Chemie, 2009-09-02  
Groundwater Chemistry I, 2009-09-28  
Physik für Naturwissenschaftler I, 2012-05-10  
Physik für Naturwissenschaftler II, 2012-05-10  
Basic knowledge in chemistry, water chemistry, and physics

**Frequency:** yearly in the summer semester

**Requirements for Credit Points:**  
For the award of credit points it is necessary to pass the module exam. The module exam contains:  
KA [90 min]  
KA [90 min]  
AP: Lab reports

**Credit Points:** 6

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):  
KA [w: 1]  
KA [w: 1]
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<th>AP: Lab reports [w: 2]</th>
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<tr>
<td><strong>Workload:</strong></td>
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<tr>
<td>The workload is 180h. It is the result of 90h attendance and 90h self-studies.</td>
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</table>
### Module Name:
**Hydrogeology II**

**Institute(s):** Institute of Mining and Special Civil Engineering

### Competencies:
The students will be able to solve practically relevant hydrogeological problems. They will be able to select appropriate techniques for both investigation and data evaluation. In particular they will gain knowledge with respect to all issues concerning groundwater protection.

### Contents:
1. **Lecture Hydrogeology II**: practically relevant hydrogeological tasks and techniques such as hydrogeological mapping, prognosis of water demand, geophysical exploration and measuring techniques, drilling of wells, well development and well rehabilitation, hydrogeological field measurements, pumping-test (design, performance, evaluation), parameter determination in the lab, natural/artificial tracers, groundwater chemistry (sensors, sampling, conservation, analytical techniques). Paleohydrogeology, perma-frost, fresh-saltwater interface at coastal sites, geothermal systems and geothermal energy, engineering and mining hydrogeology, examples from regional hydrogeology

2. **Practical exercises II**: working with hydrogeological maps, groundwater recharge, saltwater intrusion, geodetic leveling, GPS, DGPS, water sampling, well design, well construction, and well rehabilitation, pumping test performance and evaluation (steady state and transient), diffusion and dispersion.

3. **Lecture groundwater protection**: Legal regulations, designing and controlling well head protection zones according to W 101, restrictions in protection zones. General groundwater protection, soil protection law, UVP-law (environmental assessment studies), European water frame work, calculating ground water vulnerability, groundwater information systems

4. **Groundwater protection seminar and practical training**: designing a well head protection zone, presenting a talk and a paper

### Literature:
- Driscoll (1997): Groundwater and Wells. DWGW-Richtlinie W101

### Types of Teaching:
- S1 (WS): with practical training / Lectures (3 SWS)
- S1 (WS): Seminar (3 SWS)

### Pre-requisites:
**Recommendations:**
- Angewandte Geowissenschaften I, 2009-08-26
- Basic knowledge in Applied Geosciences

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA [90 min]
- AP: Report of practical training
- AP: Report of well head protection zone, Talk (10 min) and paper (6 pages)

### Credit Points:
7

### Grade:
The Grade is generated from the examination result(s) with the following
<table>
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<tr>
<td>KA [w: 2]</td>
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<tr>
<td>AP: Report of practical training [w: 1]</td>
</tr>
<tr>
<td>AP: Report of well head protection zone, Talk (10 min) and paper (6 pages) [w: 2]</td>
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<tr>
<th>Workload:</th>
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<tbody>
<tr>
<td>The workload is 210h. It is the result of 90h attendance and 120h self-studies.</td>
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</table>
Data: RHEMINE. MA. Nr. 2017 / Examination number: 30410  
Version: 23.01.2019  
Start Year: WiSe 2019

<table>
<thead>
<tr>
<th>Module Name:</th>
<th>Rheology; Microtectonics, Neotectonics</th>
</tr>
</thead>
</table>
| Responsible: | Ratschbacher, Lothar / Prof. Dr.  
Kroner, Uwe / PD Dr.  
Ratschbacher, Lothar / Prof. Dr.  
Schneider, Susanne / Dr.  |
| Lecturer(s): |  |
| Institute(s): | Institute of Geology  |
| Duration: | 2 Semester(s)  |
| Competencies: | Verständnis der materialwissenschaftlichen Aspekte von Gesteinsdeformation, Erdbebengeologie und Störungszonen  
Understanding the Materials Science aspects of rock deformation; earthquake geology; nature of fault zones  |
| Contents: | • Materialwissenschaftliche Betrachtung von Gesteinen (Materials Science of rocks)  
• Theorie und Praxis der neotektonischen, paläoseismologischen und geomorphologischen Analyse (Aspects of neotectonics, paleoseismology, tectonic geomorphology)  
• Erdbebengeologie (Earthquake geology)  |
| Literature: | Twiss & Moores (various editions) Structural Geology  
Burbank & Andersen (2011) Tectonic Geomorphology  
McCalpin (2009) Paleoseismology  
Yeats et al. (1997) The Geology of Earthquakes  
Publikationen in Fachzeitschriften  |
| Types of Teaching: | S1 (WS): Rheology and Neotectonics / Lectures (3 SWS)  
S1 (WS): Rheology and Neotectonics / Exercises (1 SWS)  
S1 (WS): Rheology and Neotectonics / Seminar (1 SWS)  
S2 (SS): Microtectonics / Lectures (1 SWS)  
S2 (SS): Microtectonics / Exercises (1 SWS)  |
| Pre-requisites: |  |
| Recommendations: | Bachelor Geowissenschaften  |
| Frequency: | yearly in the winter semester  |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam.  
The module exam contains:  
MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 60 min]  
The type of exam will be announced at the beginning of the term.  |
| Credit Points: | 8  |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w):  
MP/KA [w: 1]  |
| Workload: | The workload is 240h. It is the result of 105h attendance and 135h self-studies. Letzteres umfasst Vor- und Nachbereitung der Lehrveranstaltung und Prüfungsvorbereitungen. |
|-------|--------------------------------------------------|----------------------|---------------------|
| Module Name: | **Ore Deposits & Economic Geology** | | |
| (English): | | | |
| Responsible: | Seifert, Thomas / Prof. Dr. | | |
| Lecturer(s): | Seifert, Thomas / Prof. Dr. | | |
| Institute(s): | Institute of Mineralogy | | |
| Duration: | 1 Semester(s) | | |
| Competencies: | Offering engineers and non-geoscientists the opportunity to get some background knowledge on the genesis of ore deposits and resulting implications for exploration and processing. | | |
| Contents: | An introduction to ore-forming environments. Major case studies of ore and industrial mineral deposits will also be discussed. An integral part of the course is the study of hand specimens. | | |
| Types of Teaching: | S1 (SS): Lectures (1 SWS) | | |
| | S1 (SS): Exercises (1 SWS) | | |
| Pre-requisites: | **Recommendations:** | | |
| | No requirements. | | |
| Frequency: | yearly in the summer semester | | |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] | | |
| Credit Points: | 3 | | |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1] | | |
| Workload: | The workload is 90h. It is the result of 30h attendance and 60h self-studies. | | |
### Module Name: Petrology of Metamorphic Rocks

**English:**

**Responsible:** Schulz, Bernhard / Prof. Dr.

**Lecturer(s):** Schulz, Bernhard / Prof. Dr.

**Institute(s):** Institute of Mineralogy

**Duration:** 1 Semester(s)

**Competencies:** Acquisition of theoretical and practical skills in the analysis of pressure-temperature-deformation paths in metamorphic rocks

**Contents:** Variable, for example: microanalytical analysis of metamorphic rocks and geothermobarometry, case studies in orogenic belts

**Literature:**

**Types of Teaching:**
- S1 (WS): Lectures (1 SWS)
- S1 (WS): Exercises and seminars / Exercises (5 SWS)
- S1 (WS): Practical Application (1 d)

**Pre-requisites:**

**Recommendations:**
Grundlagen der Strukturgeologie, 2015-09-07

**Frequency:**
yearly in the winter semester

**Requirements for Credit Points:**
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA [90 min]
- PVL: Participation in the seminars
- PVL have to be satisfied before the examination.

**Credit Points:** 6

**Grade:** The Grade is generated from the examination result(s) with the following weights (w):
- KA [w: 1]

**Workload:** The workload is 180h. It is the result of 98h attendance and 82h self-studies.
<table>
<thead>
<tr>
<th>Data:</th>
<th>Module Name: Forschungsseminar Tektonik/Geochronologie</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOMS. MA. Nr. 2018 / Examination number: 30413</td>
<td>(English): Research Seminar in Tectonics and Geochronology</td>
</tr>
<tr>
<td>Version: 22.01.2019</td>
<td>Responsible: Ratschbacher, Lothar / Prof. Dr.</td>
</tr>
<tr>
<td>Start Year: SoSe 2019</td>
<td>Lecturer(s): Ratschbacher, Lothar / Prof. Dr.</td>
</tr>
<tr>
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<tr>
<td>Module Name: Forschungsseminar Tektonik/Geochronologie</td>
<td>Institute(s): Institute of Geology</td>
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<tr>
<td>Competencies:</td>
<td>Duration: 1 Semester(s)</td>
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<tr>
<td>The goal is to enhance the abilities in scientific thinking, presentation, and discussion. This involves participation in lectures of external scientists and own presentations. Der Student soll lernen, wissenschaftlich integrativ zu denken, ein wissenschaftliches Thema selbstständig zu bearbeiten und vor einem Fachpublikum zu präsentieren und zu verteidigen.</td>
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<tr>
<td>Contents:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Literature:</td>
<td></td>
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<tr>
<td>Article of scientific literature</td>
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<tr>
<td>Artikel der internationalen Fachliteratur</td>
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<tr>
<td>Types of Teaching:</td>
<td></td>
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<tr>
<td>S1 (SS): Lectures (1 SWS)</td>
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<tr>
<td>S1 (SS): Seminar (1 SWS)</td>
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<td>Pre-requisites:</td>
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<tr>
<td>Recommendations:</td>
<td></td>
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<tr>
<td>Geowissenschaftliche Kenntnisse</td>
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<td>Frequency:</td>
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<tr>
<td>yearly in the summer semester</td>
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<tr>
<td>Requirements for Credit Points:</td>
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<tr>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains:</td>
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<tr>
<td>AP: Literary studies, scientific presentation and discussion</td>
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<tr>
<td>Credit Points:</td>
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<tr>
<td>The Grade is generated from the examination result(s) with the following weights (w):</td>
<td></td>
</tr>
<tr>
<td>AP: Literary studies, scientific presentation and discussion [w: 1]</td>
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<tr>
<td>Workload:</td>
<td></td>
</tr>
<tr>
<td>The workload is 90h. It is the result of 30h attendance and 60h self-studies.</td>
<td></td>
</tr>
<tr>
<td>Data:</td>
<td>PRAKGTB. MA. Nr. 2096 / Examination number: -</td>
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<td>-------</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Module Name:</td>
<td>Practical Training SMRM</td>
</tr>
<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
</tr>
<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering</td>
</tr>
<tr>
<td>Duration:</td>
<td>4 Week(s)</td>
</tr>
<tr>
<td>Competencies:</td>
<td>By help of own practical work and observation the students should get abilities and skills in the field of sustainable technologies in geotechnics and mining, rehabilitation and the design and recultivation of former mining areas.</td>
</tr>
<tr>
<td>Contents:</td>
<td>The practical training consists of practical work in enterprises and institutions with relation to mining and remediation.</td>
</tr>
<tr>
<td>Literature:</td>
<td>Ordnung für das Grundpraktikum, TU Bergakademie Freiberg, 2003</td>
</tr>
<tr>
<td>Types of Teaching:</td>
<td>S1 (WS): Practical training in enterprises and institutions working in the field of mining or remediation / Practical Application (4 Wo)</td>
</tr>
<tr>
<td>Pre-requisites:</td>
<td>Recommendations: Students have to apply by their own in recognized enterprises/institutions. Recommendations can be obtained from institutes of TU Bergakademie Freiberg which are included in the course.</td>
</tr>
<tr>
<td>Frequency:</td>
<td>yearly in the winter semester</td>
</tr>
<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: PVL: Written confirmation of 20 shifts of practical work in recognized enterprises AP: Written report (approximately 20 pages A4) about practice in the enterprise and shift-diary PVL have to be satisfied before the examination.</td>
</tr>
<tr>
<td>Credit Points:</td>
<td>6</td>
</tr>
<tr>
<td>Grade:</td>
<td>The examination results are not rated. The credits are given when the exams are passed successfully.</td>
</tr>
<tr>
<td>Workload:</td>
<td>The workload is 180h. It includes practical work (20 shifts) and preparation of the report.</td>
</tr>
</tbody>
</table>
### Module Name:
**Hydrogeology for GW-Management - Advanced**

### Responsible:
Drebenstedt, Carsten / Prof. Dr. Hoth, Nils / Dr.

### Lecturer(s):
Hoth, Nils / Dr.

### Institute(s):
Institute of Mining and Special Civil Engineering

### Duration:
1 Semester(s)

### Competencies:
Students gain profound knowledge in karsthydrogeology and karst research. Furthermore his skills with respect to handling of data, multiple statistical evaluation will be enhanced to enable him solving hydrogeological problems on his own. Additional his team competence skills will be enforced.

### Contents:
- Detailed understanding of hydrological aspects of water cycle (measurement of the different parts)
- Estimation of GW recharge
- Hydrological processes in arid, semi-arid zones
- Aspects of irrigation methods
- Karst hydrogeology (different types of karst, karst phenomena, relevant karts features, karst indicators, karstifiable rocks, physical/chemical dissolution)
- Flow and transport in karst systems (contaminations, tracers, protection), regional examples of different karst systems
- River bank filtration
- Geophysical exploration techniques and practical aspects of borehole logging
- Data evaluation and GIS-based data handling
- 2D data analysis, kriging, basics of variogram-analysis

**Practical exercises:** to GIS-based data handling and 2D – data analysis (spatial interpolation)

### Literature:
- Dreybrodt (1988) Processes in Karst Systems Physics, Chemistry and Geology,
- Kitanidis (1997) Introduction to geostatistics – applications to hydrogeology

### Types of Teaching:
- **S1 (SS): Lectures (2 SWS)**
- **S1 (SS): Exercises (1 SWS)**

### Pre-requisites:
**Recommendations:**
- Hydrogeology for GW-Management - Basics, 2018-07-04
  - Basic knowledge in statistics and data management.

### Frequency:
Yearly in the summer semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- **KA [90 min]**
- **PVL: Homework - assignments**
  - PVL have to be satisfied before the examination.

### Credit Points:
4

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
- **KA [w: 1]**
| Workload: | The workload is 120h. It is the result of 45h attendance and 75h self-studies. (75 h are spent with preparation, preparing home work and report and self study). |
### Competencies:

After successful completion of the course, students are able to:

- apply the theory of error propagation in the context of planning and critical analysis of measurement results for underground surveying campaigns,
- optimize the case specific use of suitable surveying instrumentation, the measurement design and data processing method for campaigns related to the absolute spatial orientation of underground mining workings,
- independently conduct typically underground mine surveying tasks and analyze results.

### Contents:

- legal regulations with respect to underground mine surveying (in particular German law: "Verordnung über markscheiderische Arbeiten und Beobachtung der Oberfläche - Markscheider-Bergverordnung")
- application of the theory of error propagation and GUM - Guide to the Expression of Uncertainty in Measurement for precision surveying design and evaluation of results
- transfer of coordinates and directional angles from surface to underground (mechanical and optical shaft plumbing, gyroscopic measurements, application of inertial systems)
- alignment control in underground drifts and tunnels
- underground geodetic infrastructure and mine mapping
- drill hole surveying
- recent developments in underground positioning and navigation

### Literature:

- Schulte, Lörhr, Vosen: Markascheidekunde für das Studium und die betriebliche Praxis. Springer Verlag;
- Zeitschriften: Markascheidewesen, AVN, VDV-Magazin

### Types of Teaching:

- S1 (WS): Underground Mine Surveying / Lectures (2 SWS)
- S1 (WS): Underground Mine Surveying - exercises and practical work in groups (3 SWS) / Practical Application (3 SWS)

### Pre-requisites:

**Mandatory:**

- Allgemeine Grundlagen der Vermessungs- und Instrumententechnik, 2015-06-01
- oder Introduction to surveying or similar subjects

**Recommendations:**

Basic knowledge about surveying, surveying instrumentation and underground mining.
<table>
<thead>
<tr>
<th>Frequency:</th>
<th>yearly in the winter semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [30 min] PVL: Exercises and practical work in groups PVL have to be satisfied before the examination.</td>
</tr>
<tr>
<td>Credit Points:</td>
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<tr>
<td>Grade:</td>
<td>The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]</td>
</tr>
<tr>
<td>Workload:</td>
<td>The workload is 150h. It consists of 75h presence time (lectures and underground surveying practical), and 105 hours independent work including group work, practical, self-study and preparation for examination.</td>
</tr>
</tbody>
</table>
Module Name: **Mine Water I – Formation and Treatment**  
(English):  
Responsible: **Drebenstedt, Carsten / Prof. Dr.**  
Hoth, Nils / Dr.  
Lecturer(s): **Hoth, Nils / Dr.**  
Institute(s): **Institute of Mining and Special Civil Engineering**  
Duration: 1 Semester(s)  

### Competencies:

The student will gain general knowledge about the formation of acidic mine waters and how to investigate the detailed behaviour. Furthermore, he gets knowledge about treatment strategies. So in the end he is able to choose proper measures for partial avoiding of acidic mine water formation and he can choose suitable and site specific treatment strategies.

### Contents:

**Lecture:**  
- Basics of sulphide weathering - Acid Mine and Acid Rock Drainage (AMD/ ARD) generation  
- Relevant buffer systems  
- General aspects of water treatment of different mine waters  
- Examples of special case site studies – technology of the treatment  
- Primary, secondary and tertiary measures against acidification for different mine sites  

**Exercises:**  
- Detailed explanation of investigation strategies to characterise and balance acid mine drainage behaviour for dump and tailings bodies  
- Detailed explanation of water treatment systems for different mine sites  
- Preparing an report about investigation of a given test site. Figure out the idea and planning of a water treatment for a given special mine water composition.

### Literature:

- Beale & Read (2013) Evaluating water in pit slope stability  

### Types of Teaching:

S1 (SS): Lectures (2 SWS)  
S1 (SS): Exercises (1 SWS)

### Pre-requisites:  
**Recommendations:**

Basic knowledge in hydrogeochemistry

### Frequency:

 yearly in the summer semester

### Requirements for Credit Points:

For the award of credit points it is necessary to pass the module exam. The module exam contains:  
KA [90 min]  
PVL: Exercises and homework  
PVL have to be satisfied before the examination.

### Credit Points:

6

### Grade:

The Grade is generated from the examination result(s) with the following weights (w):  
KA [w: 1]

### Workload:

The workload is 180h. It is the result of 45h attendance and 135h self-studies. (135 h are spent on preparation for the classes, preparing the report and with self study)
<table>
<thead>
<tr>
<th>Data:</th>
<th>Module Name: <strong>Remote Sensing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination number: -</td>
<td></td>
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<tr>
<td>Start Year: WiSe 2010</td>
<td></td>
</tr>
<tr>
<td>Module Name: <strong>Remote Sensing</strong></td>
<td></td>
</tr>
<tr>
<td>(English):</td>
<td>Responsibles: <strong>Gloaguen, Richard / Dr.</strong></td>
</tr>
<tr>
<td>Lecturer(s):</td>
<td><strong>Gloaguen, Richard / Dr.</strong></td>
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<tr>
<td></td>
<td><strong>Ratschbacher, Lothar / Prof. Dr.</strong></td>
</tr>
<tr>
<td>Institute(s):</td>
<td><strong>Institute of Geology</strong></td>
</tr>
<tr>
<td>Duration:</td>
<td>1 Semester(s)</td>
</tr>
<tr>
<td>Competencies:</td>
<td>Acquisition of theoretical and practical skills in remote sensing with a focus on the analysis of surface processes</td>
</tr>
<tr>
<td>Contents:</td>
<td>Variable, for example: Remote sensing applications to Geoscience with a focus on the analysis of tectonics and tectonic geomorphology in active orogenic belts.</td>
</tr>
<tr>
<td>Types of Teaching:</td>
<td>S1 (WS): Lectures (1 SWS)</td>
</tr>
<tr>
<td></td>
<td>S1 (WS): Exercises (3 SWS)</td>
</tr>
<tr>
<td>Pre-requisites:</td>
<td><strong>Recommendations:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grundlagen der Geofenerkundung, 2014-07-01</strong></td>
</tr>
<tr>
<td></td>
<td>Bachelor course in remote sensing</td>
</tr>
<tr>
<td>Frequency:</td>
<td>yearly in the winter semester</td>
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<tr>
<td>Requirements for Credit Points:</td>
<td>For the award of credit points it is necessary to pass the module exam.</td>
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<td></td>
<td>The module exam contains:</td>
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<td></td>
<td>KA [90 min]</td>
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<td></td>
<td>AP: Project presentation</td>
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<td>Credit Points:</td>
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<tr>
<td></td>
<td>KA [w: 1]</td>
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<td>AP: Project presentation [w: 4]</td>
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<tr>
<td>Workload:</td>
<td>The workload is 180h. It is the result of 60h attendance and 120h self-studies.</td>
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</table>
**Module Name:** Hydrogeology for GW-Management - Basics

**Responsible:** Drebenstedt, Carsten / Prof. Dr.
Hoth, Nils / Dr.

**Lecturer(s):** Hoth, Nils / Dr.

**Institute(s):** Institute of Mining and Special Civil Engineering

**Duration:** 1 Semester(s)

**Competencies:** The student will gain general knowledge to characterise and investigate hydrogeological systems. So he will be able to solve relevant hydrogeological tasks. He will be able to select appropriate techniques for investigation and data evaluation. Furthermore he will gain knowledge around groundwater protection measures.

**Contents:**

**Lecture:**
- general understanding of subsurface flow-processes (water-saturated GW-zone and water-unsaturated “soil-zone”).
- porous media behaviour of loose rock aquifers (differences of kf-value versus permeability)
- fissure/ fracture driven preferential flow in hard rock bodies
- methods to estimate relevant flow parameters (challenges around)
- pumping test (design, performance) and evaluation
- saline water intrusion (fresh-saltwater interface at coastal sites).
- Ground water flow to wells and drilling of wells (well development, rehabilitation)
- basic understanding of acid mine drainage generation
- Well head protection zones – general GW protection
- European water frame work

**Practical exercises:**
- Estimation of relevant aquifer parameters (kf-values)
- Characterisation of water samples
- Sampling (low flow sampling), filtration, impact of construction materials on monitoring wells,
- Classification of loose rock materials
- hXRF-measurements as basis for qualitative characteristics of loose rock and dump/ tailings materials

**Literature:**
- DWGW-Richtlinie W101

**Types of Teaching:**
- S1 (WS): Lectures (2 SWS)
- S1 (WS): hydrogeology - practica and exercises / Practical Application (2 SWS)

**Pre-requisites:**
- Basic knowledge in Geology, Applied Geosciences

**Frequency:** yearly in the winter semester

**Requirements for Credit Points:** For the award of credit points it is necessary to pass the module exam. The module exam contains:
- KA*: [90 min]
- AP*: Practica and exercises
| Credit Points: | 6 |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w):
| | KA*: [w: 2]
| | AP*: Practica and exercises [w: 1]
<p>| Workload: | The workload is 180h. It is the result of 60h attendance and 120h self-studies. (120 h are spent on preparation for the classes, preparing the reports and self study) |</p>
<table>
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<tr>
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<th>Version: 31.01.2019</th>
<th>Start Year: WiSe 2019</th>
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<tbody>
<tr>
<td>Module Name: Tectonics and Mineral Deposits (English): Kroner, Uwe / PD Dr.</td>
<td></td>
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</tr>
<tr>
<td>Lecturer(s): Kroner, Uwe / PD Dr.</td>
<td></td>
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<tr>
<td>Institute(s): Institute of Geology</td>
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<tr>
<td>Duration: 1 Semester(s)</td>
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<tr>
<td>Competencies: The students will be able to understand and describe (1) the causal links of plate tectonics, mantle cycle and mineral deposits at a global scale and (2) the principles of structural geology and tectonics regarding mineralization on a regional scale. The students will be able to evaluate selected structural controlled mineral deposits, for example different mineral deposits of the Erzgebirge. Special attention will be paid to structural field techniques at the outcrop level.</td>
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<tr>
<td>Types of Teaching: S1 (WS): Blockkurs (block course) / Lectures (2 SWS) S1 (WS): Geländepraktikum (field course) / Practical Application (3 d)</td>
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<tr>
<td>Pre-requisites:</td>
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<tr>
<td>Frequency: yearly in the winter semester</td>
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<tr>
<td>Requirements for Credit Points: For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [30 min]</td>
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<td>Credit Points: 4</td>
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<td>Workload: The workload is 120h. It is the result of 54h attendance and 66h self-studies.</td>
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<tr>
<td>Module Name:</td>
<td><strong>Reclamation</strong></td>
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<tr>
<td>(English):</td>
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<tr>
<td>Responsible:</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
<td></td>
</tr>
<tr>
<td>Lecturer(s):</td>
<td>Drebenstedt, Carsten / Prof. Dr.</td>
<td></td>
</tr>
<tr>
<td>Institute(s):</td>
<td>Institute of Mining and Special Civil Engineering</td>
<td></td>
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<tr>
<td>Duration:</td>
<td>1 Semester(s)</td>
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<tr>
<td>Competencies:</td>
<td>The module provides the development of expertise and methodological skills in the field of mining engineering. The students learn the theory and practice of reclamation in mining as essential element of balance for mining impacts. They understand the parallelism of mine and reclamation planning and the fact, why reclamation can exceed the mine project phase. Additionally the students will be qualified to explain scientifically reclamation measures, plan technical measures and calculate the financial expenses.</td>
<td></td>
</tr>
</tbody>
</table>
| Contents: | - Impacts of mining and its effects  
- Legal requirements for permission  
- Scientific fundamentals of reclamation (soil, ground water balance,...)  
- Concepts  
- Utilization requirements and realization in the post-mining landscaping (agriculture, forestry, waterbodies, nature protection, recreation, miscellaneous)  
- Case studies | | |
| Literature: | Pflug (Hrsg.), 1998, Braunkohlentagebau und Rekultivierung, Springer Verlag  
Olschowy, Bergbau und Landschaft, 1993, Paray Verlag  
Gilscher, Bruns, 1999, Renaturierung von Abbaustellen, Verlag Eugen Ulmer Stuttgart | | |
| Types of Teaching: | S1 (SS): Lectures (3 SWS)  
S1 (SS): Exercises (2 SWS)  
S1 (SS): Practical Application (1 SWS) | | |
| Pre-requisites: | **Recommendations:**  
Mathemathic-scientific fundamentals | | |
| Frequency: | yearly in the summer semester | | |
| Requirements for Credit Points: | For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 21 students or more) [MP minimum 30 min / KA 60 min]  
PVL: Submission and positive evaluation of module exercises  
PVL: Participation in 2 excursions of the chair Surface-Mining  
PVL have to be satisfied before the examination. | | |
| Credit Points: | 6 | | |
| Grade: | The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1] | | |
| Workload: | The workload is 180h. It is the result of 90h attendance and 90h self-studies. Self-study includes autonomous and instructed preparation and performance of follow-up course work and examination preparation. | | |
### Module Name:
**Geoscientific Communication II**

### Responsible:
Drebenstedt, Carsten / Prof. Dr.

### Lecturer(s):
Hoth, Nils / Dr.

### Institute(s):
Institute of Mining and Special Civil Engineering

### Duration:
1 Semester(s)

### Competencies:
The course intends to give students the knowledge and the ability to perform scientific database research and documentation as well as scientific writing, designing a scientific poster and presenting results in an oral talk.

### Contents:
Detailed database research, data mining, data management including raw data, scientific writing, rhetoric, and poster compilation. Major goals are learning and applying strategies of scientific enquiries using different techniques and digital sources, navigating reference management systems and compilation of bibliographies. Database concepts, publication strategies, citation of publications, Digital Object Identifier (DOI®) System, techniques for primary data publication incl. Meta data concepts are contents as well. Finally rhetoric and promoting results by means of scientific posters are content of the class.

Seminars: working on a scientific topic for a defined time, writing a 10 pages paper and presenting the results in an oral presentation.

### Literature:

### Types of Teaching:
S1 (SS): Seminar (1 SWS)
S1 (SS): Lectures (1 SWS)

### Pre-requisites:

### Frequency:
yearly in the summer semester

### Requirements for Credit Points:
For the award of credit points it is necessary to pass the module exam. The module exam contains:
- AP: Scientific manuscript (10 pages)
- AP: Oral talk [15 min]
- PVL: Participating in the lectures and seminar

PVL have to be satisfied before the examination.

### Credit Points:
5

### Grade:
The Grade is generated from the examination result(s) with the following weights (w):
- AP: Scientific manuscript (10 pages) [w: 2]
- AP: Oral talk [w: 1]

### Workload:
The workload is 150h. It is the result of 30h attendance and 120h self-studies.