Georg-August-Universität
Göttingen

Modulverzeichnis

zu der Prüfungs- und Studienordnung für den konsekutiven Master-Studiengang Hydrogeology and Environmental Geoscience (Amtliche Mitteilungen I 10/2011 S. 763)

Module

Übersicht nach Modulgruppen

1) Master-Studiengang "Hydrogeology and Environmental Geoscience"

Das Studium umfasst mindenstens 120 Anrechnungspunkte

a) Fachstudium

Es müssen folgende sieben Module im Umfang von insgesamt 54 C erfolgreich absolviert werden.

b) Professionalisierungsbereich

Es müssen Module Im Umfang von insgesamt 30 C nach Maßgabe der nachfolgenden Bestimmungen erfolgreich absolviert werden, und zwar das Pflichtmodul sowie alle Module aus zwei der drei folgenden Gruppen. Mögliche Kombinationen sind: Gruppe A und B, Gruppe A und C und Gruppe B und C.

aa) Pflichtmodul

Es muss das folgende Modul im Umfang von 6 C erfolgreich absolviert werden.

bb) Gruppe A

Wird Gruppe A gewählt, so müssen folgende zwei Module im Umfang von insgesamt 12 C erfolgreich absolviert werden.

cc) Gruppe B

Wird Gruppe B gewählt, so müssen folgende zwei Module im Umfang von insgesamt 12 C erfolgreich absolviert werden.

dd) Gruppe C

Wird Gruppe C gewählt, so müssen folgende zwei Module im Umfang von insgesamt 12 C erfolgreich absolviert werden.

c) Schlüsselkompetenzen

Es muss wenigstens ein Modul im Umfang von insgesamt wenigstens 6 C aus dem zulässigen Angebot erfolgreich absolviert werden.

d) Masterarbeit

Durch die erfogreiche Anfertigung der Masterarbeit werden 30 C erworben.

Georg-August-Universität Göttingen **Modul M.HEG.01: General Tools**	7 C 4 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
This module is designed to provide some of the basic prerequisites and general tools for the students to be able to follow the Master Course. The individual courses comprise fundamentals of mathematics required within the context of groundwater and systems modelling and a programming course. The course in Mathematics cannot replace an intensive study of the mathematical foundations for those with less mathematical background. The course Fundamentals of Geology is offered for the students without earth scientific background. It comprises a comprehensive review of the history of Earth, the main rock-forming processes, and changes of the Earth surface under atmospheric conditions.	Präsenzzeit: 56 Stunden Selbststudium: 154 Stunden

Lehrveranstaltungen:	
1. V/Ü Scientific Programming (Compulsory) *JProf. Hydrogeomechanik*	2 SWS
2. Elective Courses a. LV: V/Ü Mathematics (Elective); *JProf. Hydrogeomechanik* ***or*** b. LV: V Fundamentals of Geology (Elective); *Dr. Alfons M. van den Kerkhof*	2 SWS

Prüfung: Klausur, Prüfende/r: JProf. Hydromechanik (90 Minuten)	

Prüfungsanforderungen:	
Understanding of basic principles of mathematical procedures in natural sciences and information processing of spatial data.	

Zugangsvoraussetzungen:	**Empfohlene Vorkenntnisse:**
keine	keine
Sprache: Englisch	**Modulverantwortliche[r]:** JProf. Hydrogeomechanik; (Dr. Alfons M. van den Kerkhof)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 1
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.02: Hydrogeology I**	9 C 7 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
This module is intended to convey the fundamentals of the theory of groundwater flow and transport and to apply them in practical exercises in the field and in the laboratory. The students should be able to organise and conduct test procedures as well as to assess the specific hydrogeological site conditions. The contents of the module comprise the hydrological water balance, groundwater recharge estimation techniques, groundwater hydrology, pumping test evaluation and principles of solute transport. Relevance of this fundamental material is illustrated with examples from the hydrogeological practice, e.g. water resources exploration, and groundwater remediation. A field seminar will introduce the students into the most important field techniques of the daily practice of a hydrogeologist. During the “Advanced Hydrogeological Investigation Techniques” course, new assessment techniques for the hydraulic characterisation of aquifers are presented and demonstrated using practical examples. The advanced course on “Aquifersystems” will concentrate on the specifics of fractured aquifers and the particulars of the large variety of aquifer systems in Northern Germany. They can be regarded as representative for a large number of aquifer types.	Präsenzzeit: 98 Stunden Selbststudium: 172 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Introduction to Hydrogeology *Prof. Dr. Martin Sauter; Dr. Tobias Geyer*	3 SWS
2. LV: GÜ Hydrogeological Field Trip and Hydrological Measuring *Tobias Geyer, Prof. Dr. Martin Sauter*	1 SWS
3. LV: V Advanced Hydrogeological Investigation Techniques *Prof. Dr.-Ing. habil. Thomas Ptak-Fix*	1 SWS
4. LV: V/GÜ Geology of Aquifer systems *Prof. Dr. Martin Sauter*	2 SWS

Prüfung: Klausur (60 Minuten)	

Prüfungsanforderungen:	
Theory and practice of groundwater flow and solute transport processes, implementation in the field.	

Zugangsvoraussetzungen:	**Empfohlene Vorkenntnisse:**
keine	keine
Sprache: Englisch	**Modulverantwortliche[r]:** Prof. Dr. Martin Sauter (Dr. Tobias Geyer)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit:	**Empfohlenes Fachsemester:**

zweimalig	1
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.03: Hydrogeochemistry**	9 C 7 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
The module intends to convey an understanding for the role of chemical processes in water-rock interaction. The first lecture introduces the essential thermodynamics to understand basic and coupled electrolyte equilibria (i.e. redox processes, acid/ base reactions, solubility, complexation, ion exchange) in a natural environment and is accompanied by simple and complex calculations of real world problems as well as coursework. The second lecture focuses on the classification of organic compounds and pollutants in the subsurface. Relevant properties are discussed together with property-structure-relationships. The environmental and subsurface behaviour of organic compounds is introduced in terms of relevant distribution equilibria and kinetically controlled processes. Complex examples are provided as coursework helping to apply gained knowledge. The isotope hydrology course is intended to provide the techniques to differentiate between different types of water of variable origins. Fundamentals of fractionation effects and the limitations of the methods are discussed.	Präsenzzeit: 98 Stunden Selbststudium: 172 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Inorganic Hydrogeochemistry *Dr. rer. nat. Tobias Licha*	3 SWS
2. LV: V/Ü Hydrogeochemistry of Organic Contaminants *Dr. rer. nat. Tobias Licha*	2 SWS
3. LV: V/Ü Isotope Hydrology *Dr. Manuela Lodemann*	2 SWS

Prüfung: Klausur (120 Minuten) **Prüfungsvorleistungen:** Wöchentliche Hausaufgabe zu LV 1+2 (jeweils ca. 1 Seite)	

Prüfungsanforderungen: Knowledge about basic inorganic equilibrium water chemistry, water chemistry data interpretation, contaminant classes, basic organic chemistry, structure-properties relationships for organic compounds, distribution equilibria, isotope hydrology	

Zugangsvoraussetzungen: keine	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. rer. nat. Tobias Licha (Prof. Dr. Martin Sauter)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 1
Maximale Studierendenzahl:	

25	

Georg-August-Universität Göttingen **Modul M.HEG.04: Hydrology**	7 C 5 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
"Applied Stataistics in Hydrogeology" focuses on probability and statistics in hydrology. Main topics are: descriptive statistics, regression and correlation, probability distribution, parameter estimation methods, statistical tests, frequency analysis and time series analysis. Examples and exercises on applied statistics in hydrology are provided. "Appllied Operation Research" focuses on methods applied to water resources management. The course introduces important approaches for optimization and uncertainty assessment: e.g. linear, non-linear, dynamic programming, fuzzy theory, multi-criteria decision analysis and multi-objective optimization. The lecture includes practical exercises in the field of water resources and environment. The second course gives an overview about the fundamentals of surface water hydrology. Main topics are: climate, hydrologic cycle, river basin characterisation, precipitation, surface runoff and river discharge, unsaturated zone assessment, evapotranspiration, river morphology, erosion and sediment transport, precipitation-runoff processes and modeling, water balance, surface water quality assessment, hydrometry, regionalization and hydrological mapping, open channel hydraulics and fundamentals of hydraulic modeling. The third course provides knowledge about GIS techniques (e.g. spatial data models, data input techniques, spatial analysis) applied in hydrologic, geological and environmental studies. Students gain practical skills by computer exercises with state of the art software.	Präsenzzeit: 70 Stunden Selbststudium: 140 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Applied Statistics in Hydrology or Applied Operation Research *Dr. -Ing. Bernd Rusteberg*	1 SWS
2. LV: V/Ü Surface Water Hydrology *Dr. -Ing. Bernd Rusteberg*	2 SWS
3. LV: V/Ü Geographic Information Systems *Dr. rer. nat. Bianca Wagner*	2 SWS

Prüfung: Klausur (120 Minuten)	

Prüfungsanforderungen:	
Understanding of basic principles and application of state of the art methods in surface water hydrology and applied statistics.	

Zugangsvoraussetzungen:	**Empfohlene Vorkenntnisse:**
keine	keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. -Ing. Bernd Rusteberg (Dr. rer. nat. Bianca Wagner)
Angebotshäufigkeit:	**Dauer:**

Jedes Sommersemester	1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 2
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.05: Hydrogeology II**	8 C 6 SWS

Lernziele/Kompetenzen: This module builds on the foundations of „Hydrogeology I“ and concentrates on specific relevant fields. The first and second course focus on the understanding and modeling of processes, their interaction and weighting on groundwater catchment scale. Mass balances for sub systems and their individual impact on the whole mass balance for groundwater catchments are addressed. The third course will convey principles of field testing techniques employed in hydrogeology such as pumping tests, slug tests, tracer experiments, sampling as well as direct push investigation methods.	**Arbeitsaufwand:** Präsenzzeit: 84 Stunden Selbststudium: 156 Stunden

Lehrveranstaltung: Catchment Hydrogeology **1. LV:** V/Ü Catchment Hydrogeology; *Dr. Tobias Geyer* **2. LV:** GÜ Field Trip – Catchment Hydrogeology; *Dr. Tobias Geyer*	3 SWS
Prüfung: Klausur (45 Minuten)	5 C

Lehrveranstaltung: Hydrogeological Field Seminar *Inhalte*: LV: GÜ Hydrogeological Field Seminar *Prof. Dr.-Ing. habil. Thomas Ptak-Fix*	3 SWS
Prüfung: Bericht (max. 10 Seiten)	3 C

Prüfungsanforderungen: Theory of flow and transport processes on groundwater catchment scale, theory and practical application of hydrogeological characterisation techniques using field investigation methods.	

Zugangsvoraussetzungen: M.HEG.02	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Prof. Dr.-Ing. habil. Thomas Ptak-Fix (Dr. Tobias Geyer)
Angebotshäufigkeit: Jedes Sommersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 2
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.06: Groundwater Modeling**	8 C 6 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
This module introduces the student to the commonly used mathematical tools as well as to state of-the-art numerical groundwater modeling techniques, including visualization of the results. Groundwater modeling allows a consistent assembly of multiple types of data from laboratory and field investigations, environmental system analysis, process understanding, planning of water management and remedial activities, risk assessment, decision making etc.. The first and second course focus on the numerical modeling of flow and non-reactive as well as reactive transport in porous media (aquifers). It includes topics such as model design, mathematical process formulation (process equations) and numerical methods for solving the governing equations. Simple modeling problems will be discussed and exercised by the students using computer codes in tutorials to complement the presentations given in the lecture. The third course deals with special advanced modeling techniques. The focus will be on basin scale integrated hydrosystem modeling, covering porous and fractured media, saturated and unsaturated zones, surface water - groundwater interaction, surface water modeling, hillslope hydrological aspects, including reactive contaminant transport. Students will gain hands on experience with models through computer exercises.	Präsenzzeit: 84 Stunden Selbststudium: 156 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Groundwater Flow Modeling	3 SWS
Prof. Dr. Martin Sauter, Prof. Dr.-Ing. habil. Thomas Ptak-Fix	
2. LV: V/Ü Groundwater Transport Modeling	2 SWS
Prof. Dr.-Ing. habil. Thomas Ptak-Fix, Prof. Dr. Martin Sauter	
3. LV: V/Ü Advanced Modeling Techniques	1 SWS
Prof. Dr. Edward A. Sudicky (Waterloo, CN) or Prof. Dr. R. Therrien (Univ. Laval)	

Prüfung: Bericht (max. 20 Seiten)	

Prüfungsanforderungen:	
Knowledge about theoretic background and state of the art techniques in groundwater modelling, understanding of main concepts of integrated hydrosystem modelling and practical skills.	

Zugangsvoraussetzungen:	**Empfohlene Vorkenntnisse:**
M.HEG.02, M.HEG.03	keine
Sprache: Englisch	**Modulverantwortliche[r]:** Prof. Dr.-Ing. habil. Thomas Ptak-Fix (Prof. Dr. Martin Sauter)
Angebotshäufigkeit: Jedes Sommersemester	**Dauer:** 1 Semester
Wiederholbarkeit:	**Empfohlenes Fachsemester:**

zweimalig	2
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.07: Geophysics**	6 C 4 SWS

Lernziele/Kompetenzen: In this module the students will learn to understand in how far the methods of Applied Geophysics can assist in the hydraulic characterisation of aquifers, the detection of different quality waters as well as general concepts of parameter regionalisation in three-dimensional space. The module is composed of a lecture, concentrating on the theory and the presentation of the basic techniques employed in Applied Geophysics, i.e. seismics, resistivity techniques, magnetics, gravimetry and borehole geophysics. Their relevance for hydrogeological problems is illustrated with examples. The field course builds on this foundation and demonstrates practical application of the various techniques in the field.	**Arbeitsaufwand:** Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden

Lehrveranstaltung: V/Ü Applied Geophysics and Hydrogeophysics *Prof. Dr. Andreas Weller (TU Clausthal)*	2 SWS
Prüfung: Klausur (90 Minuten)	

Lehrveranstaltung: GÜ Geophysical Field Seminar *Prof. Dr. Andreas Weller (TU Clausthal)*	2 SWS
Prüfung: Bericht (max. 5 Seiten), unbenotet	

Prüfungsanforderungen: Theory and practical application of applied geophysical methods in the solution of hydrogeological problems.	

Zugangsvoraussetzungen: keine	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Prof. Dr. Andreas Weller (Prof. Dr. Martin Sauter)
Angebotshäufigkeit: Jedes Sommersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 2
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.31: Systems Modeling**	6 C 5 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
The first course focuses on unsaturated zone processes. Lectured topics include: soil-water-plant-atmosphere system, soil-water, energy and solute balance, soil physics, soil water flow and reactive transport, mathematical models, groundwater recharge and protection, environmental monitoring. The second course deals with surface water modeling methods for river basin management and pollution control. The lecture presents different modeling concepts and shows by means of case studies how river catchment models can be applied to analyse the impact of man´s activity, water resources development strategies or scenarios of socio-economic development and global change on run-off, water balance and environment. The third course deals with non-Darcian flow processes and transport phenomena which can be observed in strongly heterogeneous media.	Präsenzzeit: 70 Stunden Selbststudium: 110 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Modeling of unsaturated Zone Processes *Prof. Dr. Wolfgang Durner (TU Braunschweig)*	2 SWS
2. LV: V/Ü Surface Water Modeling *Prof. Dr.-Ing. Günter Meon* (TU Braunnschweig)	2 SWS
3. LV: V/Ü Simulation of Flow and Transport in Fractured and Karstified Aquifers *Dr. Tobias Geyer*	1 SWS

Prüfung: Klausur (90 Minuten)	

Prüfungsanforderungen:	
Understanding of main concepts of unsaturated zone processes, river catchment modelling, theory of simulation of flow and transport processes in fractured/karstified media.	

Zugangsvoraussetzungen: M.HEG.02, M.HEG.04	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. Tobias Geyer (Dr.-Ing. Bernd Rusteberg)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.32: Integrated Water Resources Management**	6 C 5 SWS

Lernziele/Kompetenzen: The first course focuses on integrated water resources planning and management. The lecture treats: irrigation planning and management, fluvial transport and river regulation, drinking water supply, surface water reservoir planning and operation, conjunctive use of groundwater and surface water resources, water reuse concepts and groundwater artificial recharge, flood and drought management, economic project feasibility, project planning and water master plans, social, political, legal and institutional aspects of IWRM, performance and decision criteria, decision support systems for IWRM, transboundary and conflict management. The second course focuses on urban hydrology and groundwater management issues. Further important aspects are: e.g. impact of urban development on groundwater, sustainable management and protection of groundwater resources in urban environments, innovative management concepts. The third course deals with Environmental Impact Assessment studies – EIA for water resources development projects. History and development of EIA procedures, regulations and standards in different parts of the world are discussed. Environmental screening and scoping methods are presented and EIA studies are analysed.	**Arbeitsaufwand:** Präsenzzeit: 70 Stunden Selbststudium: 110 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Water Resources Planning and Management *Dr. -Ing. Bernd Rusteberg*; PV: unbenoteter Bericht, max. 10 Seiten und Vortrag (10 Min.)	3 SWS
2. LV: V Urban Hydrology and Groundwater Management *Prof. Dr. John Tellam (Univ. of Birmingham - UK)*	1 SWS
3. LV: V Environmental Impact Assessment (EIA) *Dr. Andrea Herch / Achim Brönner* (ERM GmbH)	1 SWS

Prüfung: Klausur (120 Minuten)	

Prüfungsanforderungen: Understanding of basic principles and state of the art methods for integrated and sustainable water resources planning and management and EIA.	

Zugangsvoraussetzungen: M.HEG.02, M.HEG.04	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. -Ing. Bernd Rusteberg (Prof. Dr.-Ing. habil. Thomas Ptak-Fix)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3

Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.33: Georeservoirs I**	6 C 5 SWS

Lernziele/Kompetenzen: This module intends to convey a general understanding for the relevant processes and the general concepts involved in the exploitation of geothermal energy. The module is subdivided into “Deep Geothermics”, concentrating on power and heat production at large depths (> 4000m) “Shallow Geothermis”, dealing with heat extraction at shallow depths (< 500m), and the illustration of the use of geothermal energy with case studies. For the assessment and exploitation of geothermal energy, general knowledge of groundwater flow and transport is a prerequisite, provided in modules elsewhere. Course contents of this module comprise some basic principles, the regional assessment of the geothermal potential in Germany and Europe, required site conditions for economical exploitation, generally employed testing procedures, economical assessment methods, fractures and faults, fluid flow in fractured systems, stimulation methods.	**Arbeitsaufwand:** Präsenzzeit: 70 Stunden Selbststudium: 110 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Deep Geothermics *JProf. Hydrogeomechanik*	2 SWS
2. LV: V/Ü Shallow Geothermics *Dr. Manuela Lodemann*	1 SWS
3. LV: V/Ü Fluidtransport in Reservoirs *JProf. Dr. Sonja L. Philipp (Prof. Dr. Martin Sauter/Prof. Dr.-Ing. habil. Thomas Ptak-Fix)*	3 SWS

Prüfung: Klausur (120 Minuten)	

Prüfungsanforderungen: Prerequisites for the economical exploitation of shallow and deep geothermal energy, design of geothermal plants.	

Zugangsvoraussetzungen: keine	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. Manuela Lodemann (JProf. Hydrogeomechanik)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.34: Georeservoirs II**	6 C 5 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
The module “Georeservoirs II” deals with processes in georeservoirs (geothermal, energy storage, CO2-storage and hydrocarbons), their identification and quantification of process parameters. Processes in georeservoirs comprise hydraulic, thermal, mechanical and chemical processes as well as their coupling. The investigation of georeservoirs is one of the main research focuses in the Applied Geology and nowadays a highly relevant field in energy research issues. During the courses, the methods of the investigation, characterisation and modelling of georeservoirs shall be conveyed to the students, together with illustrations of practical examples of case studies. A field trip shall be conducted to geothermal plants and drilling sites.	Präsenzzeit: 70 Stunden Selbststudium: 110 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Processes in Georeservoirs *JProf. Hydrogeomechanik*	2 SWS
2. LV: V/Ü Characterisation of Georeservoirs *Ass. JProf. Hydrogeomechanik*	2 SWS
3. Exploration of Geothermal Energy (Exkursion) *Dr. Manuela Lodemann*	1 SWS

Prüfung: Klausur (60 Minuten)	

Prüfungsanforderungen:	
Prerequisites of the understanding of reservoir functioning and prediction of their future dynamics	

Zugangsvoraussetzungen: keine	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** JProf. Hydrogeomechanik (Dr. Manuela Lodemann)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.35: Water Pollution Control & Remediation**	6 C 4 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
The first course comprises topics of environmental geochemistry such as: natural and anthropogenic fluxes and interactions of harmful elements in different environmental spheres (air, water, soil, sediment & biosphere); interactions of these elements with solid water interface; speciation, critical loads and levels, environmental records and global change. The second course introduces sampling strategies and basic chemical analytical methods as applied for the analysis of organic compounds. It further familiarises the student with data quality evaluation and data interpretation to identify subsurface processes. The third course is on innovative remediation techniques such as: surfactant flushing, in-situ redox manipulations, air sparging, alcohol swelling, catalysts, etc. The applicability and economic aspects of remediation technologies are addressed. Furthermore, design, operation and monitoring of waste disposal facilities are discussed. Examples of applications are presented.	Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Environmental Geochemistry *Prof. Dr. Hans Ruppert*	2 SWS
2. LV: V/Ü Sampling, Chemical Analysis and Data Evaluation *Dr. rer. nat. Tobias Licha*	1 SWS
3. LV: V/Ü Innovative Remediation Techniques and Waste Deposal *Prof. Dr. James F. Barker (Waterloo, CN)*	1 SWS

Prüfung: Klausur (120 Minuten)	

Prüfungsanforderungen:	
Understanding of water chemistry relevant processes in natural systems and innovative remediation techniques, skills related to state-of-the-art environmental risk assessment	

Zugangsvoraussetzungen:	**Empfohlene Vorkenntnisse:**
M.HEG.02, M.HEG.03	keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. rer. nat. Tobias Licha (Prof. Dr.-Ing. habil. Thomas Ptak-Fix)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.36: Environmental Monitoring**	6 C 5 SWS

Lernziele/Kompetenzen:	**Arbeitsaufwand:**
The first course focuses on innovative investigation and monitoring techniques. Both integral and high resolution point scale, non-invasive and invasive investigation techniques are presented, and scale-heterogeneity relationship issues are discussed. The second course addresses the problem of salinity in groundwater, characterisation, mapping, modelling and the management of groundwater resources in presence of salinity, including coastal aquifers and inland aquifers with saline water bodies. The third course provides knowledge about remote sensing techniques (e.g. remote sensing scanning techniques, image processing, interpretation) applied in hydrologic and environmental studies. Finally the module is supplemented with the basics of well construction and completion.	Präsenzzeit: 70 Stunden Selbststudium: 110 Stunden

Lehrveranstaltungen:	
1. LV: V/Ü Investigation Techniques and Monitoring *Prof. Dr.-Ing. habil. Thomas Ptak-Fix*	2 SWS
2. LV: V/Ü Saline Groundwater *Dr. Jacob Bensabat (EWRE Haifa, Israel)*	1 SWS
3. LV: V/Ü Applied Remote Sensing Techniques *Dr. Bianca Wagner*	1 SWS
4. LV: V Well Design and Construction *Dr. Manuela Lodemann*	1 SWS

Prüfung: Klausur (120 Minuten)	

Prüfungsanforderungen:	
Investigation and monitoring techniques, seawater intrusion control, remote sensing techniques, basic principles of well construction.	

Zugangsvoraussetzungen:	**Empfohlene Vorkenntnisse:**
M.HEG.02, M.HEG.04, M.HEG.07	keine
Sprache: Englisch	**Modulverantwortliche[r]:** Prof. Dr.-Ing. habil. Thomas Ptak-Fix (Dr. rer. nat. Tobias Licha)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 1 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3
Maximale Studierendenzahl: 25	

Georg-August-Universität Göttingen **Modul M.HEG.37: Projects**	6 C 3 SWS

Lernziele/Kompetenzen: In the first sub module the students will be able to chose between the compilation of a literature review report and the preparation of a computer program. They are designed to lay foundations for the later Master Thesis Project. In the second sub module the student will be assigned to an integrated project which should be related to a course relevant subject and research topics of the Department of Applied Geology. The module is complemented with the discussion of cases studies for the illustration of real world problems. The students are expected to present the objectives and concept of their Master Thesis before they start to get to work, to discuss their approach and methodology. Furthermore, they will participate in the weekly research colloquium of the Department of Applied Geology	**Arbeitsaufwand:** Präsenzzeit: 42 Stunden Selbststudium: 138 Stunden

Lehrveranstaltung: Teilmodul: S Literature Review OR Computer Programme	1 SWS
Prüfung: Bericht (10 - 15 Seiten) oder Computer Programm	3 C

Lehrveranstaltung: Teilmodul: S Assigned Project	1 SWS
Prüfung: Bericht (10 - 15 Seiten) und Vortrag (max. 20 Min.) zum Assigned Project	3 C

Lehrveranstaltung: Teilmodul: S Seminar Applied Geology OR S Masterseminar *Prof. Dr. Martin Sauter or Prof. Dr. Hans Ruppert*	1 SWS
Prüfung: Vortrag (max. 20 Min.), unbenotet	

Prüfungsanforderungen: Literature review (report), computer programme (operational code) and assigned project (report and oral presentation) in the context on an open seminar, organized by the students themselves.	

Zugangsvoraussetzungen: keine	**Empfohlene Vorkenntnisse:** keine
Sprache: Englisch	**Modulverantwortliche[r]:** Dr. Alfons M. van den Kerkhof (Prof. Dr.-Ing. habil. Thomas Ptak-Fix)
Angebotshäufigkeit: Jedes Wintersemester	**Dauer:** 2 Semester
Wiederholbarkeit: zweimalig	**Empfohlenes Fachsemester:** 3
Maximale Studierendenzahl: 25	