Karlsruhe Institute of Technology

institute of geography & geoecology

Module handbook

Bachelor of Science
Geoecology

Last update: February 15th, 2010

FACULTY FOR CIVIL ENGINEERING, GEO- AND ENVIRONMENTAL SCIENCE
Institute for Geography and Geoecology

KIT – Karlsruhe Institute of Technology - University of the federal state of Baden-Württemberg and national Forschungszentrum of the Helmholtz-Gemeinschaft

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Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology
Module title:	Inorganic chemistry

geök-G1

Module category: Science principles				
Core module / core elective module: core module				
Module requirements: none				
Prerequisite for: none				
Term: ☒ WS annually ☐ per semester	Duration: ☐ 1 semester ☒ 2 semesters	Recommended term: 1st and 2nd semester	Credit points: 13	Work load: 147 h contact hours 243 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW *3
G1-1	Principles of inorganic chemistry: Introduction into inorganic and general chemistry (for students in natural sciences)	L*1	42 h	138 h	4
G1-2	Inorganic chemistry lab courses for students of physics and geoecology	P*2	105 h	105 h	6

*1: Lecture/ *2: Practical lab course/ *3: Semester periods per week.

Aims / intended learning outcomes:

The students will be expected to achieve a basic understanding of inorganic chemistry. Being familiar with the periodic table of elements as well as the fundamental constitution of atoms and their chemical bond the students can describe specific inorganic compounds, estimate their reactive capacity and interpret the underlying chemical principals. Having gained hands-on experience with analytical laboratory applications the students are also capable of handling various hazardous and toxic substances.

Module contents:

- Matter constitution, atomic theory, periodic table of elements
- Introduction to the chemical bond
- Metals, ionic crystals, the covalent bond, complex chemistry
- Chemical reactions, chemical equilibrium, law of mass action, solubility product
- Acid-base reaction, acid-base equilibrium, redox
- Phase equilibrium, heterogeneous equilibriums, precipitation reaction
- Basic principles of electrochemistry,
- Chemistry of the elements
- Chemical equilibrium in water solution
- Conducting chemical analysis

Examination and grading	
Module evaluation: The module grade results from the weighted arithmetic average of learning points from both the introductory as well as the final exam to G1-2.	
Module tutor: Prof. Dr. C. Feldmann Institute of Inorganic Chemistry	Primary tutors: Prof. Dr. C. Feldmann, Dr. Christopher Anson
Recommended literature: § MORTIMER, MÜLLER (current edition): Chemie, Thieme Verlag § RIEDEL (current edition): Moderne Anorganische Chemie, de Gruyter Verlag § HOLLEMAN,WIBERG (current edition): Lehrbuch der Anorganischen Chemie, de Gruyter Verlag § JANDER, BLASIUS: (current edition): Lehrbuch der analytischen und präparativen anorganischen Chemie, Hirzel Verlag § Script from lab course	

Description of the module components:

G1-1	Title of the module component		Lecturer
	Principles of inorganic chemistry: Introduction into inorganic and general chemistry (for students in natural sciences), L		Prof. Dr. C. Feldmann
Language	Course vacancies	Credit points	Registration
German	No limitation	6	No entry requirements
Course mode	Lecture 100 %		
Contents	• Matter constitution, atomic theory, periodic table of elements • Introduction to the chemical bond • Metals, ionic crystals, the covalent bond, complex chemistry • Chemical reactions, chemical equilibrium, law of mass action, solubility product • Acid-base reaction, acid-base equilibrium, redox • Phase equilibrium, heterogeneous equilibriums, precipitation reaction • Fundamental terms of electrochemistry, • Chemistry of the elements • Chemical equilibrium in water solution		
Evaluation	The content of the lecture is tested on the introductory exam for the chemistry lab courses G1-2		

G1-2	Title of module component		Lecturer
	Inorganic chemistry lab courses for students of physics and geoecology		Dr. Christopher Anson
Language	Course vacancies	Credit points	Registration
German	25 – 30 for laboratory work	7	to participate is a registration required
Course mode	Laboratory 80 %, seminar 20 %		
Contents	• Hazards and safety at work • Basic techniques in a chemical laboratory • Chemical equilibrium in diluted solution • Acid-base equilibrium • Law of mass action and Solubility • Reactions and detection of cations and anions • Analysis and separation of cations • Gravimetrical analysis • Quantitative analysis • Acid–base titration • Precipitation titration • Coordination compound production • Redox and principles of electrochemistry		
Evaluation	Experiments have to be carried out successfully. After having accomplished the lab course this module component ends with a final exam.		

Karlsruhe Institute of Technology
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Degree program: B. Sc. Geoecology

geök-G2

Module title: Organic chemistry

Module category: Science principles

Core module / core elective module: core module

Module requirements: none

Prerequisite for: none

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ SS annually ☐ per semester	☐ 1 semester ☒ 2 semester	2nd and 3rd semester	10	145 h contact hours 155 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW *3
G2-1	Organic chemistry I	L*1	61 h	71 h	3
G2-2	Organic chemistry lab courses for students pursuing teaching certification in chemistry, biology and geoecology students	P*2	84 h	84 h	6

*1: Lecture/ *2: Practical lab course/ *3: Semester periods per week.

Aims / intended learning outcomes:

The students will be expected to achieve a basic understanding of organic chemistry, familiarity with the structure of organic molecules, their intermolecular interaction as well as their reaction kinetics. The students will be able to describe specific organic compounds, estimate their reactive capacity and interpret the underlying chemical principals. The students will gain hands-on experience with selective methods of carbon-carbon bond formation and the assembly of complex glass apparatus. Furthermore, they will become familiar with the safe usage of toxic and hazardous materials.

Module contents:

- The structure of organic molecules and their molecular interaction
- Introduction to the reaction of organic molecules
- Kinetics, acid-base mechanisms
- Alkanes and their reactions, nomenclature and stereochemistry
- Alkenes, haloalkanes, aromatic hydrocarbons, alcohols, ethers und their chemical reactions
- Aldehydes, ketones, carbonic acids and their derivatives
- Amines, thioles, lipides, sugar, amino- and nucleic acids, biopolymers
- Set-up of complex glass apparatuses
- Hazardous substances and safety at work
- Synthesis of 6 organic compounds

Examination and grading	
Module evaluation: The module grade will be formed by the exam at the end of lecture G2-1. A mandatory precondition for approval of the module is a successful completion of G2-2. These marks will not be graded.	
Module tutor: Prof. Dr. Stefan Bräse Institute of Organic Chemistry	Primary tutors: Prof. Dr. Stefan Bräse, Prof. Dr. Joachim Podlech, Dr. Norbert Foitzik
Recommended literature: § VOLLHARDT, K.P.C., SCHORE, N.E. (current edition): Organische Chemie, Weinheim, Wiley-VCH § BECKER, H.G.O. (current edition): Organikum – organisch-chemisches Praktikum, Wiley-VCH	

Description of the module components:

	Title of the module component		Lecturer
G2-1	Organic chemistry I		Prof. Dr. S. Bräse, Prof. Dr. J. Podlech
Language	Course vacancies	Credit points	Registration
German	No limitation	4,5	No registration required
Course mode	Lecture 100 %		
Contents	• The structure of organic molecules and their intermolecular interaction • Introduction to the reaction of organic molecules • Kinetics, acid-base mechanisms • Alkanes and their reactions, nomenclature and stereochemistry • Alkenes and haloalkanes • Aromatic hydrocarbons • Alcohols & ethers and their chemical reactions • Aldehydes & ketones • Carbonic acids and their derivatives • Amines, thioles • Lipides, sugar • Amino and nucleic acids • Biopolymers		
Evaluation	120 min. exam about the lecture content		

<table>
<tr><td rowspan="2">G2-2</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Organic chemistry lab courses for students pursuing a teaching certification in chemistry, biology and geoecology students</td><td>Dr. N. Foitzik</td></tr>
<tr><td>Language</td><td>Vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>25 – 30 for laboratory work</td><td>5,5</td><td colspan="2">Please contact Dr. Foitzik, (Room 108, Build. 30.42)</td></tr>
<tr><td>Course mode</td><td colspan="4">Laboratory 85 %, seminar 15 %</td></tr>
<tr><td>Contents</td><td colspan="4">• Set-up of complex glass apparatuses
• Hazardous substances and safety at work

Synthesis of 6 organic compounds
• Block 1: 1 compound Radical substitution, Nucleophilic substitution
• Block 2: 1 compound Elimination with formation of C-C multiple bonds
Addition reaction on non activated C–C multiple bonds
• Block 3: 1 compound Electrophilic and nucleophilic substitution on aromatic hydrocarbons, oxidation and dehydration reaction
• Block 4: 2 compound Reactions of carbonyl compounds
• Block 5: 1 compound Reactions of other heteroanalog carbonyl compounds, rearrangement reactions</td></tr>
<tr><td>Evaluation</td><td colspan="4">Experiments have to be carried out successfully. They will not be graded.</td></tr>
</table>

Karlsruhe Institute of Technology
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Degree Program: B. Sc. Geoecology

geök-G3

Module title: Environmental chemistry

Module category: Science principles

Core module / core elective module:	core module
Module requirements:	none
Prerequisite for:	none

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☐ 1 semester ☒ 2 semester	3rd and 4th semester	6	73,5 contact hours 106,5 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW *3
G3-1	Geochemistry I	L*1	21 h	39 h	2
G3-2	Environmental analysis lab course	L + P*2	52,5 h	67,5 h	1 + 4

*1: Lecture/ *2: Practical lab course/ *3: Semester periods per week.

Aims / intended learning outcomes:

The students will be expected to achieve a basic understanding of geochemistry and environmental analysis. They will obtain a substantial knowledge of fundamental chemical principles that have led to the formation and evolution of the universe and the terrestrial body. Based on the different material components they will become familiar with the main mechanisms of the earth's chemical development and differentiation. The students will be expected to understand geochemical processes in the context of the chemical evolution of the atmosphere, the oceans and the pedosphere throughout the history of the earth. Furthermore they should be able to define the specific properties of chemical elements and distinguish between the common systems of radioactive and stable Isotopes and understand their role in detecting geochemical mechanisms. The students will be expected to be familiar with the following topics: Cosmochemistry, geochemistry of the lithosphere, dating, developement of the earth's crust, the origin of igneous rocks, sedimentary processes and weathering. They will become acquainted with common methods in environmental chemistry, which are attributed to the instrumental analysis. While taking both guideline and critical values into account the students should become capable of evaluating analytic data statistically.

Module contents:

- Cosmochemistry, formation and development of the terrestrial body
- Isotopic chemistry, geochemistry of the lithosphere
- Weathering processes
- Aquatic geochemistry, instrumental analysis
- Guidelines for laboratories
- Samplings and sample preparation
- Evaluation and interpretation of analytic data.

Examination and grading

Module evaluation:

The module grade is arranged as follows:
50% from the examination at the end of G3-1 and
50% from the oral examination at the end of G3-2.

Module tutor:	Primary tutors:
PD Dr. Thomas Neumann Institute of Mineralogy und Geochemistry	Prof. Dr. Thomas Neumann Dr. Utz Kramar, Dr. Zsolt Berner

Recommended literature:

§ ALBAREDE F. (2003): Geochemistry, An Introduction. Cambridge University Press.

§ BROEKER W.S (1994): Labor Erde. Springer Verlag, Berlin.

§ KRAUSKOPF K.B. & BIRD D.K. (1995): Introduction to Geochemistry, McGraw Hill, Inc.

§ SCHWEDT G. (2007): Taschenatlas der Analytik. Wiley-VCH.

§ HEINRICHS H. & HERRMANN A.G. (1990): Praktikum der Analytischen Geochemie. Springer Verlag, Berlin.

Description of the module components:

G3-1	Title of the module component		Lecturer
	Geochemistry I		Prof. Dr. T. Neumann
Language	Course vacancies	Credit points	Registration
German	No limitation	2	No entry requirements
Course mode	Lecture 100 %		
Contents	• Cosmochemistry (development of the universe, formation of the elements in our solar system) • Development and formation of the terrestrial body (condensation and differentiation) • Properties of chemical elements • Isotope geochemistry (radio-gene and stable isotopes) • Geochemistry of the lithosphere and weathering processes • Aquatic geochemistry		
Evaluation	60 min. examination about the content of the lecture		

<table>
<tr><td rowspan="4">G3-2</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Environmental analysis lab courses - Course A -</td><td rowspan="3">Prof. Dr. T. Neumann, Dr. U. Kramar , Dr. Z. Berner</td></tr>
<tr><td colspan="3">Environmental analysis lab courses - Course B -</td></tr>
<tr><td colspan="3">Environmental analysis lecture</td></tr>
<tr><td>Language</td><td>Vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>25 – 30</td><td>4</td><td colspan="2">A registration is required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 20 %, lab course 80 %</td></tr>
<tr><td>Contents</td><td colspan="4">Lecture:
The accompanying lecture conveys the theoretical foundation for the lab course and is subdivided into the following sections:
• Guidelines for laboratories
• Samplings and sample preparation
• Dissolution and extraction techniques
• Potentiometry/ ion chromatography/ photometry
• Atom absorption and atomic absorption spectroscopy
• Carbon and sulphur analysis
• X-ray fluorescence analysis
• Analytic calculating/ statistical data evaluation
• Quality control

Lab course:
The students learn important methods of modern environmental analysis on the basis of a case study “arsenic- and heavy metal contamination of groundwater and soils in the mining site of Wiesloch”. During a short study trip water and soil are sampled within the area of investigation. Using special electrodes, on-site measurements of important hydro-chemical parameters such as oxygen, pH-value, temperature and conductivity are carried out. The samples are prepared in the lab and relevant compounds are quantified using photometry, AAS, ICP-AES, CSA und XRF. The entire results are evaluated taking both guideline and critical values of soils and ground water into account.</td></tr>
<tr><td>Evaluation</td><td colspan="4">30 min. colloquium</td></tr>
</table>

Karlsruhe Institute of Technology
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Degree program:	B. Sc. Geoecology
Module title:	Mathematics
	geök-G4
Module category:	Science principles
Core module / core elective module:	core module
Module requirements:	none
Prerequisite for:	none

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☐ 1 semester ☒ 2 semester	1st and 2nd semester	10	84 h contact hours 216 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW*3
G4-1	Mathematics I for biology and chemistry students	L*1 +T*2	42 h	108 h	3 + 1
G4-2	Mathematics II for biology and chemistry students	L + T	42 h	108 h	3 + 1

*1: Lecture/ *2: Tutorial/ *3 Semester periods per week.

Aims / intended learning outcomes:

The students will be expected to achieve the basic criteria required to understand, handle and solve mathematical problems in connection with relevant research aims. They will become acquainted with integral and differential calculus, linear algebra, multidimensional analysis and be able to apply mathematical concepts and techniques, which are essential for the independent work in this field. The students will learn to apply geometric perspectives and have an ability to interpret mathematical models of scientific phenomena.

Module contents:

- Numbers
- Functions
- Limits
- Differential calculus for functions with one variable
- Differential calculus with several variables
- Integral calculus for functions with one variable
- Linear algebra
- Basic differential equations

Examination and grading	
Module evaluation: The module grade results from the weighted arithmetic average of the examination from the module components G4-1 und G4-2.	
Module tutor: Dr. Klaus Spitzmüller Institute for Algebra and Geometry	Primary tutor: PD Dr. Gabriele Link
Recommended literature: § DÜRRSCHNABEL, K. (2004): Mathematik für Ingenieure, Teubner Verlag § RÖSCH, N. (1993): Mathematik für Chemiker, Springer Verlag § REINSCH, E.-A. (2004): Mathematik für Chemiker, Teubner Verlag	

Description of the module components:

G4-1	Title of the module component		Lecturer
	Mathematics I for biology and chemistry students (L)		Dr. Steffen Winter
	Mathematics I for biology and chemistry students (T)		Dr. Steffen Winter
Language	Course vacancies	Credit points	Registration
German	No limitation	5	No entry requirements
Course mode	Lecture 75 %, tutorial 25 %		
Contents	• Numbers: Natural numbers, prime numbers, whole numbers, mathematical induction, rational numbers, real numbers, complex numbers, equations and inequalities, absolute value. • Functions: Functions, graphs, function compositions, inverse functions, polynomials, fundamental theorem of algebra, interpolation, trigonometric functions • Limits: Limits of sequences, convergent criteria, Cauchy sequence, limits of series, absolute convergence, convergent criteria for series, power series, limits and continuity in functions • Differential calculus for functions with one variable: Derivatives, rules of derivation, Taylor's theorem, L'Hôpital's rule • Integral calculus for functions with one variable: Integrability, special integrals, indefinite integrals, fundamental theorem of calculus, mean value theorem, substitution formula, integration by parts, partial fraction decomposition		
Evaluation	Final examination, the successful completion of the unmarked "exercises sheets" is a precondition to participate in the examination of this module component. The tutorials, that take place on a weekly basis, are strongly recommended.		

G4-2	Title of the module component	Lecturer

	Mathematics II for biology and chemistry students (L)		PD Dr. Gabriele Link
	Mathematics II for biology and chemistry students (T)		PD Dr. Gabriele Link
Language	Vacancies	Credit points	Registration
German	No limitation	5	No registration required
Course mode	Lecture 75 %, tutorial 25 %		
Contents	• Linear Algebra: Vectors in 3D, addition, multiplication, cross product, scalar product, geometric interpretation, general vector spaces, subspaces, Euclidean vector spaces linear independence, basis & dimension, linear transformation, transformation matrix, matrix calculations, systems of linear equations, solution theory, determinants, endomorphism, eigenvalue & eigenvector, symmetric matrices, principal axis transformation • Ordinary differential equations: Ordinary differential equations of the first order, linear systems of the first order, existence theorem & uniqueness theorem, ordinary differential equations of the second order, reduction to a first order system • Differential calculus with several variables Partial derivatives, gradients, vector field, scalar potential, chain rule, extrema with auxiliary conditions, Taylor's theorem		
Evaluation	Final examination, the successful completion of the upgraded "exercises sheets" is a precondition to participate in the examination of this module component. The tutorials, that take place on a weekly basis, are strongly recommended.		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology	geök-G5
Module title:	Statistics	
Module category:	Science principles	
Core module / core elective module:	core module	
Module requirements:	none	
Prerequisite for:	P2	

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☒ 1 Semester ☐ 2 Semester	3rd Semester	6	63 h Contact hours 117 Private studies

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW *4
G5-1	Statistics for biology students	L*1 + T*2	42 h	93 h	3 + 1
G5-2	Computer assisted tutorial in statistics for biology students	P*3	21 h	24 h	2

*1: Lecture/ *2: Tutorial/ *3: Practical lab course/ *4: Semester periods per week.

Aims / intended learning outcomes:

The students will be expected to achieve a basic understanding of descriptive and inductive statistics in geoecology. Being familiar with the principles of the probability theory, the students are able to judge the applicability of statistical methods, interpret results and analyse data using "R" for statistical programming.

Module contents:

- Statistical constants and graphics;
- Regression / correlation analysis;
- Random experiments, random events and probability
- Probability distribution, random variables and its feature size
- Conditional probability and statistical independence
- Central limit theorem
- Estimation theory and confidence interval
- First principles of the test theory; One sample test
- Comparison of two or more samples; Variance analysis
- Analysis of variance (ANOVA)
- Chi-square test
- Goodness of fit-Test, for example test for normality
- Statistical analysis of a contingency table
- Statistical program "R"

Examination and grading	
Module evaluation: The completion of the exercise sheets and the tasks in G5-2 are both a precondition for a successful completion of the module. The module grade is equivalent to the graded exam in G5-1.	
Module tutor: PD Dr. Dieter Kadelka Institute for Stochastic	Primary tutor: PD Dr. Dieter Kadelka, Jürgen Kampf
Recommended literature: § Lecture- and tutorial scripts	

Description of the module components:

G5-1	Title of the module component		Lecturer
	Statistics for Biologists L		PD Dr. D. Kadelka
	Statistics for Biologists T		PD Dr. D. Kadelka
Language	Course vacancies	Credit points	Registration
German	No limitation	4,5	No entry requirements
Course mode	Lecture 75 %, tutorial 25 %		
Contents	Statistical Methods (view module content)		
Evaluation	The successful completion of the unmarked “exercise sheets” is a precondition to participate in both the exam following the lecture and in the tutorial (equals the module grading).		

G5-2	Title of module component		Lecturer
	Computer assisted tutorial in statistics for biology students		PD Dr. D. Kadelka Jürgen Kampf
Language	Vacancies	Credit points	Registration
German	25	1,5	Participation requires a notification in advance
Course mode	100% practical computer-course		
Contents	Statistical methods acquainted in G5-1 are put into practice by using the statistical program "R"		
Evaluation	Unmarked tasks using the program "R"		

Karlsruhe Institute of Technology
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Degree program: B. Sc. Geoecology	geök-G6
Module title: Physics	

Module category: Science principles				
Core module / core elective module: core module				
Module requirements: none				
Prerequisite for: none				
Term: ☒ WS annually ☐ per semester	Duration: ☐ 1 semester ☒ 2 semesters	Recommended term: 1st and 2nd semester	Credit points: 12	Work load 126 h contact hours 178 h private Study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW*3
G6-1	Experimental Physics A	L*1+T*2	63 h	89 h	4 + 2
G6-2	Experimental Physics B	L+T	63 h	89 h	4 + 2

*1: Lecture/ *2: Tutorial/ *3: Semester periods per week.

Aims / intended learning outcomes:

By accomplishing this module the students will understand fundamental terms and methods in physics and are hereby able to explain and describe central phenomena in nature. Furthermore the students learn to reflect upon the particularities of natural science and to identify its relationship towards technology and society.

Module contents:

Mechanics

- Force, momentum, energy storage media, collision process, momentum current, oscillations, angular momentum, torque, mechanical strain, stress, momentum current density, Static fields, relativistic dynamics and relativistic kinematics

Electrodynamics

- Electric charge & electric current, electromagnetic field, Maxwell's equations, force & flux, superconductor, energy flow and momentum of the electromagnetic field, electrodynamics, electrical oscillation, alternating current, electromagnetic waves

Thermodynamics

- Entropy & temperature, amount of substance & chemical potential, Gibb's fundamental equation, Gibb's function, thermodynamic equilibrium, special systems and processes, (ideal gases, liquids and solids, currents, phase transitions, real gases, photon gas, thermal machines, entropy & probability.

Optics

- Decomposition of continuous signals, light & matter, light on interfaces (reflection and refraction), diffraction, scattering, interference, ray optics, optical instruments

Examination and grading

Module evaluation:

The module grade is based on the result of the final exam for lectures G6-1 and G6-2.

Module tutor:	Primary tutor:
Prof. Dr. Thomas Schimmel Institute for Applied Physics	Prof. Dr. Thomas Schimmel Dr. Stefan Walheim

Recommended literature: Lecture script

§ DEMTRÖDER, W. (2005): Experimentalphysik 1 - Mechanik Und Wärme, Springer Verlag, Berlin
§ DEMTRÖDER, W. (2006): Experimentalphysik 2 – Elektrizität und Optik, Springer Verlag, Berlin
§ DEMTRÖDER, W. (2005): Experimentalphysik 3 – Atome, Moleküle und Festkörper, Springer Verlag, Berlin
§ DEMTRÖDER, W. (2004): Experimentalphysik 4 – Kern-, Teilchen- und Astrophysik, Springer Verlag, Berlin

Description of the module components:

<table>
<tr><td rowspan="3">G6-1</td><td colspan="3">Title of the module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Experimental Physics A for Etec, Chem, Bio, Geo, Wiwi, LA students (L)</td><td>Prof. Dr. T. Schimmel</td></tr>
<tr><td colspan="3">Experimental Physics B for Etec, Geo, Chem, Bio, Wiwi, LA students (T)</td><td>Prof. Dr. T. Schimmel,
Dr. S. Walheim</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitations</td><td>6</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 67 %, tutorial 32 %</td></tr>
<tr><td>Contents</td><td colspan="4">Mechanics
• Force, momentum, energy storage media, collision processes, impulse current
• Oscillations, angular momentum, torque, mechanical strain, stress, momentum current density
• Static fields, relativistic dynamics and kinetics
Electrodynamics
• Electric charge and electric current, electromagnetic field
• Maxwell’s first and second equation
• Force & flux, superconductors
• Energy flux and impulse in the electromagnetic field
• Electrodynamics
• Electrical oscillation
• Alternating current
• Electromagnetic waves</td></tr>
<tr><td>Evaluation</td><td colspan="4">The contents are tested in a final exam after G6-2</td></tr>
</table>

<table>
<tr><td rowspan="3">G6-2</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Experimental Physics B for Etec, Chem, Bio, Geo, Wiwi, LA students (L)</td><td>Prof. Dr. T. Schimmel</td></tr>
<tr><td colspan="3">Experimental Physics B for Geo, Chem, Bio, Wiwi, LA students (T)</td><td>Prof. Dr. T. Schimmel,
Dr. S. Walheim</td></tr>
<tr><td>Language</td><td>Vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitations</td><td>6</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 67 %, tutorial 33 %</td></tr>
<tr><td>Content</td><td colspan="4">Thermodynamics
• Entropy& temperature
• Amount of substance & chemical potential
• Gibb’s fundamental equation, thermodynamic equilibrium
• Special systems and processes (Ideal gas, liquid and solid material)
• Flow, phase transition, real gases, photon gas
• Thermal machines
• Entropy & probability

Optics
• Decomposition of continuous signals
• Light & matter
• Light on interfaces (reflection and refraction)
• Diffraction
• Scattering
• Interference phenomena
• Classical optics
• Optical instruments</td></tr>
<tr><td>Evaluation</td><td colspan="4">Examination covering the contents of G6-1 and G6-2</td></tr>
</table>

Karlsruhe Institute of Technology
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Degree program:	B. Sc. Geoecology	geök-F1
Module title:	Technosphere - noosphere	
Module category:	Geoecology principles and consolidation	
Core module / core elective module: core module		
Module requirements:	none	
Prerequisite for:	none	

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☐ 1 Semester ☒ 2 Semesters	4th u. 5th Semester	6	63 h contact time 117h private study

Module components

No.	Module components	Type	Contact time	Private study	SPPW
F1-1	The regional plan as a tool in scheme operation	L	21 h	39 h	2
F1-2	Economic geography	L + T	42 h	78 h	2 + 2

Aims / intended learning outcomes:

The students are familiar with the decision-making criteria of enterprises in a specific location and understand why economic processes are organized differently within different institutions and nation states. Furthermore they are able to detect and interpret mechanisms that spawn socio-economic differences (e.g. polarization between rich and poor) as well as specialisation and agglomeration processes in specific economic sectors. The students are acquainted with issues of transport geography, environmental economics and resources management in the context of globalization and its effect on economic structures. In addition the students understand both basic structure and practical aspects of regional planning in Germany. They know how a regional plan is developed, what it consists of and the means by which its implementation is put into effect. The decision-making process often results in an area of conflict, which is situated between civic participation, municipal self-administration and governmental regulation. The students are able to allocate its position within these different stakeholders and employ the decision-making process in order to manage and perform environmental undertakings. Moreover the students are able to estimate the spatial significance of regional planning within the political & administrative boundary's of a dynamic region and can apply their knowledge to solve subject-related problems.

Module contents:

- National economy, Location theory and systems
- Exogenous growth model
- Globalisation, glocalisation, regionalisation
- Traffic carriers from a sectored point of view, traffic routes from a spatial perspective
- Mobility and sustainability; sustainable resource management
- Environmental enterprise policy, eco-marketing, eco-controlling
- Planning, planning systems in Germany, regional plan of the middle upper Rhine

Examination and grading

Module evaluation:

The module grade results from the weighted arithmetic average of credit points from the respective course evaluations (presentation results from F1-1 and exam results from F1-2)

Module tutor:	Primary tutor:
Prof. Dr. Caroline Kramer Institute for Geography and Geoecology	Dr. Gerd Hager

Recommended literature:

§ BATHELT, H., GLÜCKLER, J. (2003): Wirtschaftsgeographie, Stuttgart

§ HAAS, H-D., NEUMAIR, S-M. (2007): Wirtschaftsgeographie, Darmstadt

§ SCHÄTZL, L. (2003): Wirtschaftsgeographie 1, Paderborn

§ NUHN, H., HESSE, M. (2006): Verkehrsgeographie, Paderborn

§ WOTSCHÜTZKE, C-P (2006): Verkehrsgeografie, Troisdorf

§ HAAS, H-D., SCHLESINGER, D-M (2007): Umweltökonomie und Ressourcenmanagement, Darmstadt

§ ARL (2005): Handwörterbuch der Raumordnung, 4. Auflage, Hannover

§ REGIONALVERBAND MITTLERER OBERRHEIN – Regionalplan 2003 mit Anhangband 2005, 2 Bände, Karlsruhe 2003 und 2005

§ KOCH, H.-J., HANDLER, R. (2004): Baurecht, Raumordnungs- und Landesplanungsrecht, Boorberg, Stuttgart, 4. Auflage.

§ BATTIS, U., KRAUTZBERG, M., LÖHR, H. P. (2007): Baugesetzbuch, Kommentar, C. H. Beck, München, 10. Auflage.

Description of the module components:

F1-1	Title of the module component		Lecturer
	The regional plan as a tool in scheme operation		Dr. G. Hager
Language	Course vacancies	Credit points	Registration
German	No limitation	2	No registration required
Course mode	Lecture 100%		
Contents	The course deals with the principles of the planning process and the structure of planning systems in Germany. It describes the complex process that leads to the formulation of regulations regarding the long-term impacts of human behaviour on the urban environment. The municipal self-administration as well as the interests of the concerned citizens and the objective demands of the division administration can be regarded as the central issues in this course. It specifically deals with the regional planning in Germany in general and the regional plan of the middle upper Rhine in particular. In a liberal society the planning process is open to the results and binding solutions are found by means of a state supported discourse. A visit to the Regional Planning Committee in Karlsruhe and an excursion to a local municipality will contribute towards a deeper understanding of this planning process. The steps required for its direct implementation are envisaged and discussed with the local authorities.		
Evaluation	20 min. presentation of a topic which was dealt with in the lecture		

F1-2	Title of module component		Lecturer
	Economic geography L		NN
	Economic geography T		NN
Language	Course vacancies	Credit points	Registration
German	No limitation for lecture 25 – 30 for tutorial	4	No registration required
Course mode	50 % lecture, 50 % tutorial		
Content	The development and history of economic geography is defined by means of the neoclassical period and its concept of human nature, the Homo oeconomicus. Decision-making criteria of agricultural enterprises in a specific location and market-oriented services have long since been determined by means of the distance factor. Throughout a critical discourse the neoclassical location theories are presented and extended with the help of an actor-oriented approach. Social and economic processes cannot be regarded as isolated. A post-modern, knowledge based society has to act flexibly and instantly in order to prevail in the global innovation process. The social and technological change can only be explained and influenced with the help of communicative network systems. The increasing interdependencies reinforce globalization and lead to a change of perspective within social economic sciences, moving from a spatial-economic to a relative point of view. The unanchored and liberalized merchandise traffic requires the coordination of carriers but can lead to high resource consumption and environmental damage. Due to an increase in energy prices and the consumers growing ecological awareness, more and more enterprises achieve competitive advantages by means of sustainable and cost-saving logistics. The students obtain insights into established theories, but are also driven towards a critical perception by means of discussion-sessions and problem-based project work. Hereby learning can be seen as an individual process based upon the active construction of knowledge.		
Evaluation	90 min exam		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology	geök-F2
Module title:	Atmosphere	
Module category:	Geoecology principles and consolidation	
Core module / core elective module: core module		
Module requirements:	none	
Prerequisite for:	P2	

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	1st semester	6	52,5 h contact time 127,5 h private study

Module components

No.	Module components	Type	Contact time	Private study	SWW
F2-1	Climatology	L + T	42	85,5	2 + 2
F2-2	Methods of Climatology	P	10,5	42	1

Aims / intended learning outcomes:

The students will be expected to obtain a basic understanding of climatology. By gathering process-oriented knowledge of the atmosphere's composition and by using familiar measuring instruments, the students will be able to measure and evaluate specific climatic elements such as temperature, precipitation, atmospheric pressure, cloudiness, humidity, radiation, wind direction and wind speed. The data will then be interpreted against the background of climes and climatic phenomena (including those caused by man).

Module contents:

- Physical meteorological principles
- Atmospheric makeup and processes
- Climatic elements and their interdependencies
- Climatic geography
- Climatic classification, climates of the Earth (climate diagrams)
- Climate and humans
- Natural climate oscillation and its consequences
- Hazards to the Atmosphere: noxious gases, greenhouse gases, trace gases and aerosols
- Global warming/greenhouse effect
- Urban climate

Examination and grading

Module evaluation:

The module grade comprises the module component F2-1 from the contents of the lecture (50%) as well as the exercise sheet (25%) and the practical work in module F2-2 (25%)

Module tutor:	Primary tutor:
Dipl.-Geogr. Florian Hogewind Institute for Geography and Geoecology	Dipl.-Geogr. Florian Hogewind

Recommended literature:

- BENDIX, J. U. LAUER, W. (2006): Klimatologie. 2. neu bearbeitete Auflage, Braunschweig. Westermann, (Das geographische Seminar).
- BLÜTHGEN, J. (1980): Allgemeine Klimageographie. 3. neu bearbeitete Auflage, Berlin: de Gruyter.
- HÄCKEL, H. (2005): Meteorologie. 5. Auflage. UTB für Wissenschaft, Ulmer Verlag, Stuttgart.
- SCHÖNWIESE, CH.-D. (2003): Klimatologie. 2. neu bearbeitete und aktualisierte Auflage, Stuttgart: Ulmer, (Uni-Taschenbücher; 1793).
- WEISCHET, W. (2002): Einführung in die allgemeine Klimatologie: physikalische und meteorologische Grundlagen. 6. überarbeitete Auflage, Stuttgart: Borntraeger.
- WEISCHET, W., ENDLICHER, W. (1996): Regionale Klimatologie. Band 1 + 2. Teubner, Stuttgart.

Description of the module components:

F2-1	Title of the module component		Lecturer
	Climatology lecture		Dipl.-Geogr. F. Hogewind
	Climatology tutorial		
Language	Course vacancies	Credit points	Registration
German	No limitation for lecture 25-30 per tutorial	4	no registration required
Course mode	Lecture 50%, tutorial 50%		
Contents	The module component conveys the principles of climatology and meteorology and deals with the different climates of the earth. This includes a general understanding of the earth's mechanics, the earth's energy budget and the different climatic elements such as temperature, precipitation, atmospheric pressure, cloudiness, humidity, radiation, wind direction and wind speed. Consequently the climatic elements and classifications are networked and analysed regionally. Recent climatic phenomena such as El Nino and the Indian monsoon are also covered in the course. The module component constitutes the basic knowledge in order to reconstruct the vegetation-, soil- and morphoclimatic zones of the earth. Furthermore the course reveals the numerous interactions between climate and men.		
Evaluation	• Unmarked exercises • 90 min. examination		

F2-2	Title of module component		Lecturer
	Methods in climatology		Dipl.-Geogr. F. Hogewind
Language	Vacancies	Credit points	Registration
German	25 – 30 for tutorial	2	No registration required
Course mode	Practical course 100 %		
Content	Within this module component the various measuring instruments are discussed and tested during field excursions. With the use of special instruments the students collect and analyse climate data.		
Evaluation	Unmarked presentation lasting 15 minutes		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology	geök-F3
Module title: Biosphere - Flora	
Module category: Geoecology principles and consolidation	
Core module / core elective module: core module	
Module requirements: none	
Prerequisite for: P2	

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☐ 1 Semester ☒ 2 Semesters	3rd and 4th semester	10	115,5 h contact hours 184,5h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
F3-1	Ecological botany for geoecology and biology students	L	21 h	61 h	2
F3-2	Ecology and systematics of plants	L	31,5 h	60,5 h	2
F3-3	Plant identification course	T	21 h	21 h	2
F3-4	Botanical field trips	E	21 h	21 h	1
F3-5	Morphology and anatomy of plants	L	21 h	21 h	2

Aims / intended learning outcomes:

The students are able to give an overview of the flora and the systematics of lower and higher plants (algae, moss, ferns, spermatophytes). They know the insights into the phylogenetics of plants, are able to apply methodologies, classifications, systematics and can describe the composition, structure and physiology of spermatophytes. In addition, they are familiar with the identification and interpretation of the ecological interdependencies and transport phenomena within the plant kingdom. They understand data acquisition using special measuring instruments and are acquainted with the subsequent analysis and interpretation.

Module contents:

- Habitat description
- Carbon budget, mineral nutrient budget
- Measuring methods and measuring instruments for ecological parameters
- Plants and their environment strategies of plant adaptation
- Anatomy and systematics of prokaryotes, fungi, algae, moss, fern and plants
- Growth and the principles of life within plants
- Ecology and ecosystems; their interactions
- History and evolution of plants reproduction biology
- Biology and systematics of selected families

Examination and grading

Module evaluation:

The module mark results from the weighted arithmetic average of the learning points from the respective course examinations

Module tutor:	Primary tutor:
PD Dr. Claus Buschmann Botanical Institute II	PD Dr. Claus Buschmann, Dr. Max Seyfried

Recommended literature:

§ BUSCHMANN, C. & GRUMBACH, K. (1985): Physiologie der Photosynthese, Springer Verlag.

§ LARCHER, W. (2001): Ökophysiologie der Pflanzen, Ulmer Verlag.

§ LÜTTGE, U. ET AL. (2005): Botanik, Wiley-VCH.

§ SCHULZE, E.-D. ET AL. (2002): Pflanzenökologie, Spektrum Verlag.

§ TAIZ, L. & ZEIGER, E. (2000): Physiologie der Pflanzen, Spektrum Verlag.

§ STRASBURGER (AKTUELLE AUFLAGE): Lehrbuch der Botanik für Hochschulen, Heidelberg, Berlin, Spektrum Akademischer Verlag.

§ SCHMEIL, O., FITSCHEN, J. (AKTUELLE AUFLAGE): Flora von Deutschland und angrenzender Länder : ein Buch zum Bestimmen der wild wachsenden und häufig kultivierten Gefäßpflanzen, Wiebelsheim, Quelle & Meyer Verlag

§ RAVEN, P.H. (2006): Biologie der Pflanzen, de Gruyter Verlag, Berlin

Description of the module components:

<table>
<tr><td rowspan="2">F3-1</td><td colspan="3">Title of the module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Ecological botany for geoecology and biology students</td><td>PD Dr. C. Busch-mann</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation</td><td>2</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 100%</td></tr>
<tr><td>Contents</td><td colspan="4">• Habitat description: climate (radiation, temperature, precipitation, etc.) relief (exposition, slope), soil, biotic influences
• Carbon budget: photosynthesis, respiration, photorespiration, leaf- and stem composition, ecological adaptation, (light, CO_2, temperature, C4-carbon fixation, Crassulacean Acid Metabolism)
• Measuring instruments ($C0_2$/ H_20-Porometer, Measurement of sap-flow), bio energy
• Water budget: plant structure (xylem, cross section of a leaf, stem and root), water transport (transpirational pull, guttation, osmosis, stoma (structure and regulation), measuring methods (Scholander bomb, diffusion porometer, thermograph)
• Mineral nutrient and nitrogen budget: micronutrients and macronutrients, transport of mineral nutrients (uptake, transport, ion transporters), conversion (nitrogen and sulphate reduction), fertilizers.
• Plants and their environment: concept of stress, climatic factors (temperature, water, light [Phytochrom, Cryptochrom, Photo inhibition, Xanthophylls-cycle]), movements of plants (tropism, nastic movements), chemicals (salts, heavy metals, herbicides, fungicides, air pollutants), interactions with other organisms (pathogens, symbiosis, signal transduction (plant hormone, allelopathy) forest dieback, biodiversity.
• Measuring methods for plant assessment: tree ring study, pollen analysis, remote sensing.</td></tr>
<tr><td>Evaluation</td><td colspan="4">90 min. examination</td></tr>
</table>

F3-2	Title of module component		Lecturer
	Ecology and systematics of plants		Dr. M. Seyfried
Language	Vacancies	Credit points	Registration
German	No limitation	3	No registration required
Course mode	Lecture 100%		
Contents	• Species concept, methods within classification, taxonomy, systematics • Overview of the phylogenetic relationships among prokaryotes, fungi, lower and higher plants. • Systematic of algae and moss • Comparative reproduction biology of algae, moss and ferns • Early terrestrial plants • Biology and systematics of ferns • Phylogeny and systematic of gymnosperms • Phylogeny of angiosperms • Reproduction biology of angiosperms • Population biology • Biology and systematic of selected families from the basal dicotyledonous plants • Biology and systematic of selected families from the monocotyledonous plants • Biology and systematics of selected families from the eudicots • Ecology and ecosystems, interactions, landscapes		
Evaluation	Combined examination covering the contents of F3-2, F3-3 and F3-4		

F3-3	Title of module component		Lecturer
	Plant identification course (1 out of 3 courses)		Dr. M. Seyfried
Language	Vacancies	Credit points	Registration
German	25 – 30	1,5	A registration is required
Course mode	Practical course 100%		
Contents	• Usage of dichotomous keys • Relevant traits for plant identification • Identification of species coming from the most important families within the native flora (ferns, gymnosperms, angiosperms) • Main traits of the basic families Registration via the electronic university calendar; place allocation and course distribution via lists in the botanical institute I, Build. 10.40		
Evaluation	Combined examination covering the contents of F3-2, F3-3 and F3-4		

F3-4	Title of module component		Lecturer
	Botanical field trips		Dr. M. Seyfried
Language	Vacancies	Credit points	Registration
German	25 – 30 per trip	1,5	A registration is required
Course mode	Excursion 100%		
Contents	6 out of 15 different excursions have to be accomplished. Registration with Dr. Seyfried, Build. 10.40, 1. Floor, distribution of vacancies for excursions takes place within the plant identification course F3-2		
Evaluation	A report has to be turned in for each excursion. They will not be graded. Examination combining the contents of F3-2, F3-3 and F3-4		

F3-5	Title of module component		Lecturer
	Morphology and anatomy of plants		Dr. M. Seyfried
Language	Vacancies	Credit points	Registration
German	No limitation	2	A registration is required
Course mode	Lecture 100%		
Contents	• Introduction to the composition and particularities of the plant cell • Composition of the cormus, tissue types in plants • Plant growth, apical cell, apical meristem • Composition of the root • Primary stem • Secondary growth • Composition of a leaf, trichomes, emergences, stoma, functional adaptation • Metamorphoses • Principles of reproduction biology in plants • Flower, semen, fruit		
Evaluation	None		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology	geök-F4
Module title:	Biosphere - Fauna	
Module category:	Geoecology principles and consolidation	
Core module / core elective module: core module		
Module requirements:	none	
Prerequisite for:	P2	

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	2nd Semester	6	52.5 h contact time 117.5 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
F4-1	Ecology and systematics of animals	L	21 h	66 h	2
F4-2	Animal identification course	T	21 h	41 h	2
F4-3	Zoological field trips	E	10,5	10,5	1

Aims / intended learning outcomes:

The students will be expected to achieve a basic understanding of zoology. Based upon specific traits they will become able to apply the systematic classification system for animal groups and recognize relations between morphological and ecological aspects of species. By identifying representative animal groups the students will gain insight into practical field work, which includes collection and mapping of the species. At the same time the students will learn to describe the formation of biotopes and allocate biocoenosis to their respective niche.

Module contents:

- Population biology
- Relation between morphology and ecology of animals
- Ecology and ecosystems, interaction processes, landscapes
- Overview of the systematics, morphology and behaviour of native animals
- Molluscs, selected arthropod classes, insect orders & larvae, rhynchota, coleoptera, diptera, hymenoptera, myriapoda, crustacea, chelicerata, pisces and mammalia
- Identification of the above-named species by using a dichotomous key
- Bio indication, types of biotopes and their zoological management indicator species
- Ornithological, entomological, limnological or microlimnological excursions
- Excursion to the Karlsruhe Zoo

Examination and grading

Module evaluation:

The module mark is derived from the final examination, which covers F4-1, F4-2 and F4-3. A mandatory precondition for the approval of the module is to complete F4-3 successfully.

Module tutor:	Primary tutor:
Prof. Dr. Horst Taraschewski Zoological Institute I Department of Ecology und Parasitology	Prof. Dr. Horst Taraschewski, Dipl.-Biol. Nico Windschnurer

Recommended literature:

- BROHMER, P. [aktuelle Auflage]: Fauna von Deutschland: ein Bestimmungsbuch unserer heimischen Tierwelt / Matthias Schaefer, Wiebelsheim, Quelle&Meyer Verlag.
- WEHNER, R., GEHRING, W. [aktuelle Auflage]: Zoologie, Stuttgart, Thieme Verlag.
- WESTHEIDE, W., RIEGER, R. [aktuelle Auflage]: Spezielle Zoologie, Spektrum, Akad. Verl. Heidelberg.
- ENGELHARDT, W. [aktuelle Auflage]: Was lebt in Tümpel, Bach und Weiher? : Pflanzen und Tiere unserer Gewässer. Eine Einführung in die Lehre vom Leben der Binnengewässer, Stuttgart, Kosmos Verlag.

Description of the module components:

F4-1	Title of the module component		Lecturer
	Ecology and Systematics of animals		Prof. Dr. H. Taraschewski, Dr. T. Petney
Language	Course vacancies	Credit points	Registration
German	No limitation	3	No registration required
Course mode	Lecture 100%		
Content	• Population biology • Relation between morphology and ecology of animals • Ecology and ecosystems, interaction processes, landscapes Overview of the systematics, morphology and behaviour of: • Molluscs • Selected arthropod classes, insect orders and larvae • Rhynchota, coleoptera, diptera, hymenoptera, myriapoda • Crustacea, chelicerata • Pisces • Mammalia The phylogenetic relationship between animal groups and the interdependencies between animals and their environment.		
Evaluation	Content of lecture is part of the module examination		

F4-2	Title of module component		Lecturer
	Animal identification course		Prof. Dr. H. Taraschewski, N. Windschnurer
Language	Vacancies	Credit points	Registration
German	25 – 30 for tutorial	2	Participation requires a reservation in advance
Course mode	Practical course 100%		
Content	• Recognition of the organizational traits of important groups in the animal kingdom • Identification of the species by using a dichotomous key • Practical identification of molluscs, selected arthropod classes, insect orders and larvae, rhynchota, coleoptera, diptera, hymenoptera, myriapoda, crustacea, chelicerata, pisces and mammalia		
Evaluation	Content of the practical course is part of the module examination		

<table>
<tr><td rowspan="2">F4-3</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Zoological field trips</td><td>Prof. Dr. R. Paulsen, Prof. Dr. H. Taraschewski,</td></tr>
<tr><td>Language</td><td>Vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>25 – 30 per trip</td><td>1</td><td colspan="2">Participation requires the completion of the module component F4-2 and previous registration</td></tr>
<tr><td>Course mode</td><td colspan="4">Field trips 100%</td></tr>
<tr><td>Contents</td><td colspan="4">3 excursions have to be selected from the following options:
Excursion to the Karlsruhe zoo (WS)
Ornithological excursion (SS)
Entomological excursion (SS)
Limnological excursion (SS)
Microlimnological excursion (SS)</td></tr>
<tr><td>Evaluation</td><td colspan="4">Participation in the field trips and a report for each one of them.</td></tr>
</table>

Karlsruhe Institute of Technology Institute for Geography and Geoecology				
Degree program: B. Sc. Geoecology				geök-F5
Module title: Biosphere - Vegetation				
Module category: Geoecology principles and consolidation				
Core module / core elective module: core module				
Module requirements: none				
Prerequisite for: P2				
Term: ☒ WS annually ☐ per semester	Duration: ☒ 1 semester ☐ 2 semesters	Recommended term: 4th and 5th semester	Credit points: 5	Work load: 52 h contact time 98 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
F5-1	General phytogeography	L	42 h	78 h	2 + 2
F5-2	Methods in phytogeography	P	10 h	20 h	1

Aims / intended learning outcomes:

The students will be expected to learn about the living conditions of plants in interaction with their environment. They can estimate the relevance of biotic and abiotic factors and their capacity to adapt to stressors such as water shortage and mechanical influences. They will become familiar with the different mechanisms of plant distribution in space (chorology) and so be able to deduce the different vegetation zones. The students will learn to analyze and interpret different processes in vegetation dynamics and evaluate the limits of reconstruction and make predictions about the development of the vegetation cover. They will learn to distinguish between physiological and ecological amplitudes, interpret echograms and demonstrate the anthropogenic influences on vegetation cover since the neoliticum. The students will be able to define and allocate the basic processes within plant communities.

Module contents:

- Structure and anatomy, growing conditions and the growth cycles of plants
- Abiotic and biotic habitat conditions and factors
- Classifications and terminology of plants and plant communities such as pollination, reproduction and seed dispersal. Systems of plant communities
- Incidence and distribution of plants
- Historical and genetical phytogeography
- Chorology, vegetation and vegetation zones, biomes, ecosystems
- Vegetations dynamics – e.g. anthropogenic influences on plant distribution
- Shifting of vegetation zones due to global warming

- Presentation and application of field based methods in phytosociology (e.g. Braun-Blanquet, dendrometical methods)
- Qualitative and quantitative multivariate analysis

Examination and grading

Module evaluation:

The module mark results from the module component F5-1 covering the contents of the lecture (50%) as well as the exercise sheet (25%) and the practical work in module F5-2 (25%). A precondition for the approval of the module is the successful completion of F5-2. This will not be graded.

Module tutor:	Primary tutor:
Dr. Christophe Neff Institute for Geography and Geoecology	Dr. Christophe Neff

Recommended literature:

§ KLINK, H.-J. (1998): Vegetationsgeographie, Westermann Verlag, 3. Auflage.

§ PFADENHAUER, J. (1997): Vegetationsökologie: Ein Skriptum, IHW Verlag, 2. Auflage.

§ GLAVAC, V (1996): Vegetationsökologie, Spektrum Akademischer Verlag.

§ KRATOCHWIL, A., SCHWABE, A. (2001): Ökologie der Lebensgemeinschaften. Biozönologie, UTB Stuttgart

§ WALTER, H. & BRECKLE, S., W. (1999): Vegetations- und Klimazonen: Grundriss der globalen Ökologie, UTB Stuttgart.

Description of the module components:

F5-1	Title of the module component		Lecturer
	General phytogeography L		Dr. C. Neff
	General phytogeography T		Dr. C. Neff
Language	Course vacancies	Credit points	Registration
German	No limitation for lecture 25-30 per tutorial	4	No registration required
Course mode	Lecture 100%		
Contents	• Structure and anatomy, growing conditions and growth cycles of plants • Abiotic and biotic habitat conditions and factors • Classification and terminology of plants and plant communities such as pollination, reproductive- and seed dispersal types and systems of plant communities • Incidence and distribution of plants - plant ecology • Historical and genetic phytogeography • Chorology, vegetation, biotopes, vegetation zones, biomes, ecosystems • Vegetations dynamics – e.g. anthropogenic influences on plant distribution • Shifting of vegetation zones due to global warming		
Evaluation	90 min. exam covering the contents of both lecture and tutorial		

F5-2	Title of module component		Lecturer
	Methods in phytogeography		Dr. C. Neff
Language	Vacancies	Credit points	Registration
German	25 – 30	1	No registration required
Course mode	Practical work 100%		
Content	Presentation and application of field based methods in phytosociology (e.g. Braun-Blanquet, dendrometical methods). Qualitative and quantitative multivariate analysis.		
Evaluation	Field based colloquium. This will not be graded.		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology	geök-F6
Module title:	Pedosphere - Reliefsphere	
Module category:	Geoecology principles and consolidation	
Core module / core elective module: core module		
Module requirements:	none	
Prerequisite for:	P2	

Term:	Duration:	Recommended term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☐ 1 semester ☒ 3 semesters	3rd - 4th Semester	9	84 h contact hours 186 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
F6-1	Pedology	L + T	31,5 h	58,5 h	2 + 1
F6-2	Methods in pedology	P	10,5 h	19,5 h	1
F6-3	Exogenous dynamics	L + T	21 h	79 h	1 + 1
F6-4	Mineralogy and geochemistry of soils	L	21 h	39 h	2

L: Lecture P*: Practical lab course

Aims / intended learning outcomes:

The students will be expected to achieve a basic understanding of the formation of the different reliefs and the soils of the earth. By understanding the relationship between climate and weathering as well as their exogenous influences on the litho- and pedosphere, the students are able to relate both morphodynamic and pedogenic processes. Based on the different transport media they can identify and describe the cycle: erosion, transport, sedimentation and the resulting morphological forms and attributes of typical sediments in the field. With their knowledge of the physical, chemica and mineralogical properties and the composition, evolution and distribution of soil they are able to apply basic pedological field methods. In addition, due to their profound knowledge of chemical processes and the mineralogical compounds of soils the students are capable to asses soils regarding their functions, location properties as well as their storage and filtering capacity.

Module contents:

- Soil systematics, composition, genesis, protection
- Zone soils, soils of South West Germany, anthropogenic soils
- Methods of collection, analysis and interpretation of soil data
- Pedochemical and pedogenetic processes, processes in the atmosphere, weathering, erosion, sedimentation, transport through ice, wind and water
- Methods for collection, analysis and interpretation of sediments
- Mass balance, mineral assets, nutrients and pollutants in soils

- Clay minerals and secondary mineral formation

Examination and grading

Module evaluation:

The module grade results from the 30-minutes oral exam.

Module tutor:	Primary tutors:
Prof. Dr. Dieter Burger Institute for Geography and Geoecology	Prof. Dr. Dieter Burger, PD Dr. Stefan Norra

Recommended literature:

§ Vorlesungsskripte für Bodenkunde und Exogene Dynamik von Herrn Prof. Dr. Dieter Burger

§ SCHEFFER, FRITZ (2002): Lehrbuch der Bodenkunde, Scheffer, Schachtschabel, 15. Auflage, Heidelberg, Berlin, Spektrum, Akademischer Verlag.

§ PRESS, F. & SIEVER, R. (AKTUELLE AUFLAGE): Allgemeine Geologie, Spektrum Akademischer Verlag, Heidelberg – deutsche Übersetzung von „Understanding Earth"

§ WEISCHET, W. (2002): Einführung in die allgemeine Klimatologie: physikalische und meteorologische Grundlagen. 6. überarbeitete Auflage, Stuttgart: Borntraeger.

§ ZECH, W. (2002): Böden der Welt: Ein Bild-Atlas: Wiss. Buch-Ges., 2002.

§ AHNERT, F (1996): Einführung in die Geomorphologie, UTB Verlag, Stuttgart.

§ BAHLBURG, H. BREITKREUZ, CHR. (2008): Grundlagen der Geologie, Spektrum Akademischer Verlag, München.

§ FÜCHTBAUER, H. (1988): Sedimente und Sedimentgesteine, Schweizbart, Stuttgart.

§ MÜLLER, G. (1964): Methoden der Sedimentuntersuchung, Schweizbart, Stuttgart.

§ ROTHE, P (2005): Gesteine, Wiss. Buchges., Darmstadt.

§ WEISCHET, W. (2002): Einführung in die allgemeine Klimatologie: physikalische und meteorologische Grundlagen. 6. überarbeitete Auflage, Stuttgart: Borntraeger.

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Description of the module components:

<table>
<tr><td rowspan="2">F6-1</td><td colspan="3">Title of the module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Pedology</td><td>Prof. Dr. D. Burger, Dipl.-Geoökol. T. Wirsing</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation</td><td>3</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 67%, tutorial 33%</td></tr>
<tr><td>Contents</td><td colspan="4">The module component deals with the spheres of soils (Pedosphere), as an interface to all other spheres (lithosphere, biosphere, atmosphere, relief-sphere, technosphere-noosphere). The following contents will be conveyed:
• Soil components
• Physical, chemical and biological processes in soils
• Soil protection
• Processes of soil formation and pedogenetics
• Soil systematics
• Soils of South West Germany
• Zone Soils
The contents of the lecture are closely discussed during the exercises in the tutorial
• Particle/grain size and soil type
• Soil water
• Clay minerals and cation exchange
• Soil acidity
• Soil organic matter
• Soil protection
• Profile through the soils of Baden-Württemberg
• Soil types
• Soil maps
• Zone soils</td></tr>
<tr><td>Evaluation</td><td colspan="4">Contents are tested within the module exam.</td></tr>
</table>

F6-2	Title of module component		Lecturer
	Methods in Pedology		Prof. Dr. D. Burger, Dipl.-Geoökol. T. Wirsing
Language	Course vacancies	Credit points	Registration
German	25-30 for tutorial	1	A registration is required
Course mode	Tutorial 100%		
Contents	In this module component the students will be presented with pedological field methods in the lecture room. These will then be applied during the field course. The main task will be to learn how to identify the soils independently according to the general guide for soil classification (e.g. grain size analysis, measuring pH-value, soil colour)		
Evaluation	Unmarked 10-15 min. presentation and unmarked brief report of the profile description in open terrain.		

F6-3	Title of module component		Lecturer
	Exogenous dynamics		Prof. Dr. D. Burger, Dipl.-Geoökol. T. Wirsing
Language	Course vacancies	Credit points	Registration
German	No limitation for lecture 25-30 for tutorial	3	No registration required
Course mode	Lecture 50 %, tutorial 50%		
Contents	The lecture exogenous dynamics deals with the influences that act „externally“ through weathering and erosion-processes on the rock-layer (Lithosphere) and on soils (Pedosphere) and hereby form the relief (Reliefsphere). The following contents are conveyed: • Processes in the atmosphere • Weathering • Erosion, transport and sedimentation o through gravitation (slope movement) o through water o through ice o through wind Exercises: • Determine the properties of sediments such as qualitative composition, roundness, sorting		
Evaluation	Contents are tested in the module exam.		

<table>
<tr><td rowspan="2">F6-4</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Mineralogy and geochemistry of soils</td><td>PD Dr. S. Norra,</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation</td><td>2</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 100%</td></tr>
<tr><td>Contents</td><td colspan="4">Literally, soils can be seen as the fundament of life. They evolve through the interaction between the lithosphere, biosphere, hydrosphere and atmosphere and represent one of the most complex systems of the earth. Soils take over important functions as a storage and a source for nutrients, carbon, water, as a filter and buffering system and as a transformer for pollutants as well as a habitat for micro organisms, plants, animals and humans and serve as the base for various usages (e.g. agriculture and forestry, gardens, traffic and industrial locations).
Soils undergo constant change due to ongoing physical, biological, biochemical and (physical-) chemical processes that take place in and between the solid, fluid and gas phase. Finally every soil consists of chemical elements, which derive from the respective minerals and from the humus body, of which the organisms are built and those that constitute the fluid and the gas phase. Only by achieving a broad understanding of these processes and on the basis of the chemical and mineralogical composition of soils will it be possible to evaluate and protect the soil adequately. Both geochemistry as the science of the distribution and movement of chemical elements and mineralogy as the science of the minerals significantly contribute towards this better understanding.
The following contents are conveyed:
• Mass balance in soils
• Mineral assets in soils
• Pedochemical processes
• Clay minerals and secondary mineral formation
• Soil mineralization and the role of micro organisms
• Nutrients and pollutants in soils
• Anthropogenic soils
• Mineralogical and geochemical methods of analysis and evaluation.</td></tr>
<tr><td>Evaluation</td><td colspan="4">Contents are tested in the module exam</td></tr>
</table>

Karlsruhe Institute of Technology Institute for Geography and Geoecology				
Degree program: B. Sc. Geoecology				geök-F7
Module title: Hydrosphere				
Module category: Geoecology principles and consolidation				
Core module / core elective module: core module				
Module requirements: none				
Prerequisite for: P2				
Term: ☒ WS annually ☐ per semester	Duration: ☒ 1 semester ☐ 2 semesters	Recommended term: 3rd Semester	Credit points: 6	Work load: 63 h contact hours 117 h private studies

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
F7-1	Hydrography and oceanography	S	21 h	30 h	1
F7-2	Hydrological engineering and water management I (quantitative aspects of Hydrology)	L + T	42 h	87 h	2 + 2

Aims / intended learning outcomes:

The students will be expected to gain a profound understanding of the natural activities in a water cycle in both the terrestrial and the oceanic system. This will enable the students to recognize the importance of water as the driving force in the global climate system and by this comprehend, why human beings have to intervene into the natural cycle in order to minimize dangers like flooding or to provide a long term water-supply of with this rapidly decreasing resource.

Module contents:

The content of the module can be summarised with a brief description of the respective segments of the water cycle: The hydrography contains in particular the physical principles of precipitation, evaporation, surface runoff, seepage water and ground water in the terrestrial system as well as their diurnal and seasonal cycle in the different climates. Oceanography deals with the chemical composition and the physical properties of sea water and their impacts on biodiversity. Hereby the ocean current and its influence on the global climate play a major role. Hydrological engineering and water management deal with the impact of the human being and his intervention in the water cycle. The runoff-control, the canalisation of rivers, the usage of water especially in arid areas and the guaranty of water supply for the human being are some examples for this.

Examination and grading	
Module evaluation: The module grade results from the mark given in the exam following F7-2. A mandatory precondition for approval of the module is the successful completion of F7-1.	
Module tutor: Prof. Dr. Franz Nestmann Institute for Water and Water bodies Development	Primary tutors: Prof. Dr. Franz Nestmann, PD Dr. Stefan Norra
Recommended literature: § OTT, J. (1996): Meereeskunde: Einführung in die Geographie und Biologie der Ozeane. § BARNER, J. (AKTUELLE AUFLAGE): Hydrologie: Eine Einführung für Naturwissenschaftler und Ingenieure. Quelle & Meyer Verlag. § MANIAK, U. (2005): Hydrologie und Wasserwirtschaft – eine Einführung für Ingenieure, Springer Verlag. § PATT, H. (2004): Naturnaher Wasserbau – Entwicklung und Gestaltung von Fließgewässern, Springer Verlag.	

Description of the module components:

F7-1	Title of the module component		Lecturer
	Hydrography and Oceanography		PD Dr. S. Norra
Language	Course vacancies	Credit points	Registration
German	24-30 for the seminar	1,5	No registration required
Course mode	Seminar 100%		
Contents	The participants conceive and hold a presentation regarding selected issues in hydrography and oceanography. Central points are runoff regime, surface runoff, groundwater recharge, heat transmission through water, chemical composition of seawater, influence of seawater currents and the impacts on biodiversity. Simultaneously key competences are trained through literature research, citations and presentation techniques.		
Evaluation	Preparing and giving a presentation covering a certain issue (unmarked).		

<table>
<tr><td rowspan="3">F7-2</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Hydrological engineering and water management I L</td><td rowspan="2">Prof. Franz Nestmann et al.</td></tr>
<tr><td colspan="3">Hydrological engineering and water management I T</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation for lecture
25-30 for tutorial</td><td>4,5</td><td colspan="2">No entry requirements</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 50%, tutorial 50%</td></tr>
<tr><td>Contents</td><td colspan="4">• Motivation and visit to the Theodor-Rehbock Water engineering laboratory
• Principles of hydrology
• Hydraulic calculations in stream water systems
• Numeric flow simulation
• Floodwater and measurement of flood protection structures
• Constructions in water management; their sizing and handling</td></tr>
<tr><td>Evaluation</td><td colspan="4">50 min. exam</td></tr>
</table>

Karlsruhe Institute of Technology Institute for Geography and Geoecology				
Degree program: B. Sc. Geoecology				geök-F8
Module title: Lithosphere				
Module category: Geoecology principles and consolidation				
Core module / core elective module: core module				
Module requirements: none				
Prerequisite for: P2				
Term: ☒ WS annually ☐ Per semester	Duration: ☐ 1 semester ☒ 2 semesters	Recommended study term: 1st and 2nd Semester	Credit points: 10	Work load: 134,5 h contact time 165,5 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
F8-1	Minerals - Components of the earth	L + T	31,5 h	58,5 h	3
F8-2	Endogenous dynamics	L	21 h	39 h	2
F8-3	Rock and mineral identification	L + P	42 h	48 h	2 + 2
F8-4	Geological field trips (4)	E	40 h	20 h	2

Aims / intended learning outcomes:

The students will learn to recognize the main rocks and minerals, relate them to the respective formation area and put them in a general geological context. They will gain a basic understanding of the earth's complex system and understand geological processes in space and time. The students will learn to describe the crystal structure, the crystal chemistry and the physical properties of minerals. They will also be able to allocate unknown rock fragments according to their structural properties and their mineralogical composition.

Module contents:

- Crystals, crystalline structure, crystal chemistry, crystallization, crystallographic properties
- Minerals: their structure, attributes, identification and technical application
- Rocks and the structure of the lithosphere
- Igneous, sedimentary and metamorphic rocks: theirs attributes and identification
- Processes in the lithosphere and plate tectonics

Examination and grading

Module evaluation:

The module mark results from a 120 min. exam. A mandatory precondition for approval of the module is the successful completion of each module component.

Module tutor:	Primary tutor:
PD Dr. Jörg-Detlef Eckhardt Geological Institute – Mineralogy and Petrology	PD Dr. Jörg-Detlef Eckhardt, Prof. Dr. Reinhard O. Greiling, Prof. Dr. Heinz-Günther Stosch and the lecturers of the geosciences

Recommended literature:

- KLEIN, C. & HURLBUT, C.S. JR. (2001): Manual of Mineral Science, 22. Auflage, John Wiley & Sons, New York.
- MARKL, G. (2004): Minerale und Gesteine: Eigenschaften – Bildung – Untersuchung, Elsevier / Spektrum Akademischer Verlag, Heidelberg.
- KLEBER, W. (1998): Einführung in die Kristallographie, Verlag Technik.
- OKRUSCH, M. & MATTHES, S. (2005): Mineralogie. Eine Einführung in die spezielle Mineralogie, Petrologie und Lagerstättenkunde, Springer Verlag.
- PRESS, F. & SIEVER, R. (AKTUELLE AUFLAGE): Understanding Earth, W.H. Freeman & Company, New York.
- PRESS, F. & SIEVER, R. (AKTUELLE AUFLAGE): Allgemeine Geologie, Spektrum Akademischer Verlag, Heidelberg – deutsche Übersetzung von „Understanding Earth"
- ROTHE, P. (2002): Gesteine, Entstehung – Zerstörung – Umbildung, Wissenschaftliche Buchgesellschaft, Darmstadt.
- SKINNER, B.J. & PORTER, S.C. (1999): The Dynamic Earth, John Wiley & Sons, New York, 4. Auflage.
- TARBUCK, E.J. & LUTGENS, F.K. (2000): Earth Science, Prentice-Hall, Upper Saddle River / New Jersey, 9. Auflage.
- VINX, R. (2005): Gesteinsbestimmung im Gelände, Elsevier – Spektrum Akademischer Verlag, München.
- EISBACHER, G.H. & Kley, J. (2001): Grundlagen der Umwelt- und Rohstoffgeologie, Georg Thieme Verlag, Stuttgart
- BROWN, G.C. & MUSSETT, A.E. (1993): The inaccessible Earth.- Chapman and Hall, London
- TURCOTTE, D.L. & SCHUBERT, G. (2002): Geodynamics. – 2nd edition, Cambridge University Press, Cambridge
- COX, A. & HART, R.B. (1986): Plate Tectonics - How it Works, Blackwell, Oxford
- EISBACHER, G.H. (1996): Einführung in die Tektonik, 2. Auflage, Enke, Stuttgart
- FRISCH, W. & MESCHEDE, M. (2005): Plattentektonik, Primus Verlag, Darmstadt
- NICOLAS, A. (1995): The mid-oceanic ridges - mountains below sea level.- Springer, Heidelberg
- WINDLEY, B.F. (1995): The Evolving Continents, 3rd edition, Wiley, Chicester
- GRADSTEIN, F.M., OGG, J.G. & SMITH, A.G. (2004): A Geologic Time Scale 2004, Cambridge University Press, Cambridge
- NEUENDORF, K.K.E., MEHL, J.P. & JACKSON, J.A. (EDITORS) (2005): Glossary of Geology, 8th edition, American Geological Institute, Alexandria, Virginia, USA, xii

Description of the module components:

<table>
<tr><td rowspan="2">F8-1</td><td colspan="3">Title of the module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Minerals- Components of the earth</td><td>PD Dr. J.-D. Eck-hardt</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation</td><td>3</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 100%</td></tr>
<tr><td>Contents</td><td colspan="4">The students will be acquainted with the crystallographic structure, the crystal chemistry and the physical properties of minerals. Their knowledge and understanding will serve as a precondition for a potential technical application of minerals.
With these goals in view the following areas are included:
• Minerals as crystals
• Formation of crystals
• Relationship between crystalline structure and crystalline elements
• Crystal chemistry
• Minerals and their structure
• Structurally dictated properties of crystals
• Physical properties of crystals</td></tr>
<tr><td>Evaluation</td><td colspan="4">Examination is part of the final 120min. module exam.</td></tr>
</table>

<table>
<tr><td rowspan="2">F8-2</td><td colspan="3">Title of module component</td><td>Lecturer</td></tr>
<tr><td colspan="3">Endogenous Dynamics</td><td>Prof. Dr. R. O. Greiling, PD Dr. A. Kontny</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation</td><td>2</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">Lecture 100%</td></tr>
<tr><td>Contents</td><td colspan="4">This lecture provides a fundamental understanding of the complexity of the earth's system by using the rock cycle as a central point of view.
Hereby the main emphasis is placed on endogen processes, which refer to phenomena that are driven by physical and chemical determinants.
A. Introduction
B. Rocks and the lithosphere structure
1. Plutonic rocks
2. Volcanic rocks
3. Igneous rocks and mineral deposits
4. Sedimentary rocks, stratification, chronological order
5. Geochemistry and geophysics, composition of the earth
C. Processes in the lithosphere
1. Heat development and metamorphosis
2. Seismology and deformation
3. Magmatism, gravitation
D. Plate tectonics

An extensive model describing the recent dynamic processes as well as the processes involved in the formation of the earth:
1. Oceanic crust
2. Volcanic arc, continental edge
3. Orogeny, continental crust
4. Global plate tectonics, geodynamics
5. The evolution of plate tectonics, the formation of non renewable resources</td></tr>
<tr><td>Evaluation</td><td colspan="4">Examination is part of the final 120min. module exam.</td></tr>
</table>

F8-3	Name of module component		Lecturer
	Rock and mineral identification- V		PD Dr. J.-D. Eckhardt, PD Dr. A Kontny
	Rock and mineral identification - Ü		PD Dr. J.-D. Eckhardt, PD Dr. A Kontny
Language	Course vacancies	Credit points	Registration
German	No limitation for lecture 25 to 30 for tutorial	3	A registration is required
Course mode	Lecture 50 %, tutorial 50%		
Contents	Lecture: • Principles of mineralogy • Selected minerals and their properties • Use of minerals • What is a rock? • Igneous rocks and their properties • Sedimentary rocks and their properties • Metamorphic rocks and their properties • Use of rocks Tutorial: • Physical properties of minerals • Description of macroscopically detectable mineral properties • Detecting and identifying minerals subdivided by mineral classes. • Structural and textural rock properties and their description • Identification of rocks and classification into groups		
Evaluation	Examination is part of the final 120min. module exam.		

F8-4	Name of module component		Lecturer
	Geological field trips		See notice
Language	Course vacancies	Credit points	Registration
German	25 – 30 per field-trip	2	Registration required for participation
Course mode	Field trips 100%		
Contents	The geology of Germany is presented during different field trips on one or several days. Here the students will learn to classify a rock within its rock unit and learn about structural elements such as stratification and detecting geological joints and interferences. Among others, the field trip destinations will be the Black Forest, the Odenwald, the Taunus, the Palatinate Forest, the Upper Rhine valley, and the Southern German Escarpment landscape.		
Evaluation	Unmarked report		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology	geök-M1
Module title: Geoecology field course	
Module category: Methods	
Core module / core elective module: core module	
Module requirements: none	
Prerequisite for: P1	

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	1st semester	2	40 h contact hours 20 h private studies

M1	Title of the module component		Lecturer
	Geoecology field course		Dipl.-Geoökol. U. Schade
Language	Course vacancies	Credit points	Registration
German	25 vacancies	2	A registration is required
Course mode	Lecture 100%		

Aims / intended learning outcomes:

A case study of stream ecosystems will enable the students to recognize fundamental system components and their relationships and transfer them to other ecosystems. They will gather experience in the realization of projects, especially those requiring assessment. Project-aims, evaluation methods and different indicators will be discussed. By acquiring hands on experience in data sampling and different measurement techniques the students will evaluate their relative usefulness for practical solutions.

Module contents:

- Overview of selected environmental problems in the different spheres and ecosystems
- Specific example of a stream ecosystem: Components, interactions, functioning mode
- Environmental problems with stream waters and their specific solutions
- Project management for measures of revitalization
- Evaluation of success for revitalization methods
- Measurement methods, aims and their implementation alongside the Alb-river

Module evaluation:

The module mark is composed by the mark acquired in the final essay.

Module tutor:	Primary tutors:
Dipl.-Geoökol. Ulrike Schade Institute for Geography and Geoecology	Dipl.-Geoökol. Ulrike Schade

Recommended literature:

- MANIAK, U. (2005): Hydrologie und Wasserwirtschaft - eine Einführung für Ingenieure, 5., bearbeitete und erweiterte Auflage, Springer Verlag Berlin, Heidelberg.
- SCHWOERBEL, J., BRENDELBERGER, H. (2005): Einführung in die Limnologie, 9. Auflage, Elsevier GmbH, München, Spektrum Akademischer Verlag.
- KESSLER, H., WINKELHOFER, G. (2002): Projektmanagement - Leitfaden zur Steuerung und Führung von Projekten, 3. Auflage, Springer Verlag, Berlin, Heidelberg.
- SCHADE, U. (2006): Monitoring zur Erfolgskontrolle von Revitalisierungsprojekten an Fließgewässern - Konzeptentwicklung und Implementierung am Beispiel von Brend und Ulster im Biosphärenreservat Rhön. IN: Karlsruher Berichte zur Geographie und Geoökologie (KBzGG) des Institutes für Geographie und Geoökologie der Universiät Karlsruhe, Heft 20 - Diplomarbeit mit Handbuch.

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology
Module title:	Advanced field course
	geök-M2
Module category:	Methods
Core module / core elective module:	core module
Module requirements:	none
Prerequisite for:	none

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ SS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	4th semester	4	50,5 h contact hours 69,5 h private studies

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
M2-1	Advanced field course	P	40 h	20 h	4
M2-2	GIS - Analysis	T	33 h	27 h	2

Aims / intended learning outcomes:

By independently acquiring soil, vegetation and climatic data the students will be able to define ecosystems and understand their interdependencies. The data will be evaluated on the basis of geographic information systems.

Module contents:

The students are expected to define the ecosystems of the “Spitzberg”-area by independently selecting the appropriate evaluation approach.

The differentiation of the ecosystems will be accomplished through:

- Field survey of soil profiles
- Field survey of plant communities
- Climatic measurements

The collected data will be evaluated and presented in a graphic and digital form.

Module evaluation:

The module grade comprises the evaluation of the final essay together with a map generated by the students.

Module tutor:	Primary tutors:
Prof. Dr. Dieter Burger	Prof. Dr. Dieter Burger, Prof. Dr. Joachim Vogt, Dipl.-Geogr. Florian Hogewind

Recommended literature:

- SPONAGEL, H.(2005): Bodenkundliche Kartieranleitung Ad-hoc-Arbeitsgruppe Boden der Staatlichen Geologischen Dienste und der Bundesanstalt für Geowissenschaften und Rohstoffe, Schweizerbart 2005.
- DIERSCHKE, H. (1994): Pflanzensoziologie: Grundlagen und Methoden; 55 Tabellen? Stuttgart: Ulmer, 683 S.
- ELLENBERG, H. (1992): Zeigerwerte von Pflanzen in Mitteleuropa - 2. erweiterte Auflage, Goltze Verlag, Göttingen, 258 S.
- SCHMEIL, O., FITSCHEN, J. (2006): Flora von Deutschland und angrenzender Länder : ein Buch zum Bestimmen der wildwachsenden und häufig kultivierten Gefäßpflanzen - 93., völlig überarbeitete und erweiterte
  Auflage, Quelle & Meyer ? Wiebelsheim, 863 S.
- JANETSCHEK, H. (1982): Ökologische Feldmethoden ? Hinweise zur Analyse von Landökosystemen, Verlag Eugen Ulmer Stuttgart.
- LANDSTELLE FÜR NATURSCHUTZ UND LANDESPFLEGE BADEN-WÜRTTEMBERG (1966): Der Spitzberg bei Tübingen IN der Reihe: Die Natur- und Landschaftsschutzgebiete Baden-Württembergs, Band 3.
- MEGERLE, H., MEGERLE, A. & J. VOGT (1998): Der Spitzberg ? Festschrift für einen Berg IN: Tübinger Blätter 1998/99.
- GEOINFORMATIK GMBH (2005): ArcGIS 9 ? das Buch für Einsteiger. Herbert Wichmann Verlag, Heidelberg.
- HENNERMANN, K. (2006): Kartographie und GIS ? Eine Einführung. Wissenschaftliche Buchgesellschaft, Darmstadt.
- WARCUO, C. (2004): Von der Landkarte zum GIS ? Eine Einführung in Geografische Informationssysteme. Points Verlag, Norden Halmstadt.

Description of the module components:

M2-1	Title of the module component		Lecturer
	Advanced field course		Prof. Dr. D. Burger, Prof. Dr. J. Vogt
Language	Course vacancies	Credit points	Registration
German	25 vacancies	2	A registration is required
Course mode	Field course 100%		
Contents	The students are expected to define the ecosystems of the "Spitzberg"-area by independently selecting the appropriate evaluation approach. The differentiation of the ecosystems will be accomplished through: • Field survey of soil profiles • Field survey of plant communities • Climatic measurements		
Evaluation	Contents will be evaluated through the final essay.		

M2-2	Title of the module component		Lecturer
	GIS - Analysis		Dipl.-Geogr. F. Hogewind
Language	Course vacancies	Credit points	Registration
German	25 vacancies	2	A registration is required
Course mode	Field course 100%		
Contents	After an introduction in the statistical analysis with Excel and in the graphical presentation with ArcGIS (ESRI), the students will product different theme-maps in small teams for the final essay.		
Evaluation	Contents will be evaluated through the map generated by the students.		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology	geök-M3
Module title: Laboratory Methods	
Module category: Methods	
Core module / core elective module: core module	
Module requirements: none	
Prerequisite for: none	

Term:	Duration:	Recommended study term:	Credit points:	Workload
☒ SS annually ☐ per semester	☐ 1 semester ☒ 2 semesters	4th- 6thsemester	4	61 contact hours 59 h private studies

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
M3-1	Pedological laboratory course	P*[1]	40 h	20 h	3
M3-2	Soil mineralogical laboratory course	P	21 h	39 h	2

*[1] Practical *[2] semester periods per week

Aims / intended learning outcomes:

The students will become acquainted with the fundamental techniques of physical, chemical and mineralogical soil analysis (e.g. techniques in soil-sample preparation and measurement methods) and apply these techniques and instruments in solving specific soil problems.

Module contents:

The course presents fundamental methods concerning the mineralogical analyses of soils. The laboratory work is based on samples that are analysed with the appropriate instruments. The course also conveys information regarding the theoretical background of the analysis.

Examination procedure and requirements	
Module evaluation: The module evaluation comprises the mark given in the module component M3-2. A pre-condition for the approval of the module is the successful completion of M3-1.	
Module tutor: Prof. Dr. Dieter Burger	Tutors: Prof. Dr. Dieter Burger PD Dr. Stefan Norra, and colleges

Recommended literature:

- ALLMANN, R. (2003): Röntgenpulverdiffraktometrie. Springer, Berlin.
- AMHAUER, G., PAVICIC MK (2001): Physikalisch-chemische Untersuchungsmethoden in den Geo-wissenschaften, Band 2. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- BOENICK, W.(1983): Schwermineralanalyse. Enke, Stuttgart
- HUMOHRIES DW (1994): Methoden der Dünnschliffherstellung. Enke, Stuttgart.
- JONES MP (1997): Methoden der Mineralogie. Enke, Stuttgart.
- MACKENZIEWS, ADAMS AE (1995): Minerale und Gesteine in Dünnschliffen. Spektrum Akademischer Verlag, Heidelberg
- PAVICEVIC MK, AMTHAUER G (2000): Physikalisch-chemische Untersuchungsmethoden in den Geo-wissenschaften, Band 1. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- PUHAN D (1994): Anleitung zur Dünnschliffmikroskopie. Enke, Stuttgart.
- TUCKER M (1996): Methoden der Sedimentologie. Enke, Stuttgart.
- OWN SCRIPT
- HANDBUCH BECK, BURGER, PFEFFER (TÜBINGEN)

Description of the module components:

M3-1	Title of the module component		Lecturer
	Pedological laboratory course		Prof. Dr. D. Burger, Dipl.-Chem. M. Kull
Language	Course vacancies	Credit points	Registration
German	25 vacancies	2	A registration is required
Course mode	Laboratory course 100%		
Contents	The students will get to know the fundamental techniques of physical, chemical and mineralogical soil analysis through hands on experience: • Sample preparation • Grain size analysis (Köhn) • Determination of the Kf-factor • Determination of the pF-factor • Carbonate determination (Scheibler) • pH-Determination • Determination of the electric conductivity • C Determination; wet and dry incineration • N Determination • Exploration and determination of heavy metals		
Evaluation	Report (unmarked)		

M3-2	Title of the module component		Lecturer
	Soil mineralogical laboratory course		PD Dr. S. Norra, Dr. U. Kramer, Dr. G. Ott
Language	Course vacancies	Credit points	Registration
German	25 vacancies	2	A registration is required
Course mode	Laboratory course 100%		
Contents	The following analysis methods will be dealt with: • Determination of minerals through light microscopical methods • X-ray diffraction techniques • Thermo-Gravimetry • Determination of the inorganic and organic carbon fraction • Making of thin section, bedding and texture compounds • Scanning electron microscope		
Evaluation	Graded 30 min. colloquium		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology	geök-M4
Module title: Working techniques	
Module category: Methods	
Core module / core elective module: core module	
Module requirements: none	
Prerequisite for: none	

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ WS annually ☐ Per semester	☐ 1 semester ☒ 2 semesters	5th and 6th semester	8	73,5 contact hours 166,5 h private studies

Module components

Nr.	Module component	Type	Contact hours	Private study	SPPW*3
M4-1	Introduction in GIS for natural sciences, engineering and geo sciences students	L*1 + T*2	42 h	108 h	2+2
M4-2	Modelling	L + T	31,5 h	58,5 h	2+1

*1 Lecture *2Tutorial *3semester periods per week

Aims / intended learning outcomes:

By using modern data storage and evaluation methods the students will become able to display, correlate and edit information taken from the real world. They will learn to specifically analyse this information with the help of modern computer based methods and present the results. The students will acquire the ability to recognize system interdependencies (e.g. ecosystems) and evaluate the relative merits of various model concepts.

Module contents:

- Introduction to the methods of system analysis and modelling to quantify and describe natural systems
- Description of the steps in modelling and model analysis employing different examples of natural processes
- Selected exercises in modelling
- Practical exercises for model development on the basis of different well defined examples
- Principles of geoinformatics and their branches (Data base, Graph theory, algorithms…)
- Digital geodata and their assessment
- Normalisation and standardisation in GIS

- Transformation of frame of reference- and coordinate systems
- Modelling and formal description of geographic features (vector and raster based)
- Data conversion formats (proprietary and standardised)
- Introduction to ArcGIS

Examination and grading

Module evaluation:

The module grade comprises the weighted average of the module components M4-1 and M4-2

Module tutor:	Primary tutor:
Prof. Dr. Dieter Burger Institute für Geography und Geoecology	Dr. Joachim Wiesel, Dr. Norbert Rösch

Recommended literature:

§ IMBODEN, D. & KOCH, S. (2003): Systemanalyse – Eine Einführung in die mathematische Modellierung natürlicher Systeme. Springer Verlag, Heidelberg.

§ WAINWRIGHT, J. & MULLIGAN, M. (HRSG.) (2001): Environmental Modelling. Finding Simplicity in Complexity, Wiley VCH.

§ JÖRGENSEN, S.E., BENDORICCHIO, G. (2001): Fundamentals of Ecological Modelling, Development in Environmental Modelling, 21, Elsevier Science B. V. Amsterdam.

§ SNAPE, J.B. ET AL. (1995): Dynamics of Environmental Bioprocess, VCH Verlag.

§ BILL, R. (1999): Grundlagen der Geoinformationssysteme. Band 1: Hardware, Software und Daten, Hermann Wichmann Verlag.

§ BILL, R. (1999): Grundlagen der Geoinformationssysteme. Band 2: Analysen, Anwendungen und neue Entwicklungen, Hermann Wichmann Verlag.

§ KAPPAS, M. (aktuelle Auflage): Geographische Informationssysteme – Das Geographische Seminar, Westermann Verlag.

§ BARTELME, N. (2005): Geoinformatik. Modelle, Strukturen, Funktionen, Springer Verlag, Berlin.

§ BRAUN, G (HRSG.) (2001): GIS und Kartographie im Umweltbereich, Wichmann, Heidelberg.

§ BURROUGH, P. A AND MCDONNELL, R. A. (2006): Principles of Geographical Information Systems, Oxford.

§ FOTHERINGHAM, A.S. et al. (2000): Quantitative Geography – Perspectives on Spatial Data Analysis, London.

Description of the module components:

<table>
<tr><td rowspan="3">M4-1</td><td colspan="3">Title</td><td>Lecturer</td></tr>
<tr><td colspan="3">Introduction in GIS for natural sciences, engineering and geo sciences L</td><td>Dr. J. Wiesel, Dr. N. Rösch</td></tr>
<tr><td colspan="3">Introduction in GIS for natural sciences, engineering and geo sciences T</td><td>Dr. J. Wiesel, Dr. N. Rösch</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation</td><td>5</td><td colspan="2">No registration required</td></tr>
<tr><td>Course mode</td><td colspan="4">50 % lecture, 50 % tutorial</td></tr>
<tr><td>Contents</td><td colspan="4">• Introduction to Geographic information systems
• Frames of reference- coordinate systems and their transformation (UTM, Gauß-Krüger, Lambert…)
• Fundamentals of informatics (e.g. Data base, graph theory)
• Geographic features and their modelling (e.g. object oriented, layer)
• Vector model, Raster model, hybrid model
• Assessing digital geodata (GPS, terrestrial, …), metadata (e.g. FGDC)
• Quality and exchange of geographical-data
• Normalizing and standardizing in GIS (e.g. ISO, OGC, WFS, WMS)
• Spatial interpolation (e.g. IDW, TIN, cross validation…) and geostatistics (Criging)
• Analyzing dot patterns (e.g. Scattered squares, Nearest neighbourhood)
• Software: in particular ArcGIS, Web-GIS i. a.</td></tr>
<tr><td>Evaluation</td><td colspan="4">90 minute examination, participation in the tutorial (compulsory attendance)</td></tr>
</table>

<table>
<tr><td rowspan="3">M4-2</td><td colspan="3">Title</td><td>Lecturer</td></tr>
<tr><td colspan="3">Modelling L*</td><td>see notice</td></tr>
<tr><td colspan="3">Modelling T</td><td>see notice</td></tr>
<tr><td>Language</td><td>Course vacancies</td><td>Credit points</td><td colspan="2">Registration</td></tr>
<tr><td>German</td><td>No limitation for lecture
25 – 30 per Tutorial</td><td>3</td><td colspan="2">A registration is required</td></tr>
<tr><td>Course mode</td><td colspan="4">67 % Lecture, 33 % Tutorial</td></tr>
<tr><td>Contents</td><td colspan="4">• Model definition and -terms (systems and system limits, objects and conditions, parameter and variables, temporal and spatial variance, feedback)
• Steps in modelling (problem definition, conceptual model, coding, calibration, sensitivity, validation
• Sources of error
• Model types (physical, chemical, biological, ecological, technical, social, empirical, process oriented, statistical, dynamical, Black-box, White-box, Grey box
• Simulation and scenario generation
• Model languages (UML, Petrinetze)
• Examples for system modelling</td></tr>
<tr><td>Evaluation</td><td colspan="4">90 min. examination</td></tr>
</table>

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology

geök-Ö1

Module title: Ecosystems - principles

Module category: Ecosystems

Core module / core elective module: core module

Module requirements: none

Prerequisite for: none

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	5th semester	5	42 h contact hours 108 h private studies

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW *3
Ö1-1	Ecosystems	L*1	21 h	39 h	2
Ö1-2	Seminar "Ecosystems"	S*2	21 h	69 h	2

*1Lecture *2Seminar *3semester periods per week

Aims / intended learning outcomes:

The students will become able to recognize the composition and interdependencies of complex ecosystems and classify them into a given system. Based upon selected examples they will display and explain the importance of different environmental factors, their interactive structure and the human influence on these aspects.

Module contents:

- Interaction of various environmental factors in a complex ecosystem including the human influence
- Illustration by means of selected examples

Examination and grading

Module evaluation:

The module grade comprises the mark given in the module Ö1-1.

Module tutor:	Tutors:
Prof. Dr. Dieter Burger Institute for Geography and Geoecology	Prof. Dr. Dieter Burger, Dr. Christophe Neff

Recommended literature:

§ BLUMENSTEIN, SCHACHTZABEL (2000): Grundlagen der Geoökologie: Erscheinungen und Prozesse in unserer Umwelt, Springer Verlag.

§ BARSCH, H., BILLWITZ, K. & REUTER, B. (1988): Einführung in die Landschaftsökologie,

§ BASTIAN, O. & SCHREIBER, K.-F. (HRSG.) (1994): Analyse und ökologische Bewertung der Landschaft

Description of the module components:

Ö1-1	Title of the module component		Lecturer
	Ecosystem research		Dr. C. Neff
Language	Course vacancies	Credit points	Registration
German	No limitation	2	No entry requirements
Course mode	Lecture 100 %		
Contents	Definition, Principles in the history of ecosystem research, distribution of ecosystems, disposal of the different ecosystematic components (air, soil, water, vegetation, fauna). Functional relationship of different components and their spatial and temporal dynamics. State of the art in science, presented by means of selected examples.		
Evaluation	90 min. examination		

Ö1-2	Title of module component		Lecturer
	Seminar "Ecosystem"		Prof. Dr. D. Burger
Language	Course vacancies	Credit points	Registration
German	25-30	3	A registration is required
Course mode	100% seminar		
Contents	During a 30 min. presentation the students will present different ecosystems based upon selected examples, dealing with their components, interactions, relationships, and the human influences on them.		
Evaluation	30 min. presentation and an essay of max. 20 pages		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology

geök-Ö2

Module title: Ecosystems - application

Module category: Ecosystems

Core module / core elective module: core module

Module requirements: none

Prerequisite for: none

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ SS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	6th semester	6	68 h contact hours 112 h private study

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW
Ö2-1	Introductory seminar	S	8 h	22 h	1
Ö2-2	Field course in landscape ecology	P	60 h	90 h	3

*1 Seminar *2 Practical *3 semester periods per week

Aims / intended Learning outcomes:

During the landscape ecology field course the students will be applying field methods to environmental components like soil, water, air and biota within a specific landscape system. They will learn to understand the different assessment and evaluation tools and gain hands on experience in the context of a particular environmental problem. During this process they will also acquire skills in presentation techniques. While working in a team the students will achieve a better understanding of the theoretical background, get to know various field work methods and encounter different scientific approaches. In addition they will gain competences in conflict management, which is regarded as a key competence in this module.

Module contents:

The content of the module varies according to the landscape, its cultural setting and the current environmental issues.

Examination and grading	
Module evaluation: The module mark results from the weighted arithmetic average of the learning points from the respective course examinations.	
Module tutor: Dr. Christophe Neff Institute for Geography and Geoecology	Tutors: Dr. Christophe Neff

Description of the module components:

Ö2-1	Title of the module component		Lecturer
	Introductory seminar		Dr. C. Neff
Language	Course vacancies	Credit points	Registration
German	25-30	1	A registration is required
Course mode	Seminar 100 %		
Content	Each student will present an account of one aspect of the landscape during a 15-minute essay and a 5-10 page literature source relevant to the field trip. Every student receives feedback about his presentation providing him with advice on how to improve it. The tasks to be fulfilled during the field course are extensively presented and discussed in advance during the preparatory sessions.		
Evaluation	Brief presentation (graded)		

Ö2-2	Title of the module component		Lecturer
	Field course in landscape ecology		NN
Language	Course vacancies	Credit points	Registration
German	25-30	5	Registration required
Course mode	Field course 100 %		
Contents	During the field course the students will be divided into groups of four and will be expected to assemble different stations where they will address problems concerned with soil, water, air and biota. The field- methods will be adapted to the investigation area. Data acquisition will take place in accordance with the local ecosystem and its cultural landscape so as to display the local environmental problems. On-site data evaluation is envisaged and remaining data will be verified in the institute laboratory. By using geographic information systems (GIS) the students will generate spatial maps. Every group is expected to hand in a scientific essay in publication form, generate a digital map of the landscape, (with GIS or AutoCAD) using the acquired field data and design a scientific poster. Finally the group will present both poster and spatial map.		
Evaluation	Grade is based on the map, the poster and the presentation.		

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program:	B. Sc. Geoecology
Module title:	Key Competences
	geök-W1
Module category:	Core elective field
Core module / core elective module:	core elective module
Module Requirements:	none
Prerequisite for:	none

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☐ annually ☒ every semester	☐ 1 semester ☒ 2 semesters	5th- 6thsemester	6	According to the selected key competence

Module components

Nr.	Module components	Type	Contact hours	Private study	SPPW*2
W1	Courses offered by the House of Competence	Depends on the course selection			

*1 Practical *2 semester hours per week

Aims / intended learning outcomes:

The learning outcomes of this module can be subdivided in three main categories, which complement each other:

- Contextual knowledge
- General competences
- Practical experience orientation

Contextual knowledge:

The students will become aware of their own cultural imprint and will be able to adopt other points of view and interests (going beyond professional, cultural and linguistic borders). They will be able to perceive, compare and analyse not only their own but also foreign standards and disciplines and thus improve their relevant educational background and their approach to scientific problems. They will become aware of their professional and social responsibility, enhance their communicational skills in scientific and public discussions and gain insight into alternative approaches in other disciplines. In addition they will learn to analyse the interdependency between science, technology and society.

General competences

The students will be able to independently acquire knowledge in a purposive, structured and methodologically sound manner. They will learn how to employ this knowledge in solving scientific problems, ("research activity"), evaluate their own results and make them accessible to others. They will acquire skills in presenting technical matters to the public and obtain efficient working techniques (e.g. time- and personal management, knowledge management, problem-solution techniques, project management). They will enhance their social competences by learning how to negotiate personal relationships, how to set priorities, make decisions and take over responsibilities.

Practical experience orientation

The students will gain insight into the routine of professional activity. They will get to know the relevant institutions, job-specific action processes and action-strategies. They will learn to benefit from their own experience and explore new knowledge fields. By extending their language-skills the students will broaden their ability to communicate scientific, social and personal issues. The students will be ready to commit themselves professionally within responsible positions. They will be able to combine fundamental economic and judicial facts with their own field of experience and will understand the functionality and structure of social unities. The students will learn to accept criticism and perceive a conflict and work towards a constructive solution. They will attain certain flexibility within their individual role and adapt their patterns of interaction with whom they interact.

Module contents:

The following five electives have been selected to categorize the various courses, which are offered by the house of competence and to provide a general overview:

- Elective: "Culture, politics, science and technology"
- Elective: "Workshop for competence and creativity"
- Elective: "Personal fitness & emotional competence"
- Elective: "Tutor program"
- Elective: "Foreign languages"
- Elective: "Micro components"

All of these optional subjects are provided by the house of Competence (http://www.kit.edu/hoc) and can be selected from there.

Examination and grading

Module evaluation:

The module assessment comprises the weighted average of the given mark in each component.

Module tutor:	Tutors:
Dr. Michael Stolle - House of Competence	Academics from the University of Karlsruhe

Language

The language of instruction is German, occasionally also English. The respective language will be spoken within the core elective course: "foreign languages". Further information can be found in the course description.

ECTS

• Elective “Culture, politics- science and technology“	2 – 3 credits per course
• Elective “Workshop for competence and creativity“	2 – 3 credits per course
• Elective: “Personal fitness & emotional competence”	2 – 3 credits per course
• Elective “Tutor“	2 – 3 credits per course
• Elective “Foreign languages“	2 -4 credits per course
• Elective “Micro components“	1 credits per course

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology	geök-W2
Module title: Technical core elective field	
Module category: Core elective field	
Core module / core elective module: core elective module	
Module Requirements: none	
Prerequisite for: none	

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☐ annually ☒ per semester	☐ 1 semester ☒ 2 semesters	5th- 6thsemester	6	According to the selected modules

Module components

Nr.	Module components / Course	Type	Contact hours	Private study	SPPW*2
W2	Course selection	Depends on the course selection			

*1 Practical *2 semester periods per week

Aims / intended learning outcomes:

The learning outcomes of this module are manifold. According to the selected courses for the Bachelor studies fundamental competences will be conveyed in new fields of knowledge and methodologies, whereas existing expertise is extended or deepened. The student will attend the selected course after previous consultation.

Module contents:

In accordance with the selected courses

Examination and grading:

Module evaluation:

The module note results from the weighted average of the marks of the module components

Module tutor:	Tutors:
Prof. Dr. Dieter Burger Institute for Geography and Geoecology	Academics from the University of Karlsruhe
Recommended literature: Depending on the selected courses	
Language: In general German	

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology	geök-P1
Module title: Internship	
Module category: Internship and Bachelor thesis	
Core module / core elective module: core module	
Module requirements: M1	
Prerequisite for: none	

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ WS annually ☐ per semester	☒ 1 semester ☐ 2 semesters	5th semester	8	240 h contact hours

L: Lecture/P*: Practical lab course

Aims / intended learning outcomes:

After having accomplished at least 6 weeks of internship the students will obtain an outlook on practical work in Geoecology. By applying their specialized knowledge and methodologies they will gain insight into business activity and be tested on the practical transferability of their scientific study experience. This will involve an integration of their knowledge into areas where there may be conflicting business interests. They will also be able to test the transferability of their recently acquired scientific experience to new domains. To achieve this, they will be expected to contact private and public institutions and work towards independent practice.

Module contents:

The free choice of the internship enables the students to address different contents, knowledge and methods. The following areas will be available:

- Contaminated sites (exploration, restoration)
- Waste management (Consultation, avoidance, recycling)
- Internal and/or technical pollution control
- Soil/soil protection, water/stream water protection, air (Imission-control)
- Nature conservation, landscape planning, revitalization, environmental journalism
- Exchange process, climate, alternative energies
- Environmental consultancy and management, auditing and planning
- Environmental analysis (chemical, microbiological, molecular biological)

Examination and grading

Module evaluation:

The module grading comprises the mark given on a short presentation and a short report (ratio 1:2). The module grade is not considered in the Bachelor grading.

Module tutor:	Tutors:
Prof. Dr. Dieter Burger Institute für Geographie und Geoökologie	Prof. Dr. Dieter Burger and colleges
Recommended literature: Depends on the respective internship	

Karlsruhe Institute of Technology
Institute for Geography and Geoecology

Degree program: B. Sc. Geoecology

geök-P2

Module title: Bachelor thesis

Module category: Internship and Bachelor thesis

Core module / Core elective module: core module

Module Requirements: G5, F2, F3, F4, F5, F6, F7

Prerequisite for: none

Term:	Duration:	Recommended study term:	Credit points:	Work load:
☒ SS annually ☐ Per semester	☒ 1 semester ☐ 2 semesters	6th semester	16	480 h contact hours

Aims / intended learning outcomes:

Although staying in contact with their supervisor during the entire period, the students will be expected to complete the bachelor thesis autonomously to a large extent, while consequently taking the given time schedule and the underlying regularities of scientific work into account.

Being confronted with the state of the art of science and their methodologies the student will be expected to present a written thesis of a maximum 50 pages, participate satisfactorily in an oral colloquium and show skills in comprehensible and clear presentation. He will be expected to prepare and display graphs, diagrams, tabulations and abstracts, a table of contents, a bibliography and a list of figures.

Module contents:

The aim of the Bachelor thesis is to transfer the specialised knowledge and the respective techniques on a scientific project that is to be accomplished within 3 months. The content of the work depends on the respective issue whereas the interdisciplinary ecological approach plays a major role.

Examination and grading

Module evaluation:

The module grade results from the marks given on the thesis. A mandatory precondition for approval of the module is the participation and the holding of a non-graded presentation in the exam-colloquium.

Module tutor:	Primary tutors:
Prof. Dr. Dieter Burger Institute für Geographie und Geoökologie	Prof. Dr. Dieter Burger and colleges

Recommended literature:

Depends on the specific theme of the thesis.