JACOBS
UNIVERSITY

Study Program Handbook

Earth and Environmental Sciences

Bachelor of Science

Subject-specific Examination Regulations for Earth and Environmental Sciences (Fachspezifische Prüfungsordnung)

The subject-specific examination regulations for Earth and Environmental Sciences are defined by this program handbook and are valid only in combination with the General Examination Regulations for Undergraduate degree programs (General Examination Regulations = Rahmenprüfungsordnung). This handbook also contains the program-specific Mandatory Module and Examination Plans (Appendix 1a / 1b).

Upon graduation, students in this program will receive a Bachelor of Science (BSc) degree with a scope of 180 ECTS (for specifics see chapter 3 of this handbook).

Version	Valid as of	Decision	Details
Fall 2016 - V1	01.09.16	AB August 2016	Master Version
Fall 2016 - V2	01.09.17	AB August 2017	2.2 revised, 2.5 added
Fall 2016 - V3	01.09.18	Academic Senate August 29, 2018	Figure 3 updated

Contents

1 The Earth and Environmental Sciences (EES) Study Program

1.1 Concept

The Earth and Environmental Sciences (EES) program is an interdisciplinary environmental science major and provides an understanding of the natural functioning of our planet and the consequences of human impact. It combines traditional geoscience disciplines like Geochemistry, Geophysics, and Oceanography with Environmental Sciences and Social Sciences.
EES prepares our graduates for topical challenges and research questions such as the management and sustainable exploration of natural resources, the study of Earths climate and oceans. Participation in field and laboratory work as well as teamwork in multidisciplinary and multicultural groups are an important part of the studies.

1.2 Specific Advantages of the EES Program at Jacobs University

The study of Earth and Environmental Sciences will give you an excellent foundation for future careers in academic and applied fields ranging from geosciences and oceanography to climate and environmental research. You may work in international space agencies and NGOs, for mining and oil companies, or for media, press departments or publishing companies.
Our teaching philosophy emphasizes a interdisciplinary view of the world, focuses on a mixture of theoretical and hands-on practical work, and provides problem-solving skills that are in high demand from employers. This opens a wide variety of potential career paths.
Moreover, in the Earth and Environmental Sciences program, teaching and teamwork, helpdesks and personal training will provide you with a sound background in the natural sciences and mathematics. Mandatory courses in the social sciences and soft skills acquired in seminars, laboratory courses and field camps will prepare you for a leading role in today's world.

1.3 The Jacobs University Employability and Personal Development Concept

Jacobs University's educational concept aims at fostering employability which refers to skills, capacities, and competencies which transcend disciplinary knowledge and allow graduates to quickly adapt to professional contexts. Jacobs University defines employability as encompassing not just technical skills and understanding but also personal attributes and qualities enabling students to become responsible members of their professional and academic fields as well as of the societies they live in.

Graduates of JU will be equipped with the ability to find employment and to pursue a successful professional career, which means that

- graduates possess the ability to acquire knowledge rapidly, to assess information and to evaluate new concepts critically;

- graduates have communicative competences which allow them to present themselves and their ideas and to negotiate successfully;

- graduates are familiar with business-related processes and management skills and are able to manage projects efficiently and independently.

Graduates of JU will also be equipped with a foundation to become globally responsible citizens, which includes the following attributes and qualities:

- graduates have gained intercultural competence; they are aware of intercultural differences and possess skills to deal with intercultural challenges; they are familiar with the concept of tolerance;

- graduates can apply problem-solving skills in negotiating and mediating between different points of view;

- graduates can rely on basic civic knowledge and have an understanding for ethical reasoning; students are familiar with the requirements for taking on responsibility.

1.4 Career Options

Career opportunities include:

- Industry - searching for and managing natural resources such as water, fossil fuels and minerals on land and in the ocean.
- Academia - research and teaching at universities and research facilities; teaching in schools and colleges; museum work.
- (Environmental) management and consulting - investigating and monitoring ground conditions associated with planning, construction, land/ocean use, reclamation of contaminated land/seafloor, and waste disposal.
- Geological surveying - collecting surface and subsurface geological information, onshore and offshore, for geological, geophysical and geochemical databases.
- Developing methods, strategies and policies for renewable energy and sustainable resource exploitation.
- Planning satellite missions for Space Agencies.
- Working as science journalists or for publishing companies.
- Pursuing an academic career in
  - Geosciences
  - Ocean sciences
  - Environmental sciences
  - Resource exploration and management
  - Applied and theoretical physics and astronomy

In the high-ranking journal Nature, a recent article from May 2011 pointed out the superb prospects for the future job market related to Earth sciences (Nature 473, 243-244): ."There's good news for aspiring geoscientists. Job opportunities at all career stages are on the rise. There's room for those who love field work, and there's room for those who don't. Job prospects for geoscientists are excellent and are set to get even better. . Many of today's senior geoscientists were trained as specialists in relatively narrow disciplines, but in future,

most demand will be for researchers who have been trained to appreciate the interdisciplinary nature of the Earth sciences. For those willing to get interdisciplinary training, the future looks bright. The job market is flushed with opportunities."

For more details see: http://earth.user.jacobs-university.de/careers-jobs-earth-environmental-sciences/

1.5 More Information and Contact

For more information please contact the study program coordinator:

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Professor of Geosciences
Email: m.bau@jacobs-university.de
Telephone: +49 421 200-3102

or visit our program website: http://earth.user.jacobs-university.de/

2 The Curricular Structure

2.1 General

The undergraduate education at Jacobs University equips students with the key qualifications necessary for a successful academic, as well as professional career. By combining disciplinary depth and transdisciplinary breadth, supplemented by skills education and extracurricular elements, students are prepared to be responsible and successful citizens within the societies they work and live in.

The curricular structure provides multiple elements enhancing employability, transdisciplinarity, and internationality. The unique Jacobs Track, offered across all study programs, provides a broad range of tailor-made courses designed to foster career competencies. These include courses which promote communication, technology, business, (German) language, and management skills. The World Track, included in the third year of study, provides extended company internships or study abroad options. Thus students gain training on the job and intercultural experiences. All undergraduate programs at Jacobs University are based on a coherently modularized structure, which provides students with a broad and flexible choice of study plans to meet their major as well as minor study interests.

The policies and procedures regulating undergraduate study programs at Jacobs University in general can be found on the website.

2.2 The Jacobs University 3C-Model

Jacobs University offers study programs according to the regulations of the European Higher Education Area. All study programs are structured along the European Credit Transfer System (ECTS), which facilitates credit transfer between academic institutions. The three-year undergraduate program involves six semesters of study with a total of 180 ECTS credits. The curricular structure follows an innovative and student-centered modularization scheme - the 3C-Model - which groups the disciplinary content of the three study years according to overarching themes:

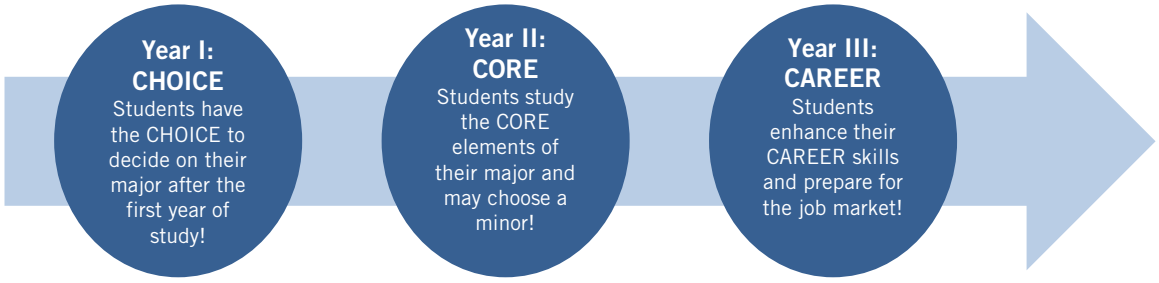


Figure 1: The Jacobs University 3C-Model

2.2.1 YEAR 1 - CHOICE

The first study year is characterized by a broad offer in disciplinary and interdisciplinary education. Students select three CHOICE modules from a variety of study programs. As a unique asset, our curricula allow students to select their study program freely from among the three selected CHOICE modules during their first year of study.

2.2.2 YEAR 2 - CORE

In the second year, students take three in-depth, discipline-specific CORE modules. One CORE module can also be taken from a second, complementary discipline, which allows students to incorporate a minor study track into their undergraduate education. Students will generally qualify for a minor if they have successfully taken at least one CHOICE module and one CORE module in a second field, and this extra qualification will be highlighted in the transcript.

2.2.3 YEAR 3 - CAREER

During their third year, students must decide on their career after graduation. In order to facilitate this decision, the fifth semester introduces two separate tracks. By default students are registered for the World Track.

1. **The World Track**
   In this track there are two mandatory elective options:
   - **Internship**
     The internship program is a core element of Jacobs Universitys employability approach. It includes a mandatory semester-long internship off-campus (minimum 16 weeks in full-time) which provides insight into the labor market as well as practical work experience related to the respective area of study. Successful internships may initiate career opportunities for students. For more information, please contact the Career Services Center (http://www.jacobs- university.de/career-services/contact).
   - **Study Abroad**
     Students can take the opportunity to study abroad at one of our partner universities. Courses recognized as study abroad credits need to be pre-approved according to the Jacobs University study abroad procedures and carry minimum of 20 ECTS credits in total. Several exchange programs allow you to be directly enrolled at prestigious partner institutions worldwide. Jacobs University's participation in Erasmus+, the European Unions exchange program, provides an exchange semester at a number of European universities including Erasmus study abroad funding.
     For more information, please contact the International Office (http://intoffice.user.jacobs-university.de/outgoing/).
2. **The Campus Track**
   Alternatively, students may also opt to follow the Campus Track by continuing their undergraduate education at Jacobs, namely by selecting an additional CORE module during their third year and redistributing the remaining courses and modules across the

third year. This opportunity can be used by students to more intensively focus on their major or to fulfill the minor requirements for a second field of interest.

In the sixth semester, all students select from a range of specialization courses within their study program and concentrate on their Bachelor thesis in the context of a Project/Thesis Module.

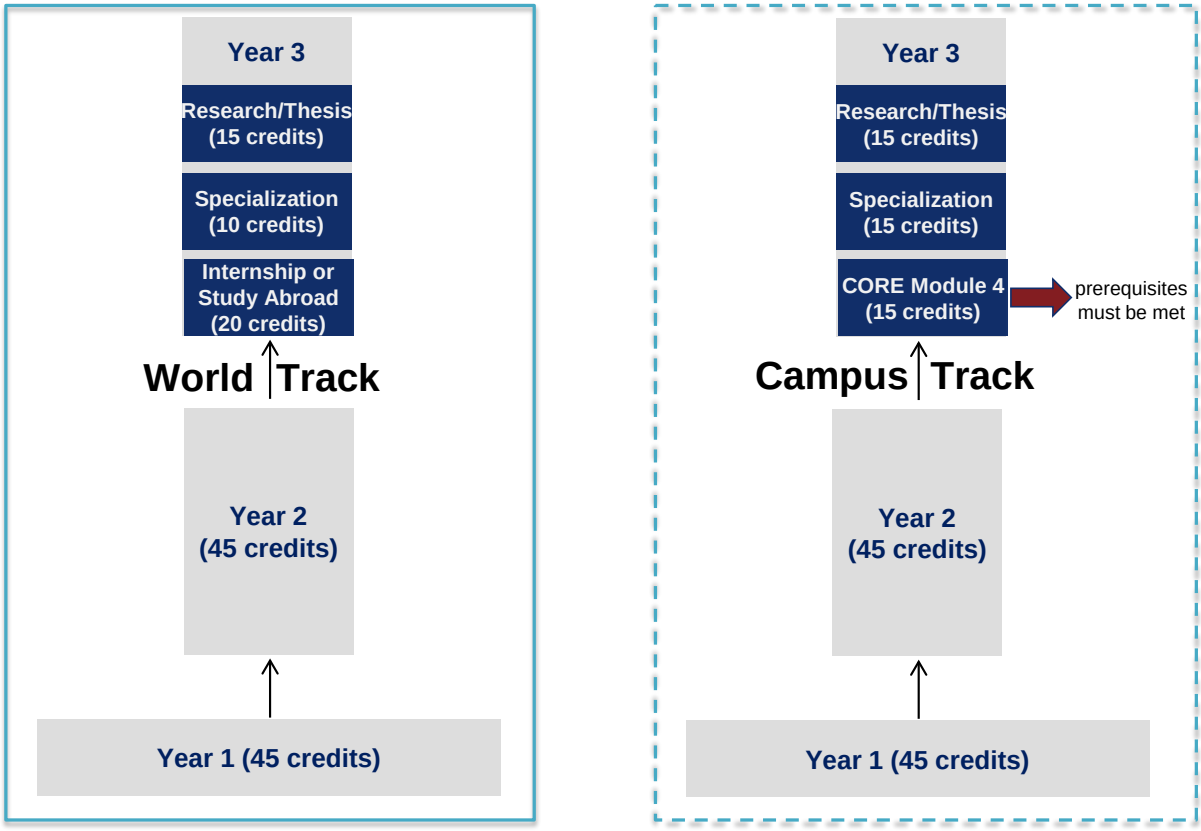


Figure 2: World Track versus Campus Track

Career Skills

Throughout their studies all students attend a mandatory set of career skills courses and events.

The mandatory Career Skills module prepares all undergraduate students at Jacobs University for the transition from student life to working life as well as for their future career. Skills, knowledge and information which are fundamental for participation in an internship or a semester abroad will be conveyed concurrently. Essential components of the module include information sessions, compulsory seminars on various career-relevant topics as well as participation in the annual Jacobs Career Fair.

The successful completion of the Career Skills Module and the encompassed single seminars are graded with Pass/Fail for all students. ECTS credits are not awarded. All undergraduate students will be automatically registered for the Career Skills Module. However, every student has to keep track of his/her individual fulfillment of requirements and has to register on Campusnet for all seminars and sessions during the official registration period at the beginning of each semester. An overview of the sequence in which components should be completed is shown in the table below:

CAREER SKILLS MODULE For Undergraduate Students matriculated Fall 2015 and Fall 2016

SEMESTER	1	2	3	4	5	6
MANDATORY BASICS	CSC-INFO Session: "CSC Services" CA01-990000		CSC-INFO Session: "World Track" CA01-990026			
MANDATORY SEMINARS	Both seminars have to be attended in your first or second semester: CSC-APPLICATION TRAINING CA01-990001 CSC-RESEARCHING & CONTACTING EMPLOYERS CA01-990004					
MANDATORY ELECTIVE SEMINARS (seminar program subject to availability)			Attend 2 out of several career skills seminars and workshops. i.e. ▪ Business Etiquette ▪ Presentation Skills ▪ Communication Skills ▪ Grad School Application Training ▪ Self-Management ▪ Time-Management ▪ Decision Making ▪ Preparing for an Interview ▪ Introduction to Project Management			
OTHER MANDATORY COMPONENTS				CSC-JACOBS CAREER FAIR in February, on campus CA01-990003	INTERNSHIP or STUDY ABROAD or CAMPUS TRACK	INTERNSHIP & STUDY ABROAD EVENT Online CSC-CAREER SURVEY CA01-990002

Figure 3: The Career Skills Module

2.3 The Jacobs Track

The Jacobs Track, another stand-alone feature of Jacobs University, runs parallel to the disciplinary CHOICE, CORE, and CAREER modules across all study years and is an integral part of all study programs. It reflects our commitment to an in-depth methodological education, it fosters our transdisciplinary approach, it enhances employability, and equips students with extra skills desirable in your general field of study. Additionally, it integrates essential language courses.

Mathematics, statistics, and other methods courses are offered to all students within a comprehensive Methods Module. This module provides students with general foundations and transferable techniques which are invaluable to follow the study content not only in the study program itself but also in related fields.

The Skills Module equips students with general academic skills which are indispensable for their chosen area of study. These could be, for example, programming, data handling, presentation skills, and academic writing, scientific and experimental skills.

The transdisciplinary Triangle Module offers courses with a focus on at least one of the areas of business, technology and innovation, and societal context. The offerings comprise essential knowledge of these fields for students from other majors as well as problem-based courses that tackle global challenges from different disciplinary backgrounds. Working together with students from different disciplines and cultural backgrounds in these courses broadens the students horizon by crossing the boundaries of traditional disciplines.

Foreign languages are integrated within the Language Module. Communicative skills and foreign language competence foster students intercultural awareness and enhance their employability in a globalized and interconnected world. Jacobs University supports its students in acquiring and improving these skills by offering a variety of language courses at all proficiency levels. Emphasis is put on fostering German language skills, as they are an important prerequisite for students to learn about, explore, and eventually integrate into their host country. Hence, acquiring 10 ECTS credits in German is a requirement for all students. Students who meet the requirements of the German proficiency level (e.g. native speakers) are required to select courses in any other language program offered.

2.4 Modularization of the Earth and Environmental Sciences Program

2.4.1 Content

Year 1
Take two mandatory modules listed below and select one further CHOICE module from a different study area.

Inorganic Chemistry and Environmental Systems (CH04-InorgChem)
The bifunctional module Chemistry and Environmental Systems provides an introduction to (inorganic) chemistry and to the anthropogenic impact on the natural (near-)surface environ-

ment of Earth. Two introductory lecture courses (Introduction to Inorganic Chemistry (focus on the elements of the PSE, molecular compounds derived from them, redox reactions) and Earth and Environmental Systems (focus on Geodynamics, Petrography, Soil Science, Oceanography, Hydrogeology, Geomorphology, and anthropogenic impact on the (near-)surface environment) are complemented by an on-campus laboratory course (Inorganic Chemistry Lab) and an off-campus field-lab (excursion) to develop fundamental practical skills.

Physics of Natural Systems (CH05-PhysNatSys)
Physics of Natural Systems provides an introduction to the physical description of natural phenomena and covers fundamental topics in physics and earth and environmental sciences (EES). Important concepts from mechanics, thermodynamics, fluid dynamics, electromagnetism, atoms and nuclei are introduced and applied to essential processes in Earth, marine, and planetary sciences. Structure and dynamics of natural systems are studied with moderate use of mathematics. Practical sessions will cover important experimental techniques and tools. This module provides a foundation for the higher level EES and Physics modules Earth, Ocean, and Environmental Physics, Physics and Technology, Theoretical Physics, and Physics of Matter.

Year 2
Take all three modules or replace one with a CORE module from a different study program.

Fundamental Earth and Environmental Sciences (CO10-FundEES)
The module Fundamental Earth and Environmental Sciences is comprised of essential geoscience courses that represent the backbone of a sound university education in the geosciences. Core courses on Sedimentology, Structural Geology, Volcanism and Metamorphism are complemented by applied courses in environmental and resource geoscience. If relevant, both marine and terrestrial systems are discussed. A key element of these courses are on-campus practicals during which the students are introduced to geological methods and techniques. These essential practical skills are further expanded upon and applied in a real-world scenario during a five day off-campus geological field camp.

Earth, Ocean and Environmental Geochemistry (CO11EOEnvChem)
The module Earth, Ocean and Environmental Geochemistry is comprised of fundamental geochemistry courses that represent the backbone of a sound university education in geochemistry and geochemistry-focussed environmental and resource science. Core courses on igneous and aqueous (trace) element geochemistry and introductory courses on stable and radiogenic isotope geochemistry are complemented by a course on the biogeochemical aspects of environmental and resource science and an off-campus field camp focusing on environmental sciences. All courses address terrestrial as well as marine systems.

Earth, Ocean and Environmental Geophysics (CO12-EOEnvPhys)
The module Earth, Ocean, and Environmental Physics covers topics and methods that are essential in geophysics and physical oceanography. Emphasis will be on the quantitative assessment of physical processes and structures in terrestrial and marine systems. Important concepts are introduced and studied in lectures, and then applied and consolidated in practical courses such as field trips and computer labs on remote sensing and data analysis. The module constitutes

one of the CORE pillars of the Earth and Environmental Sciences (EES) program and in general may complement the education of students interested in a physics-based presentation of fundamental EES topics.

Some CORE Modules require students to have taken a specific CHOICE Module. Please see the Module Handbook for details regarding pre-requisites.

Year 3
In the 3rd year students follow the World Track by default:

1. **World Track**
   5th Semester
   - Internship / study abroad

   6th Semester
   - Earth and Environmental Sciences Project / Thesis Module
   - Program-specific Specialization Module Exemplary course offering:
     - Resources and Environmental Behavior of Critical High-Technology Metals
     - Earth, Ocean and Environmental Sciences Field Lab
     - Current Topics in Earth and Marine Sciences
     - Current Topics in Resource and Environmental Sciences
     - Theoretical and Computational Physical Oceanography

2. **Campus Track**
   Students who do not enter the World Track follow the Campus Track.
   5th and 6th Semester
   - Program-specific Project / Thesis Module
   - Program-specific Specialization Module
     (please see World Track for exemplary course offering)
   - Additional CORE Module

2.5 The Bachelor Thesis / Project

This module is a mandatory graduation requirement for all undergraduate students. It consists of two components in the major study program guided by a Jacobs Faculty member:

1. **A Research Project** (5 ECTS)
   and
2. **The Bachelor Thesis** (10 ECTS)

The workload for the project component is about 125 hours and for the thesis component about 250 hours.The title of the thesis will be shown on the transcript.

2.5.1 Aims

Within this module, students apply knowledge they have acquired about their major discipline, skills, and methods to become acquainted with actual research topics, ranging from the identifi-

cation of suitable (short-term) research projects, preparatory literature searches, the realization of discipline-specific research, and the documentation, discussion, and interpretation of the results. Research results obtained from the Research Project can be embedded in the Bachelor Thesis.

2.5.2 Intended Learning Outcomes

1. Research Project
   This module component consists of a guided research project in the major study program. The well-defined research task must be completed and documented according to the scientific standards in the respective discipline. It involves a high degree of independence, supported by individualized instructor feedback and guidance.
2. Bachelor Thesis
   With their Bachelor Thesis students should demonstrate mastery of the contents and methods of the major specific research field. Furthermore, students should show the ability to analyze and solve a well-defined problem with scientific approaches, a critical reflection of the status quo in scientific literature, and an original development of their own ideas.

Both, the Research Project and the Bachelor Thesis, can also have an inter- or transdisciplinary nature - with the explicit permission of the supervisor.

2.5.3 Supervision

Both module components can be performed with the same Jacobs faculty member, or different ones, the latter in order to allow a broader research experience. Students are required to choose a supervisor, at the latest, by the end of the drop-add period of the semester in which the module component is taken. **The selected supervisor(s) must approve the Project topic and Bachelor Thesis topic before the student starts to work towards the module component.** The respective study program coordinators will assist in the search for prospective supervisor(s).

2.5.4 Registration

World Track students register for both components, at the earliest, in their 6th semester.
Campus Track students register for the Project component in the 5th and for the Bachelor Thesis component, at the earliest, in their 6th semester.

The registrations must be made before the end of the respective drop/add periods.

Later enrolment is possible for those students pursuing a second major or those who graduate late for other reasons. These students perform their (second) thesis earliest in the 7th semester of their studies. They have to contact the Student Records Office for individual registration.

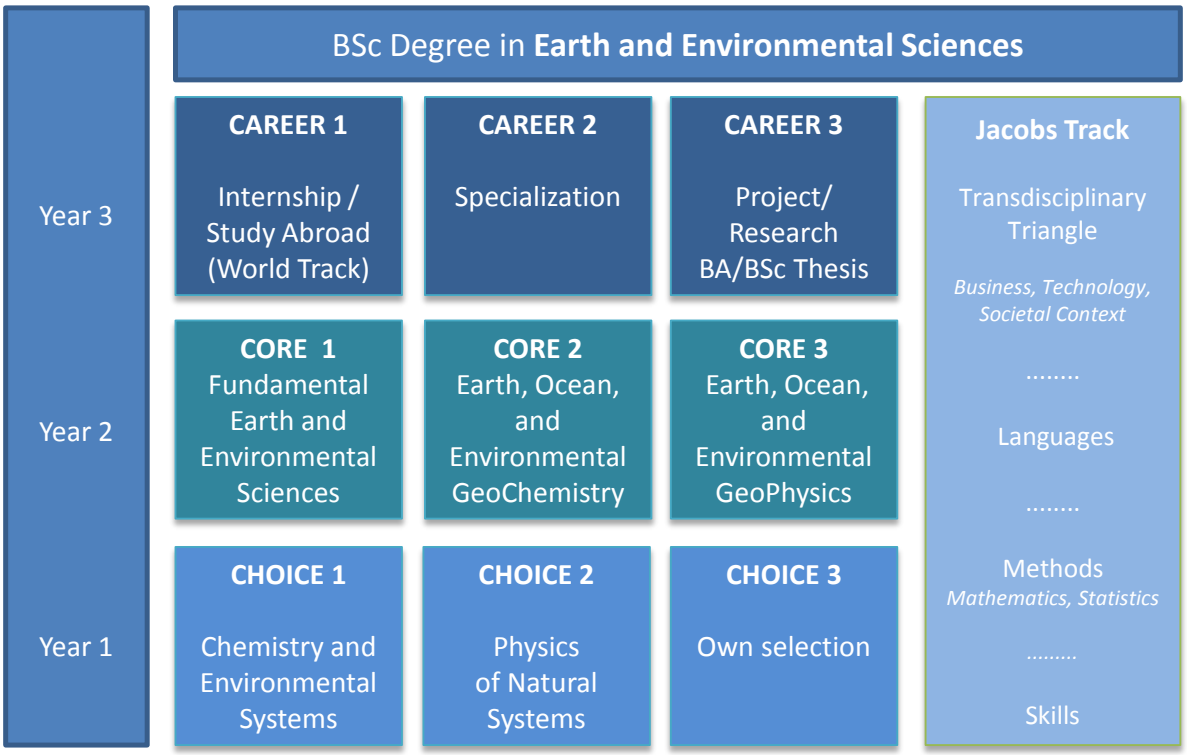
Students are allowed to extend their thesis related work into the intersession or summer break upon approval of the thesis supervisor and Student Records. Students are not allowed to register for different Bachelor Thesis courses in the same semester.

2.5.5 Formal Regulations for the Bachelor Thesis

- Timing
  The Thesis work has to be generated within the semester of registration. The semester period has 14 weeks.
- Extent
  The document must be between 15-25 pages in length, including references, but excluding appendices or supporting information. Deviations in length and format can be determined within individual study programs and should be communicated to all registered students by the study program coordinator.
- Cover page
  The cover page must show the title of the Bachelor Thesis, the university's name, the month and year of submission, the name of the student and the name of the supervisor.
- Statutory Declaration
  Each Bachelor Thesis must include a statutory declaration signed by the student confirming it is their own independent work and that it has not been submitted elsewhere. The respective form can be found on the Student Records Office website.
- Submission
  The Bachelor Thesis must be submitted as a hard copy (pdf-file) to the supervisor and additionally to the Student Records Office via online form on the Student Records Office website.

  Deadline for submission of the Bachelor Thesis is May 15 (unless specified otherwise by the Student Records Office).

2.5.6 Structure



YEAR 1 *Take three CHOICE modules, one free selection*
YEAR 2 *Take three CORE modules, one CORE module can be substituted by a CORE module from a second study program to pursue a minor*
YEAR 3 *Alternatively Campus Track with a 4th CORE module instead of internship/study abroad module*

Figure 4: Earth and Environmental Sciences Module Structure

3 Appendix 1a/1b: Mandatory Module and Examination Plans for World Track and Campus Track

Jacobs University Bremen reserves the right to substitute courses by replacements and/or reduce the number of mandatory/mandatory elective courses offered.

4 Appendix 2: Course Data for Program-Specific CHOICE and CORE Courses

All course data stated in the appendix is based on the previous study year and subject to change.

Appendix 1a - Mandatory Module and Examination Plan for World Track

Earth and Environmental Sciences – World Track

Matriculation Fall 2016

	Program-Specific Modules	Type	Status[1]	Semester	Credits		Jacobs Track Modules (General Education)	Type	Status[1]	Semester	Credits
Year 1 - CHOICE					**45**						**20**
Take the two mandatory CHOICE modules listed below, these are a requirement for the EES program.											
CH04-InorgChem	**Module: Inorganic Chemistry and Environmental Systems**		**m**		**15**		**JT-ME-MethodsMath**	**Module: Methods / Mathematics**		**m**		**7,5**
CH04-210113	Introduction to Inorganic Chemistry and Earth & Environmental Systems	Lecture	m	1	5		JT-ME-120106	Applied Calculus I	Lecture	m	1	2,5
CH04-400111	Inorganic Chemistry I Lab	Lab	m	1	2,5		JT-ME-120107	Applied Calculus II	Lecture	m	1	2,5
CH04-210114	Advanced Earth & Environmental Systems and Inorganic Chemistry	Lecture	m	2	5		JT-ME-120101	Mathematical Concepts in the Sciences	Lecture	m	2	2,5
CH04-210111	GeoEnvironmental Systems and their Chemistry - Field Lab	Excursion	m	2	2,5		**JT-SK-Skills**	**Module: Skills**		**m**		**2,5**
CH05-PhysNatSys	**Module: Physics of Natural Systems**		**m**		**15**		JT-SK-990103	Scientific and Experimental Skills	Lecture	m	1	2,5
CH05-200104	Classical Physics	Lecture	m	1	5		**JT-TA-TriArea**	**Module: Triangle Area**		**m**		**5**
CH05-200114	Classical Physics Lab	Lab	m	1	2,5			Take two courses from the triangle (BUSINESS, TECHNOLOGY &		me	1/2	5
CH05-210132	Introduction to Earth and Marine Systems	Lecture	m	2	5			INNOVATION, SOCIETAL CONTEXT) area. Each counts 2,5 ECTS [3]				
CH05-210133	Introduction to Mineralogy	Lecture	m	2	2,5		**JT-LA-Language**	**Module: Language**		**m**		**5**
	Module: CHOICE (own selection)		**e**	**1/2**	**15**			Take two German courses (2,5 ECTS each).	Seminar	me	1/2	5
Students take one further CHOICE module from those offered for all other study programs. [2]								Native German speakers take courses in another offered language				
Year 2 - CORE					**45**						**20**
Take all three modules or replace one with a CORE module from a different study program. [2]											
CO10-FundEES	**Module: Fundamental Earth and Environmental Sciences**		**me**		**15**		**JT-ME-MethodsMath**	**Module: Methods / Mathematics**		**m**		**7,5**
CO10-210201	Volcanism and Metamorphism	Lecture	m	3	2,5							
CO10-210203	Sedimentology	Lecture	m	3	2,5			Take three Methods (mandatory) elective courses (2,5 ECTS each). [2]	Lecture	me	3/4	7,5
CO10-210206	Structural Geology	Lecture	m	3	2,5							
CO10-210204	Marine Environments	Lecture	m	4	2,5							
CO10-210205	Climate Change	Lecture	m	4	2,5							
CO10-041202	Fieldtrip Environmental Changes and Challenges in Northwestern Germany	Excursion	m	4	2,5							
CO11-EOEnvChem	**Module: Earth, Ocean, and Environmental GeoChemistry**		**me**		**15**		**JT-TA-TriArea**	**Module: Triangle Area**		**m**		**7,5**
CO11-210241	Geochemistry of Igneous and Aqueous Systems	Lecture	m	3	2,5							
CO11-210302	Environmental Geochemistry	Lecture	m	3	2,5			Take three courses from the triangle (BUSINESS, TECHNOLOGY &		me	3/4	7,5
CO11-210362	Applied Geochemistry	Lecture	m	4	2,5			INNOVATION, SOCIETAL CONTEXT) area. Each counts 2,5 ECTS [3]				
CO11-210301	Isotope Geochemistry	Lecture	m	4	2,5							
CO11-210373	Mineral Resources	Lecture	m	4	2,5							
CO11-210202	Fieldtrip Volcanism and Hydrochemistry in the Eifel, Germany	Excursion	m	4	2,5							
CO12-EOEnvPhys	**Module: Earth, Ocean, and Environmental GeoPhysics**		**me**		**15**		**JT-LA-Language**	**Module: Language**		**m**		**5**
CO12-210223	Marine and Applied Geophysics	Lecture	m	3	2,5							
CO12-210225	Physics of System Earth	Lecture	m	3	5			Take two German courses (2,5 ECTS each).	Seminar	me	3/4	5
CO12-210214	Physical Oceanography	Lecture	m	3	2,5			Native German speakers take courses in another offered language				
CO12-210213	Earth System Monitoring and Remote Sensing	Lecture	m	4	2,5							
CO12-210251	Oceanographic Excursion / Research Cruise North Sea	Excursion	m	4	2,5							
Year 3 - CAREER					**45**						**5**
CA02 / CA03	**Module: Internship / Study Abroad**		**m**	**5**	**20**		**JT-SK-Skills**	**Module: Skills**		**m**		**2,5**
CA01-CarSkills	**Module: Career Skills**		**m**				JT-SK-990104	Advanced Scientific and Experimental Skills	Lecture	m	6	2,5
CA07-EES	**Module: Project / Thesis EES**		**m**		**15**		**JT-TA-TriArea**	**Module: Triangle Area**		**m**		**2,5**
CA07-210304	Project EES		m	6	5			Take one course from the triangle (BUSINESS, TECHNOLOGY &		me	6	2,5
CA07-210305	Thesis EES		m	6	10			INNOVATION, SOCIETAL CONTEXT) area. Each counts 2,5 ECTS [3]				
CAS-WT-EES	**Module: Specialization Area EES**		**m**		**10**							
	Take four specialization courses (2.5 ECTS each) [2]		me	5/6	10							
Total ECTS												**180**

[1] Status (m = mandatory, e = elective, me = mandatory elective), [2] For a full listing of all CHOICE / CORE / CAREER / Jacobs Track modules please consult the CampusNet online catalogue and / or the module handbook (on our website).
[3] You are required to take six Triangle Area courses in total. Select two from each of the three triangle areas (BUSINESS, TECHNOLOGY & INNOVATION, SOCIETAL CONTEXT).

Appendix 1b - Mandatory Module and Examination Plan for Campus Track

Earth and Environmental Sciences – Campus Track

Matriculation Fall 2016

Program-Specific Modules		Type	Status[1]	Semester	Credits	Jacobs Track Modules (General Education)		Type	Status[1]	Semester	Credits
Year 1 - CHOICE					**45**						**20**
Take the two mandatory CHOICE modules listed below, these are a requirement for the EES program.											
CH04-InorgChem	**Module: Inorganic Chemistry and Environmental Systems**		**m**		**15**	**JT-ME-MethodsMath**	**Module: Methods / Mathematics**		**m**		**7,5**
CH04-210113	Introduction to Inorganic Chemistry and Earth & Environmental Systems	Lecture	m	1	5	JT-ME-120106	Applied Calculus I	Lecture	m	1	2,5
CH04-400111	Inorganic Chemistry I Lab	Lab	m	1	2,5	JT-ME-120107	Applied Calculus II	Lecture	m	1	2,5
CH04-210114	Advanced Earth & Environmental Systems and Inorganic Chemistry	Lecture	m	2	5	JT-ME-120101	Mathematical Concepts in the Sciences	Lecture	m	2	2,5
CH04-210111	GeoEnvironmental Systems and their Chemistry - Field Lab	Excursion	m	2	2,5	**JT-SK-Skills**	**Module: Skills**		**m**		**2,5**
CH05-PhysNatSys	**Module: Physics of Natural Systems**		**m**		**15**	JT-SK-990103	Scientific and Experimental Skills	Lecture	m	1	2,5
CH05-200104	Classical Physics	Lecture	m	1	5	**JT-TA-TriArea**	**Module: Triangle Area**		**m**		**5**
CH05-200114	Classical Physics Lab	Lab	m	1	2,5		Take two courses from the triangle (BUSINESS, TECHNOLOGY & INNOVATION, SOCIETAL CONTEXT) area. Each counts 2,5 ECTS [3]		me	1/2	5
CH05-210132	Introduction to Earth and Marine Systems	Lecture	m	2	5						
CH05-210133	Introduction to Mineralogy	Lecture	m	2	2,5	**JT-LA-Language**	**Module: Language**		**m**		**5**
	Module: CHOICE (own selection)		**e**	**1/2**	**15**		Take two German courses (2,5 ECTS each). Native German speakers take courses in another offered language	Seminar	me	1/2	5
Students take one further CHOICE module from those offered for all other study programs. [2]											
Year 2 - CORE					**45**						**20**
Take all three modules or replace one with a CORE module from a different study program. [2]											
CO10-FundEES	**Module: Fundamental Earth and Environmental Sciences**		**me**		**15**	**JT-ME-MethodsMath**	**Module: Methods / Mathematics**		**m**		**7,5**
CO10-210201	Volcanism and Metamorphism	Lecture	m	3	2,5						
CO10-210203	Sedimentology	Lecture	m	3	2,5		Take three Methods (mandatory) elective courses (2,5 ECTS each). [2]	Lecture	me	3/4	7,5
CO10-210206	Structural Geology	Lecture	m	3	2,5						
CO10-210204	Marine Environments	Lecture	m	4	2,5						
CO10-210205	Climate Change	Lecture	m	4	2,5						
CO10-041202	Fieldtrip Environmental Changes and Challenges in Northwestern Germany	Excursion	m	4	2,5						
CO11-EOEnvChem	**Module: Earth, Ocean, and Environmental GeoChemistry**		**me**		**15**	**JT-TA-TriArea**	**Module: Triangle Area**		**m**		**7,5**
CO11-210241	Geochemistry of Igneous and Aqueous Systems	Lecture	m	3	2,5						
CO11-210302	Environmental Geochemistry	Lecture	m	3	2,5		Take three courses from the triangle (BUSINESS, TECHNOLOGY & INNOVATION, SOCIETAL CONTEXT) area. Each counts 2,5 ECTS [3]		me	3/4	7,5
CO11-210362	Applied Geochemistry	Lecture	m	4	2,5						
CO11-210301	Isotope Geochemistry	Lecture	m	4	2,5						
CO11-210373	Mineral Resources	Lecture	m	4	2,5						
CO11-210202	Fieldtrip Volcanism and Hydrochemistry in the Eifel, Germany	Excursion	m	4	2,5						
CO12-EOEnvPhys	**Module: Earth, Ocean, and Environmental GeoPhysics**		**me**		**15**	**JT-LA-Language**	**Module: Language**		**m**		**5**
CO12-210223	Marine and Applied Geophysics	Lecture	m	3	2,5						
CO12-210225	Physics of System Earth	Lecture	m	3	5		Take two German courses (2,5 ECTS each). Native German speakers take courses in another offered language	Seminar	me	3/4	5
CO12-210214	Physical Oceanography	Lecture	m	3	2,5						
CO12-210213	Earth System Monitoring and Remote Sensing	Lecture	m	4	2,5						
CO12-210251	Oceanographic Excursion / Research Cruise North Sea	Excursion	m	4	2,5						
Year 3 - CAREER					**45**						**5**
COXX	**Module: Additional (4th) CORE module**		**m**	**5/6**	**15**	**JT-SK-Skills**	**Module: Skills**		**m**		**2,5**
CA01-CarSkills	**Module: Career Skills**		**m**			JT-SK-990104	Advanced Scientific and Experimental Skills	Lecture	m	6	2,5
CA07-EES	**Module: Project / Thesis EES**		**m**		**15**	**JT-TA-TriArea**	**Module: Triangle Area**		**m**		**2,5**
CA07-210304	Project EES		m	5	5		Take one course from the triangle (BUSINESS, TECHNOLOGY & INNOVATION, SOCIETAL CONTEXT) area. Each counts 2,5 ECTS [3]		me	5	2,5
CA07-210305	Thesis EES		m	6	10						
CAS-CT-EES	**Module: Specialization Area EES**		**m**		**15**						
	Take **six** specialization courses (2.5 ECTS each) [2]		me	5/6	15						
Total ECTS											**180**

[1] Status (m = mandatory, e = elective, me = mandatory elective), [2] For a full listing of all CHOICE / CORE / CAREER / Jacobs Track modules please consult the CampusNet online catalogue and / or the module handbook (on our website).

[3] You are required to take six Triangle Area courses in total. Select two from each of the three triangle areas (BUSINESS, TECHNOLOGY & INNOVATION, SOCIETAL CONTEXT).

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Introduction to Inorganic Chemistry and Earth and Environmental Sciences	CH04-210113	5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CH04-InorgChem Inorganic Chemistry and Environmental Systems	125	Bachelor 1st Year CHOICE

Course Description / Content / Aims

[h2]Inorganic Chemistry[/h2]
An introduction to fundamental concepts of general/inorganic chemistry including the following areas: matter, measurements and moles, elements, compounds, units, chemical reactions, stoichiometry, equations, equilibrium, acids and bases, properties of gases.

[h2]Earth & Environmental Sciences[/h2]
Students are introduced to the fundamental principles and concepts in the geosciences, with special emphasis on the Earth's internal structure and on plate tectonics. The focus then shifts towards the "Critical Zone", i.e. on the complex near-surface environment in which interactions between rock, soil, water, air and living organisms define the natural habitat and control the availability of live-sustaining resources. Students will be introduced in a qualitative way to the basic components of and fundamental processes operating in the critical zone.

Methods of Assessment

Name	Weighting
Attendance - Kortz	5%
Exam 1 - Prof. Kortz	22%
Exam 2 - Prof. Kortz	23%
Final Exam - Prof. Bau	15%
Part Koschinsky	25%
Quizz(es) - Bau	10%

Course Name	***Course No***	***ECTS***
Inorganic Chemistry I Lab	CH04-400111	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CH04-InorgChem Inorganic Chemistry and Environmental Systems	62,5	Bachelor 1st Year CHOICE

Course Description / Content / Aims
Foundation principles of chemistry, including basic laboratory techniques, qualitative analysis of anions and cations, strong/weak acids and bases, titrations, solubility of salts, crystallization, redox reactions, gravimetric analysis, volumetric analysis, complex formation, synthesis of nanoparticles.

Methods of Assessment

Name	Weighting
Lab Performance	50%
Lab Reports	40%
Quizz(es)	10%

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
GeoEnvironmental Systems and their Chemistry-Field Lab	CH04-210111	2,5
Module Affiliation CH04-InorgChem Inorganic Chemistry and Environmental Systems	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 1st Year CHOICE
Course Description / Content / Aims Introduction to the fundamental techniques of field geology and field geochemistry including using geology, water chemistry and environmental problems in the old mining district of the Harz Mountains, Germany, as examples. The students participate in a three-day field trip that includes introductory lunchtime lectures prior to the field trip, the three-day field trip itself, and two evening lectures during the field trip.		

Course Name	***Course No***	***ECTS***
Advanced Earth and Environmental Sciences and Inorganic Chemistry	CH04-210114	5
Module Affiliation CH04-InorgChem Inorganic Chemistry and Environmental Systems	***Workload (hrs / sem)*** 125	***Level*** Bachelor 1st Year CHOICE
Course Description / Content / Aims Earth & Environmental Sciences: Following a continuation of a discussion of the fundamentals of geology, it will be demonstrated how physical, chemical and biological processes interact in the Earth System and drive the functions of ecosystems, and how human activities interfere with natural processes. Anthropogenic changes at local and global scales will be discussed, with emphasis on the degradation of the atmosphere, freshwater systems, soils, forests, grassland and cropland and on the changes of polar and coastal regions. Inorg. Chemistry: Continuation of the introduction to chemistry that comprises the following parts: Atoms and atomic structure, the hydrogen atom, many electron atoms, periodic properties of elements. The chemical bond, ionic vs covalent bond, hydrogen bond. Molecular structure (VSEPR).		

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Classical Physics	CH05-200104	5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CH05-PhysNatSys Physics of Natural Systems	125	Bachelor 1st Year CHOICE

Course Description / Content / Aims

Physics is the most fundamental of all natural sciences. A thorough background and understanding of physics is important for any description of natural systems. This course introduces to the basic principles of mechanics, thermodynamics, and optics. Emphasis is laid on general principles and fundamental concepts for the understanding of natural phenomena, not on an extensive mathematical description. Nevertheless, some basic calculus will be necessary to develop a scientific sound description of physical phenomena. Experiments and demonstrations are included in the lecture, and a tutorial is offered to discuss homework and topics of interest in more details.
The course consists of three main sections: The section on mechanics introduces the description of motion and the concepts of force and energy, including collisions, rotations, gravitation, and oscillations. The section on thermodynamics adds the concepts of heat and temperature to the description of natural systems including heat capacity, ideal gases, internal energy and the first law of thermodynamics. The section on optics introduces the concepts of light rays and waves to discuss optical instruments and the phenomena of interference and diffraction.

Methods of Assessment

Name	Weighting
Final Exam	50%
Home Work	20%
Midterm Exam	30%

Course Name	***Course No***	***ECTS***
Classical Physics Lab	CH05-200114	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CH05-PhysNatSys Physics of Natural Systems	62,5	Bachelor 1st Year CHOICE

Course Description / Content / Aims

Physics is an experimental science and the ultimate test for any theory or description of nature is the experiment. This lab course complements the Classical Physics lecture with experiments in the fields of mechanics, thermodynamics and optics. It deepens the understanding and extends the topics covered in the lecture, which is a corequisite for this course. Prior to the course, students need to attend the relevant safety instructions and will get an introduction into error analysis and calculation. The lab offers six different experiments and runs over six afternoons. The aim of the lab sessions is hands-on experience on how to investigate physical phenomena and topics presented in the lecture; to plan, carry out, and analyse experiments in physics; to describe, summarize and present experimental results adequately. Examples of experiments include the mathematical pendulum, ideal gas law and optical instruments.

Methods of Assessment

Name	Weighting
Final Exam	34%
Reports	66%

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Introduction to Earth and Marine Systems	CH05-210132	5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CH05-PhysNatSys Physics of Natural Systems	125	Bachelor 1st Year CHOICE

Course Description / Content / Aims

Planet Earth is a natural system comprising a number of compartments such as the interior, the continents, the oceans, and the atmosphere. In this course you are introduced to the complex interplay of earth and marine processes on a wide range of spatial and temporal scales. Earth's history and planetary evolution define our place in space and time. Plate tectonics and surface structures are closely linked to the composition and the dynamics of the planetary interior. We discuss the physical forces and hydrodynamical principles on our rotating planet that govern ocean currents and also atmospheric dynamics on large spatial scales.

Methods of Assessment

Name	Weighting
Exam Oceanography (Prof. Thomsen)	34%
Exam Planet Earth (Prof. Vogt)	33%
Exam Solid Earth (Prof. Unnithan	33%

Course Name	***Course No***	***ECTS***
Introduction to Mineralogy	CH05-210133	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CH05-PhysNatSys Physics of Natural Systems	62,5	Bachelor 1st Year CHOICE

Course Description / Content / Aims

This course provides an introduction to mineral sciences. Key concepts of crystallography are reviewed to show how the three-dimensional nature of crystals is related to their physical and chemical properties. An introduction to modern analytical techniques like e.g. XRD is given. Further topics include nucleation and growth of crystals from aqueous solutions, and their thermodynamic properties.

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Volcanism and Metamorphism	CO10-210201	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO10-FundEES Fundamental Earth and Environmental Sciences	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

Introduction to the fundamentals of (physical) geology. Part I starts with a discussion on how magma forms in the Earth's mantle and what igneous rocks crystallize from it. Plutonic, volcanic and pyroclastic rocks, volcanoes and their different eruption styles will be introduced. We will also discuss the reaction of rocks to increasing pressure and temperature, touch upon metamorphism and introduce the concept of metamorphic facies and the mineral assemblages typical of them. In addition to the lectures, the course also includes practicals in rock and mineral description and recognition.

Methods of Assessment

Name	Weighting
Oral Exam	100%

Course Name	***Course No***	***ECTS***
Sedimentology	CO10-210203	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO10-FundEES Fundamental Earth and Environmental Sciences	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

In this course the students will be made familiar with the basics concepts of sedimentary geology and stratigraphy. Focus will also be on the identification and recognition of sedimentary features and on an understanding of modern and ancient depositional processes and environments.

Appendix 2 - Course Data

Course Name Structural Geology	***Course No*** CO10-210206	***ECTS*** 2,5
Module Affiliation CO10-FundEES Fundamental Earth and Environmental Sciences	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims In this course the students will be made familiar with the basics concepts of structural geology. Topics such as folding and faulting will be covered and a basic introduction to geological field mapping will be provided.		
Course Name Fieldtrip Environmental Changes and Challenges in Northwestern Germany	***Course No*** CO10-041202	***ECTS*** 2,5
Module Affiliation CO10-FundEES Fundamental Earth and Environmental Sciences	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims The excursion to areas in NW Germany is comprised of several days with visits to sites such as an East Frisian Island, the UNESCO world heritage region Wadden Sea, the marsh polder land, the moraine "Geest" and/or the peat bogs. The differences in the geology, pedology and ecology will be studied to understand the historic and present development of this dynamic landscape and the consequences of the climate change for these unique ecosystems and the society. Also contamination of water and soils from industrial or agricultural activities will be studied. Additionally the opportunities as well as consequences of development in renewable energy and the effects of the political decisions on the land use and landscape will be explored.		

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Marine Environments	CO10-210204	2,5
Module Affiliation CO10-FundEES Fundamental Earth and Environmental Sciences	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims This course covers aspects of the physical, chemical and biological environments of the sea. It demonstrates human impacts on the marine environments and how science is used to predict and to solve the problems created by human activities. Attention is given to aspects of marine productivity, hydrocarbon industries, fisheries and mariculture and to the effects of the industrial developments on the marine environment. Case studies are presented to show how science can contribute to providing solutions to these problems.		
Course Name	***Course No***	***ECTS***
Climate Change	CO10-210205	2,5
Module Affiliation CO10-FundEES Fundamental Earth and Environmental Sciences	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims This course will give a brief introduction into the development of the atmosphere throughout Earth's history from the beginning of the geological record to modern times and will focus on geological, cosmogenic and anthropogenic changes. Several major events in the evolution of the Earth that had a major impact on climate will be discussed, such as the evolution of an oxic atmosphere and ocean, onset of early life, snowball Earth, and modern glaciation cycles. In the second part, the course will focus on human impact on present climate change and global warming. Causes and consequences including case studies and methods for studying climate change will be presented and possibilities of climate mitigation (geo-engineering) and adaptation of our society to climate change (such as coastal protection and adaption of agricultural practices to more arid and hot conditions) will be discussed.		

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Geochemistry of Igneous and Aqueous Systems	CO11-210241	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO11-EOEnvChem Earth, Ocean and Environmental GeoChemistry	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

This course addresses principal chemical concepts in geosystems. It will be demonstrated how chemical reactions and equilibria drive changes in the Earth's endogenic and exogenic systems. This includes an introduction to the thermodynamics and kinetics relevant for an understanding of natural systems and to the concept of geochemical modeling of igneous systems (magmas) and aqueous systems (waters). Furthermore, it covers compartments, components, and chemical processes including interactions with the biosphere in aqueous systems.

Methods of Assessment

Name	Weighting
Final Exam	50%
Midterm Exam	50%

Course Name	***Course No***	***ECTS***
Environmental Geochemistry	CO11-210302	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO11-EOEnvChem Earth, Ocean and Environmental GeoChemistry	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

In this course, human interactions with natural systems will be discussed in both qualitative and quantitative ways. The focus will be placed upon anthropogenic contamination of the environment and global consequences for the atmosphere, pedosphere and hydrosphere. The physical, chemical and biological principles of contaminant transports, transformation and uptake by organisms will be introduced. Cycling of heavy metal and radioactive compounds in terrestrial and marine environments, and behavior, transport and degradation of organic and metal-organic pollutants (examples: TBT, PCBs, DDT, etc.), will be some of the topics. Further subjects include acid mine drainage and acid rain.

Methods of Assessment

Name	Weighting
Final Exam	50%
Midterm Exam	50%

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Fieldtrip Volcanism and Hydrochemistry in the Eifel, Germany	CO11-210202	2,5
Module Affiliation CO11-EOEnvChem Earth, Ocean and Environmental GeoChemistry	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims During this fieldlab techniques commonly performed in the geosciences will be practised and “textbook geology” will be compared to “real world geology”'. During a four day excursion to the Eifel area of western Germany, which is famous for its mantle xenoliths, its Tertiary and Quaternary volcanism, and its large variety of mineral springs, the focus will be on volcanology, sedimentology and water chemistry. Fieldwork during the day will be complemented by evening seminars.		
Course Name	***Course No***	***ECTS***
Isotope Geochemistry	CO11-210301	2,5
Module Affiliation CO11-EOEnvChem Earth, Ocean and Environmental GeoChemistry	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims The first part of the course focuses on the use of stable isotopes as a means of studying biogeochemical cycles in the ocean, specifically carbon, nitrogen and sulfur cycles. It considers isotopic effects during photosynthesis, respiration, organic matter degradation, $CaCO_3$ dissolution, methanogenesis, nitrification/denitrification and sulfate reduction. This course starts with an introduction into the fundamentals of stable isotope geochemistry and moves on into more complex isotope system. Topics include: Theoretical and experimental principles; isotope fractionation mechanisms of selected elements; variations of stable isotope ratios in nature; application of stable isotope proxies in paleooceanography and -climatology. In the second part of the course the students are introduced to the basic concepts of radiogenic isotope geochemistry. The radiogenic isotope systems important in geochemistry will be explained together with applications such as radiometric age dating and characterisation of source rocks or environmental conditions.		

Appendix 2 - Course Data

Course Name Applied Geochemistry	***Course No*** CO11-210362	***ECTS*** 2,5
Module Affiliation CO11-EOEnvChem Earth, Ocean and Environmental GeoChemistry	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims The first part describes the geochemical characteristics of various igneous rocks, and the controls of plate tectonic setting and geochemical processes, such as assimilation of country rock, hydrothermal alteration and weathering, on rock chemistry. The chemical characteristics of clastic and chemical sediments will be briefly addressed, with emphasis on the former. In the second part, following an introduction to the basic concepts of aquatic chemistry, the geochemical and physical characterization of aquatic environments will be presented. This includes the composition of freshwater (rain, lake, river and ground water) systems and seawater (including hydrothermal fluids and their role for the composition of the ocean) and the formation of marine precipitates. Processes along steep physico-chemical gradients such as oxic-anoxic layers, sediment-bottom water boundaries and seawater - hydrothermal fluid mixing zones will be another focus. The interface between the aqueous compartments and the biosphere will also be addressed.		
Course Name Mineral Resources	***Course No*** CO11-210373	***ECTS*** 2,5
Module Affiliation CO11-EOEnvChem Earth, Ocean and Environmental GeoChemistry	***Workload (hrs / sem)*** 62,5	***Level*** Bachelor 2nd Year CORE
Course Description / Content / Aims This course is an introduction to the genesis, occurrence, characteristics, economic significance, and resource assessment of metallic and non-metallic ore deposits. After an introduction to the principles of ore formation, magmatic, sedimentary and metamorphic ore-forming environments are presented. Different metal ore deposits, including base metal, precious metal, iron and alloy ore deposits will be addressed. Also rare metals of interest for new high-tech industries will be a topic of the course. Deposits of industrial minerals and uranium as an energy resource will finalize the course curriculum. The lectures will be supplemented by practical exercises and student presentations on selected topics.		

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Physical Oceanography	CO12-210214	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO12-EOEnvPhys Earth, Ocean, and Environmental Physics	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

This class extends and builds on the first year courses on physical oceanography and marine sciences in general. The course focuses on the large-scale circulation of the oceans and includes temperature-salinity analysis, water mass identification, water, salt, and heat budgets. The distribution of chemical tracers, advection and diffusion will be discussed. The sources, reactions, and fates of organic molecules in the marine environment along with the stable isotope geochemistry of marine organic substances will be presented. In addition, various aspects of marine exploration and science will be touched upon.

Methods of Assessment

Name	Weighting
Final Exam	50%
Midterm Exam	50%

Course Name	***Course No***	***ECTS***
Geophysical Techniques and Applications	CO12-210223	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO12-EOEnvPhys Earth, Ocean, and Environmental Physics	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

Fundamental geophysical concepts and techniques are covered in this course, and illustrated using applications from exploration and environmental geophysics. Reflection and refraction seismics provide high-resolution measurements for revealing sub-surface structures. Electromagnetic methods are another class of techniques with a wide range of applications in geophysics. We also discuss potential field measurements and modelling in gravity and geomagnetism.

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Geophysical Hydrodynamics	CO12-210233	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO12-EOEnvPhys Earth, Ocean, and Environmental Physics	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

The course deals with the physics of fluids and other continuous media in geophysical contexts. The general mathematical description of hydrodynamic transport processes yields scalar and vectorial balance equations for media of very different nature ranging from ordinary fluids and gases to elastic materials and magnetised plasmas. Of special importance for geophysics are pseudo-forces in non-inertial frames of reference such as the Coriolis force on the rotating Earth. The concepts discussed here find a wide range of applications from ocean and atmospheric dynamics to seismology and geomagnetic dynamo action in the Earth's core.

Methods of Assessment

Name	Weighting
Final Exam	40%
Homework Assignments	30%
Quizz(es)	30%

Course Name	***Course No***	***ECTS***
Earth System Monitoring and Remote Sensing	CO12-210213	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO12-EOEnvPhys Earth, Ocean, and Environmental Physics	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

The course provides an introduction to the use of remote sensing measurements and spatial information technologies for observing, monitoring, modeling and analyzing Earth and environmental data, with particular relevance for natural resource management. Remote sensing allows the study of Earth processes on a range of spatial, temporal, and spectral scales. The growing multidimensional body of data collected by Earth observation platforms is integrated in digital mapping environments. Earth is monitored as a system with interactions between geosphere, atmosphere and biosphere. The course combines traditional lecture elements with hands-on computer training using case studies to expose students to the latest developments of Earth observation remote sensing principles and practice.

Appendix 2 - Course Data

Course Name	***Course No***	***ECTS***
Geophysical Data Analysis and Modeling	CO12-210224	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO12-EOEnvPhys Earth, Ocean, and Environmental Physics	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

The course provides an introduction to the processing, analysis, and modeling of data in Earth and Environmental Sciences. Fundamental statistical concepts are reviewed and applied to geoscientific contexts where spatio-temporal correlations are of key importance. The analysis techniques discussed in this course include Fourier methods, spectrum estimation, and time series filtering. We conclude with parameter estimation and aspects of geophysical inverse modeling.

Methods of Assessment

Name	Weighting
Attendance and Active Participation	20%
Computer Assignments	40%
Theory Quizzes	40%

Course Name	***Course No***	***ECTS***
Oceanographic Excursion: Research Cruise North Sea	CO12-210251	2,5
Module Affiliation	***Workload (hrs / sem)***	***Level***
CO12-EOEnvPhys Earth, Ocean, and Environmental Physics	62,5	Bachelor 2nd Year CORE

Course Description / Content / Aims

Oceanographic and marine geosciences excursion to practice and train field techniques in the geosciences. The excursion to Helgoland will take place on FS Heincke. The course provides students an excellent opportunity to gain some practical hands-on experience. They will be able to put to test various theories they have learned during their lectures over the past two years. It will also support and foster team work as they will have to process and interpret the acquired data as a group and write a cruise report. For cruise preparation and providing theoretical background an evening seminar prior to the cruise is mandatory.