JACOBS UNIVERSITY

Earth and Space Sciences

Bachelor's Degree Program (BSc)

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As of September 1, 2014 the School of Engineering and Science and the School of Humanities and Social Sciences have been replaced by the Focus Areas Health, Mobility and Diversity. Handbooks and policies might still refer to the old structure of Schools.

If this is the case, references to the School of Engineering and Science include courses offered within the following disciplines:

- Electrical Engineering and Computer Science
- Life Sciences
- Logistics
- Mathematical Sciences
- Natural and Environmental Sciences

References to the School of Humanities and Social Sciences include courses offered within the following disciplines:

- Economics and Management
- History
- Humanities
- Law
- Psychology
- Social Sciences
- Statistics and Methods

1 Earth and Space Sciences at Jacobs University Bremen

The interdisciplinary study program *Earth and Space Sciences (ESS)* at Jacobs University has been designed to bridge between terrestrial and extraterrestrial environments, and to create a holistic view of planet Earth in its cosmic neighborhood. ESS combines traditional geoscience disciplines like Geochemistry, Geophysics, and Oceanography with Planetary and Space Sciences to prepare our graduates for topical challenges and research questions such as the management and sustainable exploration of natural resources, the study of Earth's climate and oceans, solar-terrestrial connections, life in extreme environments, and the origin of our planet.

1.1 Concept

Key elements of the ESS study program are as follows.

Solid foundation in natural sciences. Current research themes in Earth and Space Sciences typically require expertise from a number of different natural sciences. For example, climate science brings together fundamental physics and chemistry with geology, oceanography, solar physics, and large-scale computer simulations. Training in natural sciences and mathematics is offered through, both, other study programs in the School of Engineering and Science, and courses specifically tailored for ESS students.

Interdisciplinary approach to natural systems. Natural environments are complex dynamical systems that call for a profoundly interdisciplinary approach: partial answers provided by individual disciplinary fields are combined and integrated to yield the complete picture. ESS students are exposed to natural systems and processes on Earth and other planets to train their interdisciplinary thinking right from the start. For example, the ESS program is firmly rooted in traditional geosciences because geological processes on Earth are very well understood and can serve as blueprints for processes on other planets. Geological training is broadened through the ESS combination of disciplines since comparative planetology helps to develop an integrated and holistic view also on Earth as a planetary system in space.

Common methodology in Earth and Space Sciences. Different natural systems studied within ESS are observed, analyzed, and modeled using similar methods and tools. Both the depths of the oceans and near-Earth space are explored in-situ with unmanned probes. Images and spectra of Earth and planetary surfaces and atmospheres are typically obtained by orbiting spacecraft following general remote sensing principles. ESS students are introduced to the processing, analysis, and visualization of data from such observations. Computational models in various disciplines of ESS often rest on general fluid dynamics concepts.

Jacobs University Bremen strives for excellence in teaching, and the integration of topical research themes in our study programs. Modern techniques of instruction and assessment, such as team teaching and the use of new media are an integral part of academic life on campus, as are interdisciplinary and intercultural learning. Especially in Earth and Space Sciences learning takes place not only in the classroom but to a large extent also on excursions, in the laboratory, and at external facilities such as research vessels. Regularly, students have to work in groups, and present their results in front of their peers and professors in the form of talks, posters or web pages. ESS students thus acquire a number of skills that are essential for a successful career: scientific precision, team spirit, social and presentation skills.

1.2 Curricular structure

The overall level of courses in the ESS program is raised successively in each year of study.

In their first year, our students get a thematic overview of Earth and Space Sciences and learn the foundations of core disciplines. General ESS lectures are supported by field trips. Basic courses in mathematics and other natural science and engineering courses complement the course plan.

In the second year of study, the cross-disciplinary thematic education of the first year is complemented by tailor-made courses on methods, concepts, and themes that are important for many areas of Earth and Space Sciences. ESS students take courses on geology and geosciences excursions as well as introductions to geochemistry, geophysics, oceanography, and planetary sciences.

In their third year of study, the students of Earth and Space Sciences concentrate mostly on their specialization area where they take lectures and participate in excursions. Furthermore, the students are assigned a small research project on which they are supervised individually by a member of the faculty. This may entail a field trip for gathering data or a computational project. These projects are concluded by the write-up of the Bachelor thesis at the end of the third year.

From the first year of study students in Earth and Space Sciences are exposed to real research environments. This is achieved, for example, by internships preferably in one of the partner institutions or companies. When graduating from Jacobs University, students will have spent a minimum of two months in internships.

1.3 Partner Institutions and Collaborations

The city of Bremen with its traditional strength in marine sciences and its concentration of leading aerospace companies is an ideal location for an interdisciplinary major in Earth and Space Sciences.

There are a number of existing cooperations with regional partner institutions such as the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven (AWI), the State University of Bremen, the Max-Planck-Institute for Marine Microbiology, and the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR). International cooperation partners are the University of Washington and Rice University (USA), the Institute for Space Sciences in Bucharest-Magurele (Romania), University of Johannesburg (South Africa), University of Brasilia and University of Santa Maria (Brazil). The list of industry partners in past and ongoing projects includes StatOil, Maersk, BP, Schlumberger, EADS, and OHB. These cooperations give students an early exposure to industrial and academic research.

The study program Earth and Space Sciences at Jacobs University Bremen received best marks in the 2009 and 2012 CHE rankings, and made it to the first place of the list in both rounds.

1.4 Career Options

The prospects of students with a major in Earth and Space Sciences are excellent and the opportunities diverse. Those students that strive for an academic career will go on to a Masters or PhD degree in one of the core disciplines. Those students that are looking for a career

outside academia will be well suited for positions that require a broad scientific education and numerical as well as technological skills. This could be in industry or organisations. The international character of the university and the demonstrated mobility of our students makes our graduates particularly attractive for globally operating corporations and organisations. The fact that English is the language of instruction at Jacobs University Bremen adds to the skill base of our students.

2 Modules: Earth and Space Sciences

For greater transparency of the logics and as guidance for the (prospective) student, we have structured the respective major programs in terms of modules. A module is defined as a combination of courses (lectures, lab units or other types of courses) interconnected by the same learning goals (Lernziel). Before listing the individual courses and describing their contents, these modules are presented and characterized by the skills and abilities that the student is expected to acquire. But irrespective of this overarching modular structure, the learning progress will be documented with credit points and grades attributed to the individual courses or lab units. This facilitates the control of the student's progress through the student as well as the university on a semester basis, while the modules may extend over a year or, in exceptional cases, even over longer periods. Only the core content of a major program is suited for modularisation. The freely choosable Home School electives and transdisciplinary courses fall outside this structure.

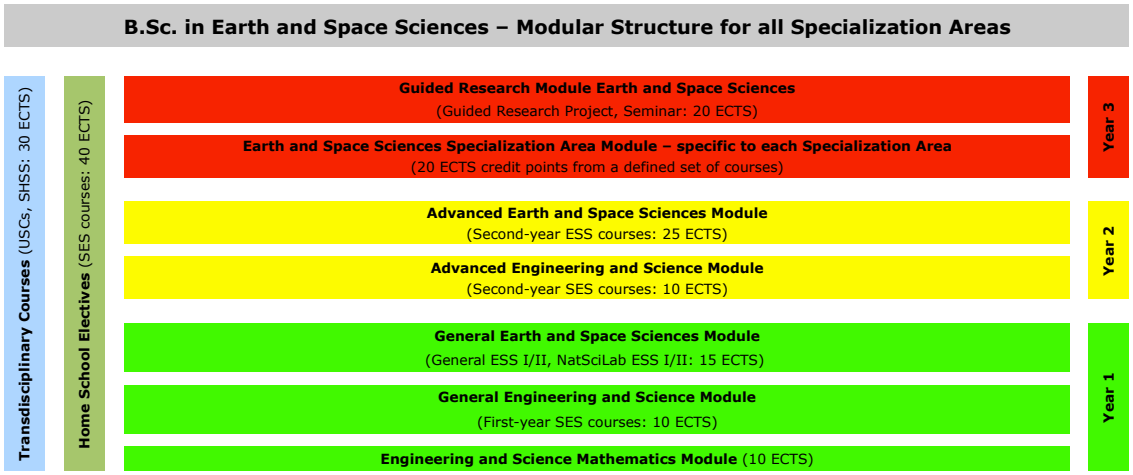

Figure 1: Earth and Space Sciences Module Structure

The modular structure of the study program Earth and Space Sciences supports a number of specialization areas that explicitly differ in only one module, namely, the third-year *Specialization Area Earth and Space Sciences Subject Module*. Furthermore, the students have to carry out a guided research project in the chosen specialization area. Defining new tracks on top of a solid base education in Earth and Space Sciences is very straightforward. The specialization areas that are defined so far are *Geophysics and Planetary Sciences* (module 210310), *Geochemistry* (module 210320), *Oceanography* (module 210330), *Resources and Environment* (module 210340).

2.1 General Science

The category of *Transdisciplinary Courses* is defined in university-wide policies and subsumes University Studies Courses and courses outside the Home School.
The category of *Home School Electives* subsumes courses in the School of Engineering and Science that are not explicitly listed in modules.

120110 – Engineering and Science Mathematics Module

Short Name: EngSciMath
Semester: 1 – 2
Credit Points: 10 ECTS

General Information Students of Earth and Space Sciences are required to take two first-year Engineering and Science Mathematics courses: one course at first-semester level, and another one at second-semester level.

210110 – General Engineering and Science Module

Short Name: ModGenEngSci
Semester: 1 – 2
Credit Points: 10 ECTS

General Information In addition to the major-specific general lectures and lab units that are listed in the *General Earth and Space Sciences Module*, ESS majors are required to take additional first-year SES courses to complement the basic education in the natural sciences and/or engineering.

Learning goals

- Introduction to other disciplines in the School of Engineering and Science (SES).

Courses The courses in this module should be chosen in accordance with the specialization areas of interest. A total of 10 ECTS credit points is required.

210210 – Advanced Engineering and Science Module

Short Name: ModAdvEngSci
Semester: 3 – 4
Credit Points: 10 ECTS

General Information In addition to the major-specific courses that are listed in the *Advanced Earth and Space Sciences Module*, ESS majors are required to take additional second-year SES courses to strengthen their education in the natural sciences and/or engineering.

Learning goals

- Advanced training in other disciplines in the School of Engineering and Science (SES).

Courses The courses in this module should be chosen in accordance with the specialization areas of interest. A total of 10 ECTS credit points is required.

2.2 Earth and Space Sciences Major

This section deals with the modules in the Earth and Space Sciences Major that are common to all specialization areas: module duration, number of credits, learning goals, and lists the courses that belong to the module. The courses themselves and course descriptions are presented in a separate section.

210100 – General Earth and Space Sciences Module

Short Name: ModGenEarthSpace
Semester: 1 – 2
Credit Points: 15 ECTS

General Information First-year lectures and field excursions in Earth and Space Sciences. Topics include structural and fundamental dynamical aspects of natural systems on Earth, its oceans, geology, atmosphere, and magnetosphere, as well as other planets and the solar system as a whole.

Learning goals The students are become acquainted with basic concepts and methods in Earth and Space Sciences. The multi-disciplinary nature of the lectures helps to develop an integrated view on key concepts in the description of natural systems which are then fostered on field excursions where students are exposed to examples that guide their thinking further in the lectures. A field excursion in geology or oceanography consists of a preparatory seminar, the excursion itself, and a concluding seminar where the students learn how to convey their findings using modern presentation tools.

Courses
210101 General Earth and Space Sciences I
210102 General Earth and Space Sciences II
210111 Natural Science Lab Unit ESS I: Harz Excursion
210112 Natural Science Lab Unit ESS II: Helgoland Excursion

210200 – Advanced Earth and Space Sciences Module

Short Name: ModAdvEarthSpace
Semester: 3 – 4
Credit Points: 25 ECTS

General Information Second-year lectures and field excursions in Earth and Space Sciences. Students are exposed to the full spectrum of ESS disciplines and methodological aspects.

Learning goals This module builds on the first-year ESS courses, develops important concepts further, and emphasizes the common methodological basis of many disciplines in Earth and Space Sciences. Fundamentals of geosciences and marine sciences are addressed in the lectures Geology I/II and during geosciences excursions. To prepare for the third-year specialization areas, a series of introductory lectures is included. Important mathematical and numerical concepts for ESS students and a course on geospatial data analysis complement the course offerings in this module. The students will learn the fundamental theoretical concepts that govern the physical and chemical processes on earth, both on land and in the ocean. They will use their newly gained fundamental and practical knowledge as well as their analytical skills to understand and solve basic problems in Earth and Space Sciences.

Courses
210201 Geology I: Volcanism and Metamorphism
210211 Geology II: Sedimentology and Structural Geology
210221 Mathematical and Computational Concepts in ESS
210231 Introduction to Geophysics
210241 Introduction to Geochemistry
210251 Introduction to Physical Oceanography
210202 Geosciences Excursion Course I: Volcanism and Water of the Eifel
210212 Geosciences Excursion Course II: Research Cruise North Sea
210222 Geospatial Data Analysis
210232 Introduction to Planetary Sciences

210300 – Guided Research and BSc Thesis Earth and Space Sciences Module

Short Name: ModGREarthSpace
Semester: 5 – 6
Credit Points: 20 ECTS

General Information This module comprises the third-year courses which lead to the BSc theses in Earth and Space Sciences. In Guided Research courses students carry out their research projects in close contact with faculty. These projects can be of experimental or of theoretical/numerical nature. The Earth and Space Sciences Seminar is the platform to present their initial work plans (in fall) as well as their final results (in spring).

Learning goals During their Guided Research projects students learn how to search the scientific literature, how to recognize challenges in a specialized field, how to set up a work plan for carrying out research, and how to organize their time in an efficient way. Furthermore, they are introduced to special research methods in their area of choice. Interim reports and the final write-up of the BSc thesis help the students developing their written communication skills. The Earth and Space Sciences Seminar aims at strengthening their oral communication abilities and their presentation skills.

Courses
210341 Earth and Space Sciences Seminar I
210342 Earth and Space Sciences Seminar II
210351 Guided Research Earth and Space Sciences and BSc Thesis I
210352 Guided Research Earth and Space Sciences and BSc Thesis II

2.3 Earth and Space Sciences Specialization Area Subject Modules

This section deals with the modules in the Earth and Space Sciences Major that are specific to one of the specialization areas: module duration, number of credits, learning goals, and lists the courses that belong to the module. The courses themselves and course descriptions are presented in a separate section. The group of modules listed here is commonly referred to as Earth and Space Sciences *Specialization Area Subject Modules*.

210310 – Specialization Area Geophysics and Planetary Sciences Module

Short Name: ModSpecGeoPlanet
Semester: 5 – 6
Credit Points: 20 ECTS

General Information Third-year lectures and excursions for students who want to specialize in Geophysics and/or Planetary Sciences.

Learning goals Students who specialize in this area will deepen their understanding of geophysics and planetary sciences. Emphasis will be put on a quantitative mathematical description of the underlying processes, to be trained in regular problem solving exercises. Methods for data analysis, interpretation, and modeling will be introduced and explained using examples from both geophysics and planetary sciences.

Courses A total of 15 ECTS credits must be chosen from the following selection of courses. Note that not all courses are offered in each Academic Year. In the Spring semester of their second year, students should consider to take specialization area courses that are offered only every other Academic Year.
210321 Advanced Planetary Sciences
210331 Physics of Planetary Interiors and Surface Processes
210312 Seismic and Electromagnetic Methods in Geophysics
210322 Gravity in Geophysics and Planetary Sciences
210332 Magnetism in Geophysics and Planetary Sciences
210392 Geophysical Time Series Analysis
210361 Specialization Area Excursion (one excursion to be chosen)
To arrive at the total of 20 ECTS credits in this module, 5 additional ECTS credits can be chosen from other ESS specialization area modules.

210320 – Specialization Area Geochemistry Module

Short Name: ModSpecGeochem
Semester: 5 – 6
Credit Points: 20 ECTS

General Information Third-year lectures and excursions for students who want to specialize in Geochemistry.

Learning goals The students complement their knowledge of geochemistry by extending it from trace element to stable and radiogenic isotope geochemistry. The more than two weeks excursion/field lab serves to better understand the geological context of geochemical samples and adds hand-on experience in sampling and on-site analyses of natural waters and rocks in surface outcrops, underground mines, and/or drill cores. The choice between the additional courses helps the students to get further in-depth knowledge in another focus area of their interest.

Courses A total of 12.5 ECTS credits must be chosen from the following selection of courses.
210362 Applied Geochemistry
210301 Stable Isotope Geochemistry
210371 Radiogenic Isotope Geochemistry
210373 Introduction to Mineralogy
210361 Specialization Area Excursion: Geochemistry
To arrive at the total of 20 ECTS credits in this module, 7.5 additional ECTS credits can be chosen from other ESS specialization area modules.

210330 – Specialization Area Oceanography Module

Short Name: ModSpecOcean
Semester: 5 – 6
Credit Points: 20 ECTS

General Information Third-year lectures and excursions for students who want to specialize in Oceanography.

Learning goals The students deepen their knowledge of the fundamental concepts in oceanography and the oceans' interactions with the earth, the cryosphere, the biosphere, and the atmosphere. The emphasis will be on the mathematical description and quantitative assessment of processes determining the function of the ocean in the Earth System. Traditional disciplinary boundaries between physics, biology, and geophysics will be crossed, providing both challenges and opportunity for students. Classes and lab/field experiments are directly linked to ongoing large scale international programs.

Courses A total of 15 ECTS credits must be chosen from the following selection of courses. Note that not all courses are offered in each Academic Year. In the Spring semester of their second year, students should consider to take specialization area courses that are offered only every other Academic Year.
210311 Dynamics of Marine Systems
210382 Advanced Physical Oceanography
210383 Computational Modeling in Earth and Marine Sciences
210361 Specialization Area Excursion: Oceanography
To arrive at the total of 20 ECTS credits in this module, 5 additional ECTS credits can be chosen from other ESS specialization area modules.

210340 – Specialization Area Resources and Environment Module

Short Name: ModSpecResEnv
Semester: 5 – 6
Credit Points: 20 ECTS

General Information Third-year lectures and excursions for students who want to specialize in Resources and Environment.

Learning goals The students deepen their knowledge of the fundamental concepts in geosciences to perform quantitative treatment of processes operating at the surface and within the Earth, that lead to the formation of natural Earth resources. Concepts of exploration, exploitation and sustainable use of resources shall be understood in the context of environmental and economic issues. Environmentally relevant processes in terrestrial and marine compartments shall be considered in a global context of geo-bio interactions.

Courses A total of 15 ECTS credits must be chosen from the following selection of courses.
210302 Environmental Geosciences
210372 Plankton Ecology
210381 Resource Geology I: Oil, natural gas and coal
210391 Resource Geology II: Ore deposits
210361 Specialization Area Excursion (one excursion to be chosen)
To arrive at the total of 20 ECTS credits in this module, 5 additional ECTS credits can be chosen from other ESS specialization area modules.

3 Requirements for a B.Sc. in Earth and Space Sciences

3.1 General Requirements

To obtain a B.Sc. degree at Jacobs University Bremen a minimum of 180 ECTS credit points must be earned over a period of 6 semesters.

- 140 ECTS credits must be earned in the School of Engineering and Science.
- 30 ECTS credits must be earned through transdisciplinary courses, comprised of courses in the School of Humanities and Social Sciences (SHSS) and University Study Courses (USC). Students can choose how many USCs or SHSS courses they take.
- 10 ECTS credits (4 courses) are accredited either for language courses or additional Home School Electives. Students can decide whether they take language courses or not.

3.2 Mandatory Courses for the Major

Requirements of the Major

Earth and Space Sciences (ESS) students choose 140 ECTS credits in Engineering and Sciences according to the following scheme:

- **Year 1 level courses**:
  - Engineering and Science Mathematics I and II (120101 or 120111 or 120121, and 120102 or 120112): 10 ECTS credits.
  - Courses that are defined in the *General Earth and Space Sciences Module* (210101, 210102, 210111, 210112): 15 ECTS credits.
  - Further first-year courses in the School of Engineering and Science, see the *General Engineering and Science Module*: 10 ECTS credits.
- **Year 2 level courses:**
  - Courses of the *Advanced Earth and Space Sciences Module*: 25 ECTS credits.
  - Further second-year courses in the School of Engineering and Science, see the *Advanced Engineering and Science Module*: 10 ECTS credits.
- **Year 3 level courses**
  - Courses defined in the respective Earth and Space Sciences *Specialization Area Subject Module* that fits the chosen specialization area: 20 ECTS credits.
  - Courses defined in the *Guided Resarch Earth and Space Sciences Module* courses at Year 3 level (Guided Research I/II, ESS Seminar I/II): 20 ECTS credit points.

Requirements of a Specialization Area

Students of Earth and Space Sciences have to select a Specialization Area where they acquire special knowledge and skills. In order to qualify for a Specialization Area, students have to

- take 20 ECTS credits of courses at Year 3 level as defined in the respective Earth and Space Sciences *Specialization Area Subject Module*, and
- successfully carry out a Guided Research Project and write a B.Sc. thesis in this specialization area.

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

4 Recommended Course Plan

Year 1 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
General ESS I / General ESS II	210101	*5.0*	m	210102	*5.0*	m
NatSciLab ESS I				210111	*2.5*	m
NatSciLab ESS II				210112	*2.5*	m
ESc Mathematics Ia/IIa	120101			120102		
or ESc Mathematics Ib/IIb	120111	*5.0*	m	120112	*5.0*	m
First-year SES courses		*5.0*	e		*5.0*	e
Language Courses or Home School Electives		*10.0*	e		*5.0*	e
Transdisciplinary Courses		*5.0*	u		*5.0*	u
Running Total / *Semester Total*	30.0	*30.0*		60.0	*30.0*	

Year 2 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Geology I / Geosciences Excursion I	210201	*2.5*	m	210202	*2.5*	m
Geology II / Geosciences Excursion II	210211	*2.5*	m	210212	*2.5*	m
Math. & Comp. Concepts / Geo. Data Analysis	210221	*2.5*	m	210222	*2.5*	m
Intro. Geophysics / Intro. Geochemistry	210231	*2.5*	m	210241	*2.5*	m
Intro. Planetary Sciences	210232	*2.5*	m			
Intro. Physical Oceanography	210251	*2.5*	m			
Second-year SES courses		*5.0*	e		*5.0*	e
Language Courses or Home School Electives		*5.0*	e		*10.0*	e
Transdisciplinary Courses		*5.0*	u		*5.0*	u
Running Total / *Semester Total*	90.0	*30.0*		120.0	*30.0*	

Year 3 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Specialization Area Courses / Excursion		*10.0*	m		*10.0*	m
Guided Research and BSc Thesis	210351	*7.5*	m	210352	*7.5*	m
Earth and Space Sciences Seminar	210341	*2.5*	m	210342	*2.5*	m
Language Courses or Home School Electives		*5.0*	e		*5.0*	e
Transdisciplinary Courses		*5.0*	u		*5.0*	u
Running Total / *Semester Total*	150.0	*30.0*		180.0	*30.0*	

C = ECTS credit points, T=type (m=mandatory, e=elective, u=university), Transdisciplinary Courses are School of Humanities and Social Sciences and University Studies Courses

4.1 Notes on the recommended course plan

Details of the course plan for students majoring in Earth and Space Sciences depend on which *Specialization Area* they intend to concentrate on:

- *Geophysics and Planetary Sciences*,
- *Geochemistry*,
- *Oceanography*, or
- *Resources and Environment*.

1. *Specialization Area Geophysics and Planetary Sciences*: In their first year, students are strongly recommended to take the courses General Physics I and II (200101, 200102). In their second year, students are encouraged to take a suitable selection of advanced physics courses. In the Spring semester of their second year, students should consider to take specialization area courses that are offered only every other Academic Year.
2. *Specialization Area Geochemistry*: In their first year, students are strongly recommended to take General Inorganic Chemistry (400101) and the associated Natural Science Lab Unit (400111). In their second-year, students are encouraged to take a suitable selection of further chemistry courses.
3. *Specialization Area Oceanography*: Courses in biology and chemistry are recommended for students who intend to focus on Marine Geology or Biological Oceanography. Students who plan to concentrate on Physical Oceanography are advised to take the courses General Physics I and II (200101, 200102) in their first year, and a suitable selection of advanced physics courses in their second year of study. In the Spring semester of their second year, students should consider to take specialization area courses that are offered only every other Academic Year.
4. *Third year of studies, all specialization areas*: Students are advised to choose their ESc Subject courses from the list of optional third-year courses of ESS Specialization Area Modules.
5. Students are recommended to choose the SHSS courses Statistics I, Statistics II and Introduction to Economics.

4.2 Recommendation Professional Skills

The SES highly recommends attending the Professional Skills seminars offered by the Career Services Center. Those seminars include soft skills development seminars and application training which will help you to cope with your studies and master your internship and job search.

All undergraduate students are required to complete an internship, normally to be accomplished between the second and third year of study. Information about the internship will be listed on the transcript. The internship must last at least two months. No credits are connected to the internship requirement. See http://www.jacobs-university.de/career-services/internship for more information on internships.

5 Courses: Earth and Space Sciences

5.1 First Year of Study

210101 – General Earth and Space Sciences I

Short Name: GenEarthSpace1
Type: Lecture
Semester: 1
Credit Points: 5.0 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Introduction to geology, oceanography, planetary and space sciences. The geology unit introduces fundamental principles and concepts in the geosciences, and puts special emphasis on the Earth's internal structure and plate tectonics. The oceanography unit introduces the relations of biology, chemistry, geology and physics in marine environments and gives basic information on techniques and methods. The planetary sciences unit discusses the inventory of the solar system from small bodies to the giant planets, with particular emphasis on terrestrial planets and their geology. The space sciences unit deals with planet Earth in the cosmos, discusses implications of the motion of Earth and Moon, and explains fundamentals of radiation physics in the planetary context.

210102 – General Earth and Space Sciences II

Short Name: GenEarthSpace2
Type: Lecture
Semester: 2
Credit Points: 5.0 ECTS
Prerequisites: 210101
Corequisites: None
Tutorial: No

Course contents This course is a continuation of the first-semester lecture *General Earth and Space Sciences I*. The concepts are developed further and in a more quantitative way. The course gives a brief geological history of the Earth, provides an introduction to crystallography, and addresses the rock cycle. Topics further include the evolution of ocean basins, the ocean as a geochemical system, as a biological system and the marine carbon cycle including the marine carbonate system. Also the role of the ocean as a resource of minerals, the use and misuse of the ocean, and environmental issues will be presented. The extraterrestrial component of the course deals with the Earth's neutral atmosphere, the near-Earth space environment, the Sun and the heliosphere, solar activity and space weather.

210111 – Natural Science Lab Unit Earth and Space Sciences I: Harz Excursion

Short Name: HarzEx
Type: Lab
Semester: 2
Credit Points: 2.5 ECTS
Prerequisites: 210101
Corequisites: None
Tutorial: No

Course contents Introduction to the fundamentals of field geology and environmental problems in the Harz Mountains. The conflict of economic benefit and environmental consequences of the long tradition of ore mining in the area will be demonstrated, and the concepts of the National Park and the Geopark will be introduced. The students have to participate in a weekend field trip that includes an introductory seminar, the field trip itself, and follow-up work such as data analysis, and the preparation of a report that is graded.

210112 – Natural Science Lab Unit Earth and Space Sciences II: Helgoland Excursion

Short Name: HelgolandEx
Type: Lab
Semester: 2
Credit Points: 2.5 ECTS
Prerequisites: 210101
Corequisites: None
Tutorial: No

Course contents Introduction to the fundamentals of field geology and field oceanography. The students have to participate in a weekend field trip that includes an introductory seminar (details will be announced by the instructor of record), the field trip itself, and follow-up work such as data analysis, and the preparation of a report that is graded.

5.2 Second Year of Study

210201 – Geology I: Volcanism and Metamorphism

Short Name: Geology1
Type: Lecture
Semester: 3
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents 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 lectures, the course comprises practicals in rock and mineral description and recognition.

210211 – Geology II: Sedimentology and Structural Geology

Short Name: Geology2
Type: Lecture
Semester: 3
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents This course provides an introduction to the fundamentals of (physical) geology. In part II, students will be made familiar with the basics concepts of structural geology, sedimentary geology and stratigraphy. Topics such as folding and faulting will be covered and a basic introduction to geological field mapping will be provided. The sedimentology part will focus on the identification and recognition of sedimentary features and an understanding of modern and ancient processes and environments.

210221 – Mathematical and Computational Concepts in ESS

Short Name: MathCompESS
Type: Lecture
Semester: 3
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents Mathematics and computational concepts and tools are important for many disciplines in the Earth and Space Sciences. This course is meant to develop and strengthen quantitative problem solving skills in these areas. We begin with a concise and hands-on review of selected mathematical topics such as multivariable calculus, complex functions, and differential equations. Computational concepts and tools include discretization, finite differencing, and the graphical representation of functions and fields.

210231 – Introduction to Geophysics

Short Name: IntroGeophysics
Type: Lecture
Semester: 3
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents Fundamental physical concepts are reviewed and then discussed in geophysical contexts. We emphasize the meaning of conservation laws in classical physics, fluid theory, and thermodynamics. Topics include classical point mechanics and rigid body dynamics, electromagnetic and seismic waves, and aspects of geophysical potential theory.

210241 – Introduction to Geochemistry

Short Name: IntroGeochemistry
Type: Lecture
Semester: 4
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents 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.

210251 – Introduction to Physical Oceanography

Short Name: IntroPhysOcean
Type: Lecture
Semester: 3
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents 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.

210202 – Geosciences Excursion Course I: Volcanism and Water of the Eifel

Short Name: GeoExc1
Type: Lab, excursion
Semester: 4
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210202
Corequisites: None
Tutorial: No

Course contents During the excursion field techniques 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.

210212 – Geosciences Excursion Course II: Research Cruise North Sea

Short Name: GeoExc2
Type: Lab, excursion
Semester: 4
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210202
Corequisites: None
Tutorial: No

Course contents Excursions to practice and train field techniques in the geosciences. Part II is an oceanographic and marine geoscience 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.

210222 – Geospatial Data Analysis

Short Name: GeoDataAnalysis
Type: Lecture
Semester: 4
Credit Points: 2.5 ECTS
Prerequisites: 210101
Corequisites: None
Tutorial: No

Course contents This course will introduce you to Geographic Information System (GIS) principles and provide you with the necessary skills and expertise needed to analyse Earth and Space Science data. A GIS allows us to combine data visually and computationally for spatial correlation, analysis, modelling and calculation. In this context, GIS has become the universal tool to integrate, analyse, manage and visualize large volumes of spatial data from multiple sources at a variety of scales. These concepts will be demonstrated and hands-on training provided using state-of-the-art software. Examples of applications to various fields such as geo- and bio-sciences, data management, habitat mapping, risk assessment and geo-marketing will be discussed and the role of the Internet in data mining and Web GIS will also be demonstrated.

210232 – Introduction to Planetary Sciences

Short Name: IntroPlanetSci
Type: Lecture
Semester: 3
Credit Points: 2.5 ECTS
Prerequisites: 210101
Corequisites: None
Tutorial: No

Course contents This course builds on the planetary sciences unit of General Earth and Space Sciences I, but develops the concepts further and in more methodological and quantitative ways. Processes acting on all planetary bodies are reviewed. Strong emphasis is on comparative planetology aspects like evolutionary processes and landforms that are relevant for several planets and satellites, in comparison to those on the Earth. Topics include: solar system formation and general evolution; impact cratering; planetary chronology; interior structure and composition of planetary bodies; planerary atmospheres and climate; planetary sedimentary, tectonic and volcanic processes (including exotic, e.g. cryovolcanism); geologic and geodynamic evolution of rocky planets and satellites.

5.3 Third Year of Study

5.3.1 Specialization Area Courses – Geophysics and Planetary Sciences

210321 – Advanced Planetary Sciences

Short Name: AdvPlanetSci
Type: Lecture
Semester: 4 or 6
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210221, 210231, 210232
Corequisites: None
Tutorial: No

Course contents The course provides insights in currently rapidly advancing subjects in Planetary Sciences, in particular areas where recent or current missions are significantly advancing or revolutionizing our knowledge of the evolution and acting processes on Solar System bodies. Topics include: Mercury and Venus volcanism and tectonics; Moon geology (remote sensing, in situ and sample return); advanced Mars geology, Mars stratigraphy and sedimentology; fluid and atmosphere-surface interaction processes in the solar System (Mars, Venus, Titan, and Earth); planetary tectonics or planets with atmospheres and airless bodies; search for extraterrestrial life; terrestrial analogues and extreme environments on Earth; meteorites and their parent bodies (from asteroids to the Moon and Mars); solar system exploration (robotic platforms and sample return). Extensive use of specialized planetary science literature will be made, in order to follow the state-of-the-art of the various topics.

210331 – Physics of Planetary Interiors and Surface Processes

Short Name: PhysPlanetInt
Type: Lecture
Semester: 4 or 6
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210221, 210231
Corequisites: None
Tutorial: No

Course contents Large-scale surface processes like plate tectonics are closely linked with heat flow and long-term convective motion in the planetary interior. We start with an overview of the physical principles that govern this kind of dynamics, proceed with models of mantle convection and tectonics, and conclude with implications for flexure and stretching in subsurface modeling.

210312 – Seismic and Electromagnetic Methods in Geophysics

Short Name: SeisElecMeth
Type: Lecture
Semester: 4 or 6
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210221, 210231
Corequisites: None
Tutorial: No

Course contents Seismic and electromagnetic methods are powerful tools for revealing subsurface structures in geophysics. The course covers their physical principles, methodology, interpretational procedures, and field applications. The main emphasis is placed on seismic methods as these are the most widely used techniques employed by the oil industry for hydrocarbon exploration.

210322 – Gravity in Geophysics and Planetary Sciences

Short Name: GravityGeoPlanet
Type: Lecture
Semester: 4 or 6
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210221, 210231
Corequisites: None
Tutorial: No

Course contents Gravity anomalies on planetary surfaces result from density inhomogeneities in the interior and can thus provide information about the composition and structure of the subsurface. On large spatial scales, gravity meters and accelerometers on orbiting spacecraft are the most efficient means to map gravity anomalies. In geophysical exploration, gravity methods are used to study anomalies on small and regional spatial scales. This course provides a general introduction to gravity methods in both geophysics and planetary sciences. We utilize potential theory and spherical harmonics for large scales. Gravity data processing and interpretation are discussed in the light of geophysical inverse methodology.

210332 – Magnetism in Geophysics and Planetary Sciences

Short Name: MagnetismGeoPlanet
Type: Lecture
Semester: 3 or 5
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210221, 210231
Corequisites: None
Tutorial: No

Course contents On Earth and other planets, magnetic phenomena are found on a wide spectrum of spatial scales ranging from small-scale magnetic anomalies caused by magnetized surface rocks to global magnetic fields generated through dynamo action in planetary interiors. This course provides a general introduction to magnetic fields and magnetic methods in both geophysics and planetary sciences. Topics include magnetic instruments, measurements, data processing, interpretation and modeling.

210392 – Geophysical Time Series Analysis

Short Name: GeoTimeSeries
Type: Lecture
Semester: 4 or 6
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210221, 210231
Corequisites: None
Tutorial: No

Course contents In geosciences and space physics, data often come in the form of time series. This course covers important approaches to time series analysis such the statistical description of data, correlation and regression, auto-correlation and cross-correlation functions, Fourier analysis, spectrum estimation, filtering, and modeling of data. Short reviews of the underlying theory are embedded in hands-on computer lab sessions where the students familiarize with the practice of time series analysis and interpretation. They learn to assess the potential and the limitations of the analysis methods, and apply them to measurements.

5.3.2 Specialization Area Courses – Geochemistry

210362 – Applied Geochemistry

Short Name: AppliedGeochemistry
Type: Lecture
Semester: 5
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210201, 210211, 210241
Corequisites: None
Tutorial: No

Course contents 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. This part consists of a combination of lectures and exercises that allow students to independently(!) interprete geochemical data. 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.

210301 – Stable Isotope Geochemistry

Short Name: StabIsoGeochem
Type: Lecture
Semester: 5
Credit Points: 2.5 ECTS
Prerequisites: 210201, 210211, 210241
Corequisites: 210362
Tutorial: No

Course contents The course content is 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 paleo-oceanography and -climatology (δ^{11}B, δ^{13}C, δ^{18}O).

210371 – Radiogenic Isotope Geochemistry

Short Name: RadIsoGeochem
Type: Lecture
Semester: 5
Credit Points: 2.5 ECTS
Prerequisites: 210201, 210211, 210241
Corequisites: 210362
Tutorial: No

Course contents In this 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. The course will consist of a combination of lectures and modelling exercises and will be held in the form of a one-week block course.

210373 – Introduction to Mineralogy

Short Name: IntroMineralogy
Type: Lecture
Semester: 3 or 5
Credit Points: 2.5 ECTS
Prerequisites: 210201, 210211, 210241
Corequisites: None
Tutorial: No

Course contents 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.

5.3.3 Specialization Area Courses – Oceanography

210311 – Dynamics of Marine Systems

Short Name: DynMarineSys
Type: Lecture
Semester: 5
Credit Points: 5.0 ECTS
Prerequisites: 210201, 210211, 210251
Corequisites: None
Tutorial: No

Course contents This course is a continuation of the second-year course on a higher level. An overview is given on sedimentological and (bio)geochemical processes that determine the geologic record. The course will first focus on sedimentological processes like erosion, transportation and deposition of particles in estuarine, beach, continental shelf and slope, and deep sea environments. It will lead to a better understanding of basic processes, such as tides, wind stress, topographic effects on turbulence, and exchange flow. The vertical and horizontal mixing and residence times of particles important to biological and geological processes will be discussed. The goal of biogeochemical oceanography is to understand what controls the abundances, kinds, and temporal variations of organisms in the sea, which are related to the flow of organic matter. Progress toward this goal usually entails identifying the patterns of variability in space and time, determining the processes producing and maintaining the patterns, then quantifying the processes. The path to predictive understanding of biogeochemical processes leads into physical, chemical, or geological oceanography.

210382 – Advanced Physical Oceanography

Short Name: AdvPhysOcean
Type: Lecture
Semester: 4 or 6
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210221, 210231, 210251
Corequisites: None
Tutorial: No

Course contents The goal of this course is to provide understanding of ocean processes and their role in climate. Fundamental concepts and their mathematical description will be introduced. The course will derive the basic equations governing the oceanic circulation and the transport of mass and tracers in the ocean. Useful approximations to these equations and their range and applications will be discussed. Starting from problems like the variability of oceanic meridional heat transport and sea level change, the course will introduce important elements of the oceanic general circulation. Topics include adjustment processes through waves, Ekman boundary layers, wind-driven and thermohaline circulation.

210383 – Computational Modeling in Earth and Marine Sciences

Short Name: CompModEarthMarine
Type: Lecture
Semester: 4 or 6
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210221, , 210251
Corequisites: None
Tutorial: No

Course contents Introduction to computational modeling techniques that are relevant for the Geosciences. Different types of differential equations will be discussed that require different numerical treatment. While stressing general principles, the emphasis will be on the coupled systems of equations that govern oceanic and atmospheric flows. The interaction of physical and numerical constraints will be addressed in the context of numerical stability. Examples with wide application in geophysical fluid dynamics will be treated in depth.

5.3.4 Specialization Area Courses – Resources and Environment

210302 – Environmental Geosciences

Short Name: EnvirGeoSc
Type: Lecture
Semester: 4 or 6
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210111 or 210112
Corequisites: None
Tutorial: No

Course contents This course covers the development of the atmosphere, the hydrosphere and the geosphere throughout Earth's history from the beginning of the geological record to modern times and focuses on geological, cosmogenic and anthropogenic changes. Several major events in the evolution of the Earth will be discussed, such as the evolution of an oxic atmosphere and ocean, onset of early life, snowball Earth, mass-extinctions in Earth history, and modern glaciation cycles. In the second (more extensive) part of the course, human interactions with natural systems will be discussed. Besides climate change and global warming, the focus is placed upon anthropogenic contamination of the environment and local as well as global consequences for the atmosphere and hydrosphere. The principles of contaminant transports and uptake by organisms are introduced. Heavy metal cycling in terrestrial and marine environments, behavior and transport of organic pollutants, and radioactive compounds are some of the topics. The concept of risk assessment studies is introduced.

210381 – Resource Geology I: Oil, Natural Gas and Coal

Short Name: ResGeology1
Type: Lecture
Semester: 5
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210211, 210202
Corequisites: None
Tutorial: No

Course contents This course is an introduction to the genesis, occurrence, characteristics, economic and geopolitical importance of hydrocarbon reservoirs. Based on the "seven petroleum geological magics" the development of petroleum systems consisting of source rocks and their maturation, migration of hydrocarbons, deposition of reservoir and seal rocks, the formation of geological traps, and the favorable timing of all these processes will be presented, followed by volumetric reservoir calculations. An overview on the chemistry and physics of oil and gas including the occurrences of conventional and unconventional oil and gas (e.g. gas hydrates and tar sands) and their geopolitical importance will be introduced. The course will be concluded with an overview on different exploration and exploitation methods (e.g. enhanced oil recovery). The lectures will be supplemented by practical exercises.

210391 – Resource Geology II: Ore Deposits

Short Name: ResGeology2
Type: Lecture
Semester: 5
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210211, 210202
Corequisites: None
Tutorial: No

Course contents This course is an introduction to the genesis, occurrence, characteristics, economic significance, and resource assessment of metallic and non-metallic ore deposits. Af-

ter 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.

210372 – Plankton Ecology

Short Name: PlanktonEcology
Type: Lecture
Semester: 3 or 5
Credit Points: 2.5 ECTS
Prerequisites: 210101, 210102, 210111 or 210112
Corequisites: None
Tutorial: No

Course contents The course will include an experimental introduction into growth dynamics and interactions of organisms in the form of experiments, which are designed by and carried out by the students under supervision. This course would also provide an introduction to phyto- and zooplankton in temperate marine systems. The students will be taught how to count, experiment with different trophic levels and identify planktonic organisms. The typical pitfalls of microscopic identification and enumeration will be highlighted. The course is usually offered as a block course during intersession in January.

5.3.5 Specialization Area Excursions

210361 – Specialization Area Excursion Geosciences

Short Name: SpecAreaExcGeosciences
Type: Excursion
Semester: 5
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210211, 210221, 210231, 210241, 210251, 210202, 210212
Corequisites: None
Tutorial: No

Course contents An extended excursion is offered to ESS students in their third year of study. Students who choose to specialize in Geochemistry or in Resources and Environment with focus on Resources should attend a two-week excursion with field lab (note that students will be required to cover the cost of food). This course will be taught during the summer break, preferentially in early June or late August (ESS students who plan to take this course are advised to do their required internship between the 2nd and 3rd semester). In the course, students will be made familiar with geological features at various scales and with techniques applied in geological field work. The excursion focuses on geological sequences that illustrate the chemical evolution of the Earths lithosphere, oceans and atmosphere, water chemistry, and (depending

on the region visited) the formation of metal deposits and their environmental impact. Hence, open-pit and underground mines are visited if possible. In the past this excursion took students to South Africa or Ireland. Students are given the opportunity to acquire water or rock samples for their B.Sc. thesis project during this excursion.

210363 – Specialization Area Excursion Oceanography

Short Name: SpecAreaExcOceanography
Type: Excursion
Semester: 5
Credit Points: 5.0 ECTS
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210211, 210221, 210231, 210241, 210251, 210202, 210212
Corequisites: None
Tutorial: No

Course contents An extended excursion is offered to ESS students in their third year of study. Students specializing in Oceanography or in Resources and Environment with focus on Environment will participate in a regular 1–2 week-long field trip to a research station at a Scandinavian fjord. During daily cruises on board of our research boat they will learn to handle oceanographic instrumentation, analyze samples, interpret and present the data in a series of drafts and a final term report.

5.3.6 Seminars and Guided Research

210341, 210342 – Earth and Space Sciences Seminar I/II

Short Name: ESS Seminar
Type: Seminar
Semester: 5 - 6
Credit Points: 2.5 ECTS each seminar
Prerequisites: 210101, 210102
Corequisites: None
Tutorial: No

Course contents This course provides a forum for the presentation of talks on the complete range of topics encountered in the Earth and Space Sciences. It serves as an integrated platform for interdisciplinary discussion and exchange of information on ongoing research within the Earth and Space Sciences community at Jacobs University Bremen. Moreover, it promotes the development and improvement of oral presentation skills. Participation in this seminar is mandatory for third-year students of Earth and Space Sciences. The topics of the presentations will be defined in one of the first seminar sessions.

210351, 210352 – Guided Research Earth and Space Sciences & BSc Thesis

Short Name: GR ESS I/II
Type: Research
Semester: 5 – 6
Credit Points: 7.5 ECTS each course
Prerequisites: 210101, 210102, 210111, 210112, 210201, 210211, 210221, 210231, 210241, 210251, 210202, 210212
Corequisites: None
Tutorial: No

Course contents Majors in Earth and Space Sciences are supposed to work on small research projects called Guided Research Projects (GRPs) in their third year of study at Jacobs University Bremen. This work is formally organized in the framework of Guided Research Courses (GRCs). A GRP may focus on experimental work, a field campaign, laboratory work, data analysis, computer simulations, theory, modelling, or a literature review. In order to be as effective as possible within the very limited amount of time, we strongly recommend to select one topic for both, the Fall and the Spring semester GRC. The Fall semester GRCs involve the preparation of the Spring semester project. The theoretical background will be presented and the related literature is reviewed and discussed. Depending on the specialization area, the basic techniques in the field, in the lab, or with computer programs, will be practiced. In Spring the lab, field, data analysis, modeling, or theory project has to be carried out. Students are also required to regularly present literature reviews related to and preliminary results of their ongoing guided research projects, thereby practicing their scientific discussion and presentation skills (oral and written). The presentations will be part of the grades. Each GRC must be concluded with a written report, which will be graded. Students who are interested in taking a GRC in Earth and Space Sciences are invited to contact the instructors of record for more information on potential project topics.