JACOBS UNIVERSITY

Study Program Handbook

Earth and Environmental Sciences

Bachelor of Science

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

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 Study and Examination Plan (Chapter 6).

Upon graduation, students in this program will receive a Bachelor of Science (BSc) degree with a scope of 180 ECTS (for specifics see Chapter 6 of this handbook).

Version	**Valid as of**	**Decision**	**Details**
Fall 2022 – V1	Sep 01, 2022	Jun 26, 2019	V1 Originally approved by the Academic Senate
		Aug 03, 2022	V1.1 Change in BQ-Modules „Ethics in Science and Technology", "Global Health" and "Global Existential Risks"
		Aug 17, 2022	V1.2 Editorial Change – Typo in "Oceanography"
		Aug 18, 2022	V1.3 Changes in "Admission Requirements" and "Internship / Startup and Career Skills"

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1 Program Overview

1.1 Concept

1.1.1 The Jacobs University Educational Concept

Jacobs University aims to educate students for both an academic and a professional career by emphasizing four core objectives: academic quality, self-development/personal growth, internationality and the ability to succeed in the working world (employability). Hence, study programs at Jacobs University offer a comprehensive, structured approach to prepare students for graduate education as well as career success by combining disciplinary depth and interdisciplinary breadth with supplemental skills education and extra-curricular elements.

In this context, it is Jacobs University's aim to educate talented young people from all over the world, regardless of nationality, religion, and material circumstances, to become citizens of the world who are able to take responsible roles for the democratic, peaceful, and sustainable development of the societies in which they live. This is achieved through a high-quality teaching as well as manageable study loads and supportive study conditions. Study programs and related study abroad programs convey academic knowledge as well as the ability to interact positively with other individuals and groups in culturally diverse environments. The ability to succeed in the working world is a core objective for all study programs at Jacobs University, both in terms of actual disciplinary subject matter and also to the social skills and intercultural competence. Study-program-specific modules and additional specializations provide the necessary depth, interdisciplinary offerings and the minor option provide breadth while the university-wide general foundation and methods modules, mandatory German language requirements, and an extended internship period strengthen the employability of students. The concept of living and learning together on an international campus with many cultural and social activities supplements students' education. In addition, Jacobs University offers professional advising and counseling.

Jacobs University's educational concept is highly regarded both nationally and internationally. While the university has consistently achieved top marks over the last decade in Germany's most comprehensive and detailed university ranking by the Center for Higher Education (CHE), it has also been listed by the renowned Times Higher Education (THE) magazine as one of the top 300 universities worldwide (ranking group 251-300) in 2019, 2020 and 2021. The THE ranking is considered as one of the most widely observed university rankings. It is based on five major indicators: research, teaching, research impact, international orientation, and the volume of research income from industry.

1.1.2 Program Concept

The BSc program Earth and Environmental Sciences (EES) at Jacobs University is an interdisciplinary science major with a strong focus on phenomena and processes encountered at or near the Earth's surface. Our students develop a holistic understanding of the Earth's surface environment with its interacting land masses, oceans, atmosphere and biosphere, and of the human impact on this environment. The EES program is based on a solid foundation in chemistry, mathematics and physics, and combines traditional geoscience disciplines such as geology, oceanography and environmental science using key methodological tools and concepts from geochemistry, geophysics, geodata analysis and data management. The modular curriculum allows for an excellent integration of optional complementary courses from the social sciences, e.g., economics and management, and from the life sciences, e.g., biochemistry, cell biology and microbiology.

The EES program imparts the knowledge and the skills that allow our graduates to address topical challenges and key research questions including the sustainable and responsible exploration of natural resources, the short- and long-term evolution of the Earth's climate and oceans, the scientific processing and analysis of large volumes of digital Earth data and pressing anthropogenic challenges to the natural environment. The EES program is ideally suited for proactive and engaged students who are passionate about planet Earth and our natural environment, its dynamics and the impact of human activities, who enjoy working outdoors, and who wish to contribute to finding solutions to pressing real-world problems.

1.2 Specific Advantages of Earth and Environmental Sciences at Jacobs University

The EES curriculum integrates a variety of course formats and educational elements ranging from lectures and seminars, field and laboratory work to on-campus and off-campus teamwork in multidisciplinary and multicultural groups. Already at the course level, theoretical concepts and important earth processes are demonstrated and illustrated using hands-on exercises, field work, and earth science data. In line with Jacobs University's 3C concept, the EES curriculum proceeds from introductory modules in the first year of study (CHOICE) to more advanced and disciplinary focused modules in the second study year (CORE). In the final year of study (CAREER), and in addition to the B.Sc. thesis project, a set of EES capstone modules bring together different strands of the education at Jacobs University in case studies and group projects, promoting social, intercultural, and presentation skills as well as raising awareness of topical real-world challenges.

EES instructors emphasize a global and interdisciplinary perspective that is firmly rooted in the natural sciences. We promote a process- and solution-oriented approach to topical challenges and problem-solving skills that are in high demand by potential employers and graduate schools, thus opening a wide range of possible career paths in academia and industry. Students graduating from the EES and its associated programs entered careers in professional areas as diverse as non-governmental organizations, mining and oil companies, international space agencies, media and press departments, publishing companies, universities, and research institutions. The excellent quality of geoscience programs at Jacobs University has been independently and consistently acknowledged by top CHE Die Zeit rankings since 2009.

1.3 Program-Specific Educational Aims

1.3.1 Qualification Aims

The B.Sc. program Earth and Environmental Sciences is fully committed to the mission of Jacobs University. With planet Earth and global environment at the heart of the study program, internationality and interdisciplinary learning are key ingredients of the EES program that benefit our graduates and supports them on their journey to become citizens of the world. The EES program strongly emphasizes everyone's responsibility for the future sustainable development of our natural environment.

In field activities, data and chemistry laboratory courses, students are exposed to modern equipment and current research methods early in their career. EES courses typically integrate theoretical concepts and processes with case studies and the application of practical and presentation skills, so that our graduates are well-prepared for a wide range of career paths in academia, business, consulting, government, and industry.

1.3.2 Intended Learning Outcomes

By the end of the program, students will be able to

- explain key concepts and processes in geology, oceanography, environmental sciences, geochemistry, Earth data science and geophysical remote sensing;
- describe and discuss marine systems and terrestrial (near-)surface systems, identify and examine their components and interactions;
- apply fundamental chemical and physical concepts and methods to solve real-world problems in terrestrial and marine systems;
- identify and differentiate sedimentary, igneous and metamorphic rocks and minerals;
- apply fundamental field skills, technologies, and concepts in Earth and Environmental Sciences to address topical issues;
- classify and analyze major anthropogenic disturbances of the natural (near-)surface system;
- describe and appraise the interdependencies between resource exploration, responsible resource exploitation and environmental protection;
- cooperate and collaborate responsibly and ethically in international and culturally diverse teams and communities;
- professionally communicate their own results in writing and in front of an audience, to both specialists and non-specialists;
- select and apply key data processing and analysis techniques in applied and environmental geosciences;
- perform quantitative analyses of materials, processes and systems, and model their dynamics;
- analyze scientific and technical questions, put them into context to what is known in the literature, and to solve the questions at hand;
- evaluate, anticipate, and proactively communicate to society the human impact on the environment, and engage ethically as an environmentally responsible person;
- apply research methods appropriate in Earth and Environmental Sciences;
- take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis;
- actively defend and promote ethical, scientific and professional standards.

1.4 Career Options

The Earth and Environmental Sciences program provides a gateway to a wide range of different career paths that reflect the diversity of Earth and Environmental Sciences. Career prospects are excellent, as there is an increasing demand for graduates with a science-based background in Earth and Environmental Sciences, especially with skill-sets that include practical field and lab work, numerical and analytical skills coupled with a sound knowledge in geochemistry, geology, oceanography, geophysics and/or data sciences. An understanding and appreciation of the inherent interdisciplinary nature of the Earth and Environmental sciences is also greatly valued by both academia and industry.

Graduates of the Earth and Environmental Sciences program at Jacobs University can choose from a broad range of careers in academia and in industry, for example in the exploration and management of natural resources such as fresh water, fossil fuels and minerals on land and in the oceans, or in research at universities and various State-, NGO- or privately-funded research facilities. Possible careers also include high-school and college teaching, environmental consulting, protection and management, work in science journalism and publishing or in the geo- and eco-tourism industry. Since positions in industry and academia often require a M.Sc. degree, the modules and courses in the Earth and Environmental Sciences program also aim to prepare students for further studies at graduate schools.

The Earth and Environmental Sciences program has an excellent placement record for its graduates in both, the international job market and highly ranked graduate programs in Germany and abroad (such as Berlin, Bremen, Munich and Tübingen in Germany, and, for example, MIT Boston, ETH Zurich, TU Delft and numerous other universities in the U.S., the Netherlands, the U.K., South Africa, Norway and Sweden). Earth and Environmental Sciences alumni are currently employed by a variety of different companies such as Equinor, Wintershall, DuPont USA, Shell, Lürssen Werft GmbH, and McKinsey, universities and research institutions such as the University of St. Andrews, UK, University of Colorado Boulder, USA, AWI Bremerhaven, MPI for Marine Microbiology, GFZ Potsdam, and Marum Bremen but also at NGOs and Federal and State departments and agencies.

Since Jacobs University is an international residential campus university, all B.Sc. students live in shared housing facilities on Jacobs Campus. The experience of living, learning, and working together with students from more than 100 different countries, ensures that all Earth and Environmental Science graduates are well-prepared for working together in highly diverse multicultural teams and environments.

In addition to the career support provided by a student's Academic Advisor, the central Career Services Center (CSC) at Jacobs University together with the Jacobs Alumni Office support students with high quality training and coaching in C.V. preparation, cover letter formulation, preparation for job interviews, business etiquette, and employer research. Furthermore, the Alumni Office helps students establish a long-lasting and worldwide network which provides support when exploring job options in academia, industry, and elsewhere.

1.5 Admission Requirements

Admission to Jacobs University is selective and based on a candidate's school and/or university achievements, recommendations, self-presentation, and performance on required standardized tests. Students admitted to Jacobs University demonstrate exceptional academic achievements, intellectual creativity, and the desire and motivation to make a difference in the world.

The following documents need to be submitted with the application:

- Recommendation Letter
- Official or certified copies of high school/university transcripts
- Educational History Form
- Standardized test results (SAT/ACT) if applicable
- ZeeMee electronic resume (optional)
- Language proficiency test results (TOEFL, IELTS or equivalent)

Formal admission requirements are subject to higher education law and are outlined in the Admission and Enrollment Policy of Jacobs University.

For more detailed information about the admission visit: https://www.jacobs-university.de/study/undergraduate/application-information

1.6 More Information and Contact

For more information please contact the study program chair:

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or visit our program website: https://www.jacobs-university.de/study/undergraduate/programs/earth-and-environmental-sciences

2 The Curricular Structure

2.1 General

The curricular structure provides multiple elements for enhancing employability, interdisciplinarity, and internationality. The unique Jacobs Track, offered across all undergraduate study programs, provides comprehensive tailor-made modules designed to achieve and foster career competency. Additionally, a mandatory internship of at least two months after the second year of study and the possibility to study abroad for one semester give students the opportunity to gain insight into the professional world, apply their intercultural competences and reflect on their roles and ambitions for employment and in a globalized society.

All undergraduate programs at Jacobs University are based on a coherently modularized structure, which provides students with an extensive and flexible choice of study plans to meet the educational aims of their major as well as minor study interests and complete their studies within the regular period.

The framework policies and procedures regulating undergraduate study programs at Jacobs University can be found on the website (https://www.jacobs-university.de/academic-policies).

2.2 The Jacobs University 3C Model

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

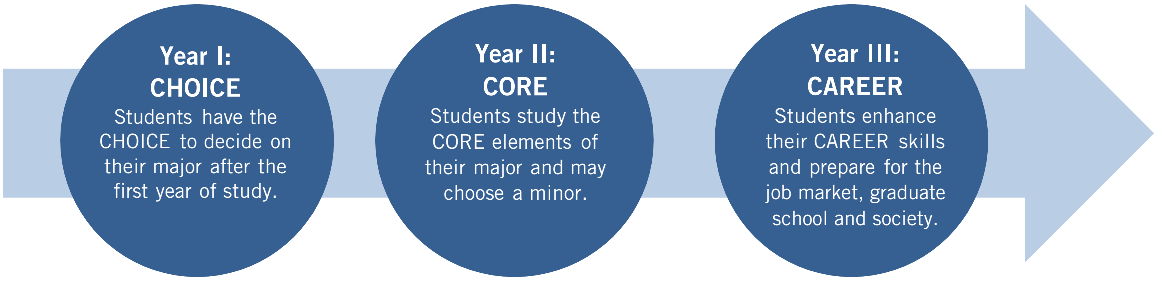

Figure 1: The Jacobs University 3C-Model

2.2.1 Year 1 – CHOICE

The first study year is characterized by a university-specific offering of disciplinary education that builds on and expands upon the students' entrance qualifications. Students select introductory modules for a total of 45 CP from the CHOICE area of a variety of study programs, of which 15-30 CP will be from their intended major. A unique feature of our curriculum structure allows students to select their major freely upon entering Jacobs University. The Academic Advising Coordinator offers curricular counseling to all Bachelor students independently of their major, while Academic Advisors support students in their decision-making regarding their major study program as contact persons from the faculty.

To pursue Earth and Environmental Sciences as a major, the following CHOICE modules (15 CP) need to be taken as mandatory modules:

- CHOICE Module: General Earth and Environmental Sciences (7.5 CP)
- CHOICE Module: General Geoscience (7.5 CP)

These CHOICE modules introduce the students in the 1st semester to the fundamentals of Earth and Environmental Sciences (e.g., the structure of the Earth, its major compartments, plate tectonics, time-scales, and the human impact on the natural environment), and in the 2nd semester provide more specific knowledge of geomaterials and geological phenomena and address the exogenic and endogenic processes that shape them.

The remaining CHOICE modules (30 CP) can be selected in the first year of studies according to interest and/or with the aim to allow a change of major until the beginning of the second year, when the major becomes fixed (see 2.2.1.1 below).

2.2.1.1 Major Change Option

Students can still change to another major at the beginning of their second year of studies if they have taken the corresponding mandatory CHOICE modules in their first year of studies. All students must participate in a seminar on the major change options in the O-Week and consult their Academic Advisor in the first year of studies prior to changing their major.

Earth and Environmental Sciences students that would like to retain an option for a major change are strongly recommended to register for the CHOICE modules of one of the following study programs in their first year. The module descriptions can be found in the respective Study Program Handbook.

- Biochemistry and Cell Biology (BCCB)
  CHOICE Module: General Biochemistry (7.5 CP)
  CHOICE Module: General Cell Biology (7.5 CP)
  CHOICE Module: General Chemistry (7.5 CP)
  CHOICE Module: General Organic Chemistry (7.5 CP)

- Medicinal Chemistry and Chemical Biology (MCCB)
  CHOICE Module: General Medicinal Chemistry & Chemical Biology (7.5 CP)
  CHOICE Module: Module: General Organic Chemistry (7.5 CP)
  CHOICE Module: General Biochemistry (7.5 CP)
  CHOICE Module: General Cell Biology (7.5 CP)

- Chemistry and Biotechnology (CBT)
  CHOICE Module: General Chemistry (7.5 CP)
  CHOICE Module: General Organic Chemistry (7.5 CP)
  CHOICE Module: General Biochemistry (7.5 CP)
  CHOICE Module: Introduction to Biotechnology (7.5 CP)

- Physics (Phys)
  CHOICE Module: Classical Physics (7.5 CP)
  CHOICE Module: Modern Physics (7.5 CP)
  CHOICE Module: Applied Mathematics (7.5 CP)
  CHOICE Module: Introduction to Robotics and Intelligent Systems (7.5 CP)

- Mathematics (Math)
  CHOICE Module: Analysis I (7.5 CP)
  CHOICE Module: Advanced Linear Algebra (7.5 CP)
  CHOICE Module: Applied Mathematics (7.5 CP)

- Computer Science (CS)
  CHOICE Module: Programming in C and C++ (7.5 CP)
  CHOICE Module: Algorithms and Data Structures (7.5 CP)
  CHOICE Module: Introduction to Computer Science (7.5 CP)
  CHOICE Module: Introduction to Robotics and Intelligent Systems (7.5 CP)

- Industrial Engineering and Management (IEM)
  CHOICE Module: General Industrial Engineering (7.5 CP)
  CHOICE Module: General Logistics (7.5 CP)
  CHOICE Module: Introduction to International Business (7.5 CP)
  CHOICE Module: Introduction to Finance and Accounting (7.5 CP)

- Global Economics and Management (GEM)
  CHOICE Module: Microeconomics (7.5 CP)
  CHOICE Module: Macroeconomics (7.5 CP)
  CHOICE Module: Introduction to International Business (7.5 CP)
  CHOICE Module: Introduction to Finance and Accounting (7.5 CP)

- International Business Administration (IBA)
  CHOICE Module: Microeconomics (7.5 CP)
  CHOICE Module: Macroeconomics (7.5 CP)
  CHOICE Module: Introduction to International Business (7.5 CP)
  CHOICE Module: Introduction to Finance and Accounting (7.5 CP)

- International Relations: Politics and History (IRPH)
  CHOICE Module: Introduction to International Relations Theory (7.5 CP)
  CHOICE Module: Introduction to Modern European History (7.5 CP)

- Society Media and Politics (SMP)
  CHOICE Module: Introduction to the Social Sciences 1: Politics and Society (7.5 CP)
  CHOICE Module: Introduction to the Social Sciences 2: Media and Society (7.5 CP)

2.2.2 Year 2 – CORE

In their second year, students take a total of 45 CP from a selection of in-depth, discipline-specific CORE modules. Building on the introductory CHOICE modules and applying the methods and skills acquired so far (see 2.3.1), these modules aim to expand the students' critical understanding of the key theories, principles, and methods in their major for the current state of knowledge and best practice.

To pursue Earth and Environmental Sciences as a major, at least 30 CP from the following mandatory elective CORE modules need to be taken:

- CORE Module: Environmental Science (7.5 CP)
- CORE Module: Geochemistry of Igneous and Aqueous Systems (7.5 CP)
- CORE Module: Earth Data Science (7.5 CP)
- CORE Module: Oceanography (7.5 CP)
- CORE Module: Mineral, Metal and Water Resources (7.5 CP)
- CORE Module: Geophysical Remote Sensing (7.5 CP)

The CORE Modules are arranged as three sets of module pairs, with each pair comprising one fall (F) and one spring (S) module. It is recommended that a student chooses the Fall (F) and Spring (S) semester module pair ME-F and ME-S to focus on Marine Environmental Science and Oceanography, GR-F and GR-S to focus on Geochemistry and Resources and their impact on the environment, and module pair ED-F and ED-S to focus on Earth Data Science and Remote Sensing (for details see section 7 Module Descriptions). The contents of these paired CORE modules are structurally connected and completion of both modules will be guaranteed by scheduling.

15 CP in CORE modules can be selected in the second year of studies according to interest and/or with the aim to pursue a minor in a second field of studies.

2.2.2.1 Minor Option

Earth and Environmental Sciences students can take CORE modules (or more advanced Specialization modules) from a second discipline, which allows them to incorporate a minor study track into their undergraduate education, within the 180 CP required for a bachelor's degree. The educational aims of a minor are to broaden the students' knowledge and skills, support the critical reflection of statements in complex contexts, foster an interdisciplinary approach to problem-solving, and to develop an individual academic and professional profile in line with students' strengths and interests. This extra qualification will be highlighted in the transcript.

The Academic Advising Coordinator, Academic Advisor, and the Study Program Chair of the minor study program support students in the realization of their minor selection; the consultation with the Academic Advisor is mandatory when choosing a minor.

As a rule, this requires Earth and Environmental Sciences students to:

- select two CHOICE modules (15 CP) from the desired minor program in the first year and
- substitute two of the mandatory elective Earth and Environmental Sciences CORE modules in the second year (one in the 3rd and one in the 4th semester) with the default minor CORE modules of the minor study program.

The requirements for each specific minor are described in the handbook of the study program offering the minor (Chapter 3.2) and are marked in the respective Study and Examination Plans.

For an overview of accessible minors, please check the Major/Minor Combination Matrix which is published at the beginning of each academic year.

2.2.3 Year 3 – CAREER

During their third year, students prepare and make decisions about their career path after graduation. To explore available choices and to gain professional experience, students undertake a mandatory summer internship. The third year of studies allows EES students to take Specialization modules within their discipline, but also focuses on the responsibility of students beyond their discipline (see Jacobs Track).

The 5th semester also opens a mobility window for a diverse range of study abroad options. Finally, the 6th semester is dedicated to fostering the students' research experience by involving them in an extended Bachelor thesis project.

2.2.3.1 Internship / Start-up and Career Skills Module

As a core element of Jacobs University's employability approach students are required to engage in a mandatory two-month internship of 15 CP that will usually be completed during the summer between the second and third years of study. This gives students the opportunity to gain first-hand practical experience in a professional environment, apply their knowledge and understanding in a professional context, reflect on the relevance of their major to employment and society, reflect on their own role in employment and society, and find a professional orientation. The internship can also establish valuable contacts for the students' Bachelor's thesis project, for the selection of a Master program graduate school or further employment after graduation. This module is complemented by career advising and several career skills workshops throughout all six semesters that prepare students for the transition from student life to professional life. As an alternative to the full-time internship, students interested in setting up their own company can apply for a start-up option to focus on developing of their business plans.

For further information, please contact the Career Services Center (https://www.jacobs-university.de/career-services)

2.2.3.2 Specialization Modules

In the third year of their studies, students take 15 CP from major-specific or major-related, advanced Specialization Modules to consolidate their knowledge and to be exposed to state-of-the-art research in the areas of their interest. This curricular component is offered as a portfolio of modules, from which students can make free selections during their fifth and sixth semester. The default Specialization Module size is 5 CP, with smaller 2.5 CP modules being possible as justified exceptions.

To pursue Earth and Environmental Sciences as a major, at least 15 CP from the following mandatory elective Specialization Modules need to be taken:

- Specialization: Advanced Earth and Environmental Sciences Field lab (5 CP)
- Specialization: Global Change and Systems Thinking (5 CP)
- Specialization: Modelling of Earth System Data (5 CP)
- Specialization: Current Topics in Earth and Environmental Science (5 CP)

In addition to the advancement of disciplinary skills within EES, these specialization modules are also meant to bring together different disciplinary threads developed in the CORE area in an interdisciplinary context, thus realizing the idea of capstone modules in the third year of study.

2.2.3.3 Study Abroad

Students have the opportunity to study abroad for a semester to extend their knowledge and abilities, broaden their horizons and reflect on their values and behavior in a different context as well as on their role in a global society. For a semester abroad (usually the 5th semester), modules related to the major with a workload equivalent to 22.5 CP must be completed. Modules recognized as study abroad CP need to be pre-approved according to Jacobs University study abroad procedures. Several exchange programs allow students to directly enroll at prestigious partner institutions worldwide. Jacobs University's participation in Erasmus+, the European Union's exchange program, provides an exchange semester at a number of European universities that include Erasmus study abroad funding.

For further information, please contact the International Office (https://www.jacobs-university.de/study/international-office).

EES students that wish to pursue a study abroad in their 5th semester are required to select their modules at the study abroad partners such that they can be used to substitute between 10-15 CP of major-specific Specialization modules and between 5-15 CP of modules equivalent to the non-disciplinary Big Questions modules or the Community Impact Project (see Jacobs Track). In their 6th semester, according to the study plan, returning study-abroad students complete the Bachelor Thesis/Seminar module (see next section), they take any missing Specialization modules to reach the required 15 CP in this area, and they take any missing Big Questions modules to reach 15 CP in this area. Study abroad students are allowed to substitute the 5 CP Community Impact Project (see Jacobs Track below) with 5 CP of Big Questions modules.

2.2.3.4 Bachelor Thesis/Seminar Module

This module is a mandatory graduation requirement for all undergraduate students. It consists of two module components in the major study program guided by a Jacobs faculty member: the Bachelor Thesis (12 CP) and a Seminar (3 CP). The title of the thesis will appear on the students' transcripts.

Within this module, students apply the knowledge skills, and methods they have acquired in their major discipline to become acquainted with actual research topics, ranging from the identification of suitable (short-term) research projects, preparatory literature searches, the realization of discipline-specific research, and the documentation, discussion, and interpretation of the results.

With their Bachelor Thesis students demonstrate mastery of the contents and methods of their major-specific research field. Furthermore, students 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 the original development of their own ideas. With the permission of a Jacobs Faculty Supervisor, the Bachelor Thesis can also have an interdisciplinary nature. In the seminar, students present and discuss their theses in a course environment and reflect on their theoretical or experimental approach and conduct. They learn to present their chosen research topics concisely and comprehensively in front of an audience and to explain their methods, solutions, and results to both specialists and non-specialists.

2.3 The Jacobs Track

The Jacobs Track, an integral part of all undergraduate study programs, is another important feature of Jacobs University's educational model. The Jacobs Track runs parallel to the disciplinary CHOICE, CORE, and CAREER modules across all study years and is an integral part of all undergraduate study programs. It reflects a university-wide commitment to an in-depth training in scientific methods, fosters an interdisciplinary approach, raises awareness of global challenges and societal responsibility, enhances employability, and equips students with augmented skills desirable in the general field of study. Additionally, it integrates (German) language and culture modules.

2.3.1 Methods and Skills Modules

Methods and skills such as mathematics, statistics, programming, data handling, presentation skills, academic writing, and scientific and experimental skills are offered to all students as part of the Methods and Skills area in their curriculum. The modules that are specifically assigned to each study programs equip students with transferable academic skills. They convey and practice specific methods that are indispensable for each students' chosen study program. Students are required to take 20 CP in the Methods and Skills area. The size of all Methods and Skills modules is 5 CP.

To pursue EES as a major, the following Methods and Skills modules (15 CP) need to be taken as mandatory modules:

Methods Module: Mathematical Concepts for the Sciences (5 CP)

Methods Module: Chemistry for Natural Scientists (5 CP)

Methods Module: Physics for Natural Scientists (5 CP)

For the remaining 5 CP EES students can choose freely among offered Methods Modules.

2.3.2 Big Questions Modules

The modules in the Big Questions area (10 CP) intend to broaden students' horizons with applied problem solving between and beyond their chosen disciplines. The offerings in this area comprise problem-solving oriented modules that tackle global challenges from the perspectives of different disciplinary backgrounds that allow, in particular, a reflection of acquired disciplinary knowledge in economic, societal, technological, and/or ecological contexts. Working together with students from different disciplines and cultural backgrounds, these modules cross the boundaries of traditional academic disciplines.

Students are required to take 10 CP from modules in the Area. This curricular component is offered as a portfolio of modules, from which students can make free selections during their 5th and 6th semester with the aim of being exposed to the full spectrum of economic, societal, technological, and/or ecological contexts. The size of Big Questions Modules is either 2.5 or 5 CP.

2.3.3 Community Impact Project

In their 5th semester students are required to take a 5 CP Community Impact Project (CIP) module. Students engage in on-campus or off-campus activities that challenge their social responsibility, i.e., they typically work on major-related projects that make a difference in the community life on campus, in the campus neighborhood, Bremen, or on a cross-regional level. The project is supervised by a faculty coordinator and mentors.

Study abroad students are allowed to substitute the 5-CP Community Impact Project with 5 CP of Big Questions modules.

2.3.4 Language Modules

Communication skills and foreign language abilities foster students' intercultural awareness and enhance their employability in an increasingly globalized and interconnected world. Jacobs University supports its students in acquiring and improving these skills by offering a variety of language modules at all proficiency levels. Emphasis is put on fostering the German language skills of international students as they are an important prerequisite for non-native students to learn about, explore, and eventually integrate into their host country and its professional environment. Students who meet the required German proficiency level (e.g., native speakers) are required to select modules in any other modern foreign language offered (Chinese, French or Spanish). Hence, acquiring 10 CP in language modules, with German mandatory for non-native speakers, is a requirement for all students. This curricular component is offered as a four-semester sequence of foreign language modules. The size of the Language Modules is 2.5 CP.

3 Earth and Environmental Sciences as a Minor

A Minor in Earth and Environmental Sciences is a valuable complementary study component for students with a strong general interest in environmental topics and/or for those who would like to pursue a career that requires interdisciplinary knowledge of the natural environment, the acquisition and processing of Earth (Big) data, and/or the natural resource sector on the one hand, and/or of computer science, economics, microbiology, biotechnology, chemistry or physics on the other.

The Earth and Environmental Sciences program, therefore, is structured in a way that allows students to not only choose a default set of CORE courses for a Minor in Earth and Environmental Sciences, but that also makes provision for two alternative sets of CORE courses (see 3.2 Module Requirements). However, while the course schedule always allows students to choose the default set of CORE courses, it cannot be guaranteed that in each individual case the alternative sets of CORE courses for a Minor can be taken.

3.1 Qualification Aims

The purpose of a Minor in Earth and Environmental Sciences is to prepare students to deal with the pressing challenges of the next decades, such as Climate Change, scarcity of water and mineral resources, and responsible and sustainable interaction with the environment. A Minor in Earth and Environmental Sciences enables them to understand, discuss, participate in and promote science-based approaches which address these issues.

3.1.1 Intended Learning Outcomes

With the default minor in Earth and Environmental Sciences, students will be able to:

- explain key concepts and processes in geology, oceanography and environmental sciences;
- describe and discuss marine systems and terrestrial (near-) surface systems, identify and examine their components and interactions;
- identify and differentiate sedimentary, igneous and metamorphic rocks and minerals;
- apply fundamental field skills, technologies, and concepts in Earth and Environmental Sciences;
- classify and analyze major anthropogenic disturbances of the natural system;
- cooperate and collaborate responsibly and ethically in international and culturally diverse teams and communities.

3.2 Module Requirements

A Minor in Earth and Environmental Sciences requires 30 CP. The default option to obtain a Minor in Earth and Environmental Sciences is marked in the Study and Examination Plan in chapter 6. It includes the following CHOICE and CORE modules:

Set of CHOICE modules:

- CHOICE Module: General Earth and Environmental Sciences (7.5 CP)
- CHOICE Module: General Geoscience (7.5 CP)

Default set of CORE modules:

- CORE Module: Environmental Science (7.5 CP)
- CORE Module: Oceanography (7.5 CP)

Upon the consultation with the Academic Advisor and the EES Study Program Coordinator, individual CORE modules from the default minor can be replaced by other advanced modules (CORE or Specialization) from the EES major.

Scheduling and pre-requisites allowing, substitution of the default set of CORE modules with the following alternative sets (A1 and A2) of CORE modules is possible:

Alternative (A1) set of CORE courses:

- CORE Module: Geochemistry of Igneous and Aqueous Systems (7.5 CP)
- CORE Module: Mineral, Metal and Water Resources (7.5 CP)

Alternative (A2) set of CORE courses:

- CORE Module: Earth Data Science (7.5 CP)

- CORE Module: Geophysical Remote Sensing (7.5 CP)

Upon consultation with the Academic Advisor and the EES Study Program Coordinator, individual CORE modules from the default minor can be replaced by other advanced modules (CORE or Specialization) from the EES major.

3.3 Degree

After successful completion, the minor in Earth and Environmental Sciences will be listed on the final transcript under PROGRAM OF STUDY and BA/BSc – [name of the major] as "(Minor: Earth and Environmental Sciences)".

4 Earth and Environmental Sciences Undergraduate Program Regulations

4.1 Scope of these Regulations

The regulations in this handbook are valid for all students who entered the Earth and Environmental Sciences undergraduate program at Jacobs University in Fall 2021. In case of conflict between the regulations in this handbook and the general Policies for Bachelor Studies, the latter applies (see http://www.jacobs-university.de/academic-policies).

In exceptional cases, certain necessary deviations from the regulations of this study handbook might occur during the course of study (e.g., change of the semester sequence, Assessment Type:, or the teaching mode of courses).

In general, Jacobs University Bremen reserves therefore the right to change or modify the regulations of the program handbook also after its publication at any time and in its sole discretion.

4.2 Degree

Upon successful completion of the study program, students are awarded a Bachelor of Science degree in Earth and Environmental Sciences.

4.3 Graduation Requirements

In order to graduate, students need to obtain 180 CP. In addition, the following graduation requirements apply:

Students need to complete all mandatory components of the program as indicated in the Study and Examination Plan in Chapter 6 of this handbook.

5 Schematic Study Plan for Earth and Environmental Sciences

Figure 2 shows schematically the sequence and types of modules required for the study program. A more detailed description, including the Assessment Type:s, is given in the Study and Examination Plans in the following section.

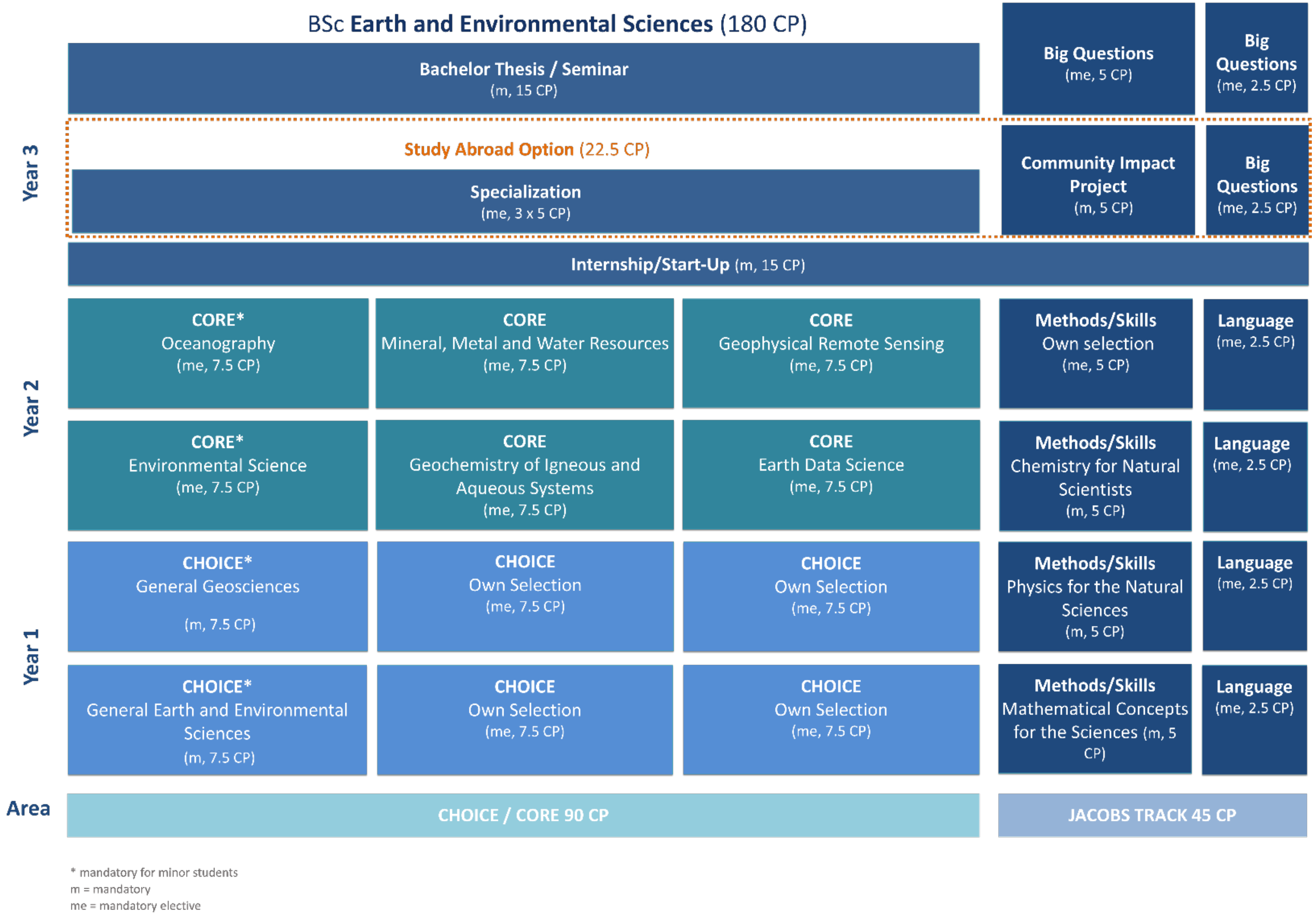

Figure 2: Schematic Study Plan for EES

* mandatory for minor students (default minor)
m = mandatory
me = mandatory elective

6 Study and Examination Plan

Earth and Environmental Sciences (EES)

Matriculation Fall 2022

	Program-Specific Modules	Type	Assessment	Period	Status[1]	Sem.	CP
Year 1 - CHOICE							**45**
Take the mandatory CHOICE modules listed below, this is a requirement for the EES program							
	Unit: EES (default minor)						**15**
CH-130	**Module: General Earth and Environmental Sciences** (default minor)				**m**	**1**	**7.5**
CH-130-A	Structure and Geological Evolution of the Earth	Lecture	Written Exam	Examination period			2.5
CH-130-B	Structure and Dynamics of the Earth's Atmosphere and Oceans	Lecture					2.5
CH-130-C	Anthropogenic Impact on the Earth's Surface Environment	Lecture / Field Lab					2.5
CH-131	**Module: General Geosciences** (default minor)				**m**	**2**	**7.5**
CH-131-A	Volcanism and Metamorphism	Lecture	Oral examination	Examination period			2.5
CH-131-B	Sedimentology	Lecture					2.5
CH-131-C	Structural Geology	Lecture					2.5
	Unit: CHOICE (own selection)					**1+2**	**30**
Take four further CHOICE modules from those offered for all other study programs[2]							
Year 2 - CORE							**45**
Take all CORE modules listed below or replace 15 CP with suitable CORE modules from other study programs[2]							
	Unit: Marine Environmental Science (default minor)						**15**
CO-460	**Module: Environmental Science** (default minor)				**me**	**3**	**7.5**
CO-460-A	Marine Environments	Lecture	Written Exam	Examination period			2.5
CO-460-B	Environmental Geochemistry	Lecture					2.5
CO-460-C	Environmental Mineralogy	Lecture					2.5
CO-461	**Module: Oceanography** (default minor)				**me**	**4**	**7.5**
CO-461-A	Physical Oceanography	Lecture	Written Exam	Examination period			2.5
CO-461-B	Marine Geophysics	Lecture					2.5
CO-461-C	Oceanographic Research Cruise	Field Lab					2.5
	Unit: Geochemistry and Resources						**15**
CO-462	**Module: Geochemistry of Igneous and Aqueous Systems**				**me**	**4**	**7.5**
CO-462-A	Igneous Trace Element and Radiogenic Isotope Geochemistry	Lecture	Written Exam	Examination period			2.5
CO-462-B	Aqueous and Marine Geochemistry	Lecture					2.5
CO-462-C	Stable Isotope Geochemistry	Lecture					2,5
CO-463	**Module: Mineral, Metal and Water Resources**				**me**	**3**	**7.5**
CO-463-A	General Mineral Resources	Lecture	Written Exam	Examination period			2.5
CO-463-B	Critical High-Technology Metals: Resources and Environmental Impact	Lecture					2.5
CO-463-C	Fieldcamp: Geology, Metals and Freshwater Resources	Field Lab					2.5
	Unit: Earth Data Science and Remote Sensing						**15**
CO-464	**Module: Earth Data Science**				**me**	**4**	**7.5**
CO-464-A	Surface and Subsurface Systems: Data, Models, and Processes	Lecture	Project	Examination period			2.5
CO-464-B	Marine and Atmospheric Systems: Data, Models, and Processes	Lecture					2.5
CO-464-C	Introduction to Geographic Information Systems	Lecture					2.5
CO-465	**Module: Geophysical Remote Sensing**				**me**	**3**	**7.5**
CO-465-A	Earth and Planetary Surfaces in Remote Sensing Data	Lecture	Term Paper	During the Semester			2.5
CO-465-B	Climate System Dynamics Observed from Space	Lecture					2.5
CO-465-C	Global Geophysical Fields and Models	Lecture					2.5
Year 3 - CAREER							**45**
CA-INT-900	**Module: Internship / Startup and Career Skills**				**m**	**4/5**	**15**
CA-INT-900-0	Internship / Startup and Career Skills	Internship	Report/Business Plan	During the 5th semester			15
Module Code	**Module: Seminar / Thesis EES**				**m**	**6**	**15**
CA-EES-800-T	Thesis EES		Thesis and Presentation	15th of May			12
CA-EES-800-S	Seminar EES			During the semester			3
	Unit: Specialization EES				**m**		**15**
Take a total of 15 CP of specialization modules							
CA-S-EES-801	Advanced Earth and Environmental Sciences Field Lab	Field Lab	Project Report	During the semesterd	me	5	5
CA-S-EES-802	Global Change and Systems Thinking	Lecture	Oral Exam	Examination period	me	5	5
CA-S-EES-803	Modelling of Earth System Data	Lecture	Term Paper	Examination period	me	5	5
CA-S-EES-804	Current Topics in Earth and Environmental Sciences	Seminar	Term Paper	Examination period	me	5	5
Total CP							**45**

	Jacobs Track Modules (General Education)	Type	Assessment	Period	Status[1]	Sem.	CP
Year 1							**15**
	Unit: Methods / Skills						**10**
JTMS-MAT-07	**Module: Mathematical Concepts for the Sciences**				**m**	**1**	**5**
JTMS-07	Mathematical Concepts for the Sciences	Lecture	Written exam	Examination period	m	1	5
JTMS-SCI-15	**Module: Chemistry for Natural Scientists**				**m**	**2**	**5**
JTMS-15	Chemistry for Natural Scientists	Lecture	Written exam	Examination period	m	2	5
	Unit: Language				**m**		**5**
	German is default language. Native German speakers take modules in another offered language.						
JTLA-xxx	**Module: Language 1**				**m**	**1**	**2.5**
JTLA-xxx	Language 1	Seminar	Various	Various	me		2.5
JTLA-xxx	**Module: Language 2**				**m**	**2**	**2.5**
JTLA-xxx	Language 2	Seminar	Various	Various	me		2.5
Year 2							**15**
	Unit: Methods / Skills						**10**
Select from Methods / Skills modules offered in the Fall semester							
JTMS-xxx-xx	**Module: Methods (own selection)**		**Various**	**Various**	**me**	**3**	**5**
JTMS-SCI-17	**Module: Physics for the Natural Sciences**				**m**	**2**	**5**
JTMS-17	Physics for the Natural Sciences	Lecture	Written exam	Examination period			5
	Unit: Language						**5**
	German is default language. Native German speakers take modules in another offered language.						
JTLA-xxx	**Module: Language 3**				**m**	**3**	**2.5**
JTLA-xxx	Language 3	Seminar	Various	Various	me		2.5
JTLA-xxx	**Module: Language 4**				**m**	**4**	**2.5**
JTLA-xxx	Language 4	Seminar	Various	Various	me		2.5
Year 3							**15**
	Unit: Big Questions						**10**
JTBQ-xxx	Module: Big Questions				**m**	**5/6**	
Take a total of 10 CP of Big Questions modules (each 2.5 or 5 CP) as mandatory elective		Various	Various	Various	**me**		10
	Unit: Community Impact Project						**5**
JTCI-CI-950	**Module: Community Impact Project**				**m**	**5**	**5**
JTCI-950	Community Impact Project	Project	Project	Examination period			5
Total CP							**180**

[1] Status (m = mandatory, 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 study program handbooks.

Figure 3: Study and Examination Plan EES

7 Earth and Environmental Science Modules

7.1 General Earth and Environmental Sciences

Module Name	*Module Code*	*Level (type)*	*CP*
General Earth and Environmental Sciences	CH-130	Year 1 (CHOICE)	7.5

Module Components

Number	*Name*	*Type*	*CP*
CH-130-A	Structure and Geological Evolution of the Earth	Lecture	2.5
CH-130-B	Structure and Dynamics of the Earth's Atmosphere and Oceans	Lecture	2.5
CH-130-C	Anthropogenic Impact on the Earth's Surface Environment	Field lab and lecture	2.5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Andrea Koschinsky, Vikram Unnithan	• Earth and Environmental Science (EES)	Mandatory for: EES

Entry Requirements			*Frequency*	*Forms of Learning and Teaching*
Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	Annually (Fall)	• Lecture (55 hours) • Field Lab (25 hours) • Private study (107.5 hours)
☒ None	☒ None	• None	*Duration* 1 semester	*Workload* 187.5 hours

Recommendations for Preparation

None

Content and Educational Aims

The module is an introduction to how planet Earth works with a focus on the formation and geological evolution of the Earth, the natural processes that affect and shape the Earth, and the environmental issues pertinent to society. Students learn about the internal structure and the different compartments of the Earth, the fundamental concept of plate tectonics, the basic minerals and rocks that the Earth is composed of, the oceans, the atmosphere, and environmental issues resulting from human impact. Students are encouraged to think about the interconnectedness of the Earth as a system. The interdisciplinary nature of Earth and Environmental Science is emphasized throughout the course. Field components complement and extend the lecture material.

Intended Learning Outcomes

By the end of this module, students will be able to

- describe the general structure and compartments of the Earth and the fundamental concept of plate tectonics;
- recognize the most common Earth materials and suggest in which geological settings they are likely to be found;
- use the proper scientific terminology in the field of Earth and Environmental Science.

- discuss natural processes that shape the Earth and the implications these processes have for the evolution of our planet and the environment;
- appreciate and appraise the Earth as a complex and evolving dynamic system in the context of the long timescales and slow rates of geological processes and the short timescales and fast rates of human impact;
- recognize the multi- and interdisciplinary nature of Earth and Environmental Science and synthesize geologic knowledge to holistically view, assess, and interpret geological materials, structures and processes;
- assess the extraction and use of various natural resources, land-use and climate change, and the impact these changes have on society.

Indicative Literature

Tarbuck, E.J. and Lutgens, F.K. (2015): Earth Science. London: Pearson Education.

Johnson, C., Matthew, D., Affolter, P., Inkenbrandt, C. M. An Introduction to Geology (2017) Salt Lake City: Salt Lake Community College.

United Nations Environmental Programme (2015).One Planet Many People. Retrieved from: https://na.unep.net/atlas/onePlanetManyPeople/book.php.

Usability and Relationship to other Modules

- Recommended for all EES CHOICE and CORE modules.
- Mandatory for a major and minor in EES.

Examination Type: Module Examination

Assessment Type: Written examination Duration: 120 minutes

Weight: 100%

Module achievement: The Field-Lab report is a prerequisite, ("Studienbegleitleistung") for being admitted to the written examination.

Scope: All intended learning outcomes for the module.

7.2 General Geosciences

Module Name		*Module Code*	*Level (type)*	*CP*
General Geosciences		CH-131	Year 1 (CHOICE)	*7.5*
Module Components				
Number	*Name*		*Type*	*CP*
CH-131-A	Volcanism and Metamorphism		Lecture + tutorials + excursion	2.5
CH-131-B	Sedimentology		Lecture + tutorials + Excursion	2.5
CH-131-C	Structural Geology		Lecture + tutorials + excursion	2.5

Module Coordinator	***Program Affiliation***	***Mandatory Status***
Vikram Unnithan, Michael Bau	• Earth and Environmental Sciences (EES)	Mandatory for EES.

Entry Requirements			***Frequency***	***Forms of Learning and Teaching***
Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	Annually (Spring)	• Lecture (26.25 hours) • Tutorials (26.25 hours) • Excursion (20.00 hours) • Self-study (115 hours)
☒ None	☒ None	• None	***Duration***	***Workload***
			1 semester	187.5 hours

Recommendations for Preparation

Attendance of the module EES-CH-GenEES Introduction to Earth and Environmental Sciences

Content and Educational Aims

The module is comprised of essential geoscience courses that represent the backbone of a sound university education in the geosciences. This includes key lectures in Sedimentology, Structural Geology, Volcanism and Metamorphism, complemented by on-campus (tutorials) and off-campus (fieldlab/excursion) practicals. Based on the lectures that provide the students with the necessary background information and theoretical framework, key elements of this module are hands-on tutorials and an off-campus practical (2-day excursion) during which students are introduced to geological methods and techniques, resulting in a close combination of teaching theoretical knowledge and essential practical skills in a real-life environment.

Intended Learning Outcomes

By the end of this module, students will be able to

- identify and differentiate sedimentary, igneous and metamorphic rocks and minerals using the relevant scientific terminology;
- describe the major rock-forming minerals in igneous, metamorphic and sedimentary rocks and the processes that produce their specific mineralogical and textural features;
- describe sedimentary structures and reflect on sedimentary environments and depositional processes;
- identify and explain geological structures and phenomena in the field;
- recognize, interpret geological structures, describe the geometry and location of geological structures at depth, and illustrate links to mining, resource exploration;
- appraise the close relationship and manifold dependencies between geology, environment, and society.

Indicative Literature

Tucker, M.E. (2011). Sedimentary Rocks in the Field: A Practical Guide (Geological Field Guide Book 38). Hoboken:Wiley.

Fossen, H. (2010). Structural Geology. Cambridge: Cambridge University Press.

Lisle, R. J. (1988). Geological Structures and Maps. Oxford: Butterworth-Heinemann Ltd.

Coe, A (2010). Geological Field Techniques. Hoboken: John Wiley & Sons.

Usability and Relationship to other Modules

- Pre-requisite for CO-460, CO-461, EES-CO-Geochem, CO-463, and CA-S-EES-801.
- Mandatory for a major and minor in EES.
- Elective for all other undergraduate study programs.
- This module is a continuation of the module CH-130 which, however, is not a pre-requisite.

Examination Type: Module Examination

Assessment Type: Oral examination with practical component | Duration: 60 min
Weight: 100%

Scope: All intended learning outcomes of the module.

7.3 Environmental Science

Module Name		*Module Code*	*Level (type)*	*CP*
Environmental Science		CO-460	Year 2 (CORE)	7.5
Module Components				
Number	*Name*		*Type*	*CP*
CO-460-A	Marine Environments		Lecture	2.5
CO-460-B	Environmental Geochemistry		Lecture	2.5
CO-460-C	Environmental Mineralogy		Lecture	2.5
Module Coordinator Andrea Koschinsky, Laurenz Thomsen	***Program Affiliation*** • Earth and Environmental Sciences (EES)		***Mandatory Status*** Mandatory elective for EES and CBT	
Entry Requirements *Pre-requisites* ☒ None	*Co-requisites* ☒ None	*Knowledge, Abilities, or Skills* • Basics of Earth and Enviromental Sciences and Geosciences	***Frequency*** Annually (Spring) ***Duration*** 1 semester	***Forms of Learning and Teaching*** • Lectures (52.5 hours) • Private study (135 hours) ***Workload*** 187.5 hours
Recommendations for Preparation Please review the content of the EES CHOICE modules CH-130 and CH-131.				
Content and Educational Aims This module provides an exploration of the evolution of the Earth's environment and of the progressive exploitation of environmental resources by humankind. Students will study the different physical, chemical and biological processes that generate the Earth's environment and that support life in the different environmental compartments. The importance of Environmental Science is based on the need for sustainable development and environmental management as a key to a secure future of humankind. The courses as part of the module aim to review the large-scale global processes that shape the terrestrial and marine systems with their specially adapted ecosystems. They illustrate how anthropogenic interactions such as resource extraction, energy consumption, and pollution interfere with these natural processes, which ecosystems respond to these changes and introduce concepts and strategies of remediation. The students will learn to distinguish between natural and anthropogenic environmental change and learn to read from the geological record to understand present changes and predict the impacts of future global change. The courses in the module will consider both terrestrial systems such as freshwater and soil systems, as well as marine systems from coastal to deep-ocean environments, always in the context of their special environmental parameters and related environmental vulnerability or resilience.				

Intended Learning Outcomes

By the end of this module, students will be able to:

- critically assess the natural and human-driven systems and processes that provide resources, produce energy and affect the climate and our Earth surface environment;
- connect environmental conditions to the development of specific adapted terrestrial and marine ecosystems;
- use numerical tools and publicly available scientific data to demonstrate important concepts about the Earth, its climate, and resources;
- use mineralogical and geochemical tools to identify the status and composition of an environmental system and its dynamics;
- distinguish between natural and anthropogenic factors that are responsible for patterns of global warming, ocean deoxygenation and acidification, contamination and other environmental changes in the past century;
- apply sedimentological, chemical and biological data as proxies to reconstruct ancient environments and climates;
- suggest mitigation strategies to remediate water, soil and air pollution, negative changes in the marine system, and global warming;
- demonstrate awareness of the difficulties involved in the detection of any unusual environmental change signal above the background noise of natural variability.

Indicative Literature

Schwedt, G (1997). The Essential Guide to Environmental Chemistry. Hoboken: Wile

Langmuir, D. (1996). Aqueous Environmental Geochemistry. New Jersey: Prentice Hall.

Klein, C. Philpotts, A. (2016). Earth Materials: Introduction to Mineralogy and Petrology. Cambridge: Cambridge University Press.

Usability and Relationship to other Modules

- This module prepares and relates to CO-462, CO-461, CA-S-EES-802.
- Mandatory elective for major in EES.
- Mandatory for a minor in EES and CBT
- Elective for all other undergraduate study programs.
- This module serves as a mandatory elective specialization module for CBT students: due to the size of the module students who take the module may exceed the workload of 30 CP per semester.

Examination Type: Module Examination

Assessment Type:: Written examination

Duration: 180 min

Weight: 100%

Scope: All indented learning outcomes of the module

7.4 Oceanography

Module Name		*Module Code*	*Level (type)*	*CP*
Oceanography		CO-461	Year 2 (CORE)	7.5
Module Components				
Number	*Name*		*Type*	*CP*
CO-461-A	Physical Oceanography		Lecture	2.5
CO-461-B	Marine Geophysics		Lecture	2.5
CO-461-C	Oceanographic FieldLab: Research Cruise North Sea		Field lab	2.5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Prof. Dr. Laurenz Thomsen, Prof. Dr. Vikram Unnithan	• Earth and Environmental Sciences (EES)	Mandatory elective for EES

Entry Requirements			*Frequency*	*Forms of Learning and Teaching*
Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	Annually (Fall)	• Lectures (35 hours) • Private study (112.5 hours) • Field lab (40 hours)
☒ None	☒ None	• Basics of Earth and Enviromental Sciences and Geosciences	*Duration*	187.5 hours
			1 semester	

Recommendations for Preparation
Please review the content of the EES CHOICE modules CH-130 and CH-131.

Content and Educational Aims

This module will further develop your understanding of our marine environment and how it interacts with the Earth's processes. The role of the ocean on weather, climate, food availability, and mineral resources is often discussed in the news. The ocean is one part of the earth system. It mediates processes in the atmosphere by the transfer of mass, momentum, and energy through the sea surface. It receives water and dissolved substances from the land. It also lays down sediments or produces crusts, enriched with mineral resources. Hence an understanding of the ocean is important for understanding the Earth as a system, especially for understanding important problems such as global change and the supply of resources. Theory, observations, and numerical models are used to describe ocean dynamics. None is these can sufficiently explain the complexity of ocean dynamics by itself. This module offers an introduction to marine physics and geophysics, emphasizing theory, more applied and hands-on aspects, and the introduction of tools and techniques. Furthermore, students learn to operate selected geoscientific instruments and the basics of data acquisition in the field. The module covers topics and methods that are essential in physical oceanography and geophysics. Emphasis will be on the quantitative assessment of physical processes and structures in marine systems. Important concepts are introduced and studied in the lectures, and then applied and consolidated during a research cruise to the North Sea, where team-work is fostered and data interpretation will be practiced.

Intended Learning Outcomes

By the end of this module, students will be able to

- enumerate and describe ocean processes and their role in the proper functioning of our planet;
- acquire basic skills required to quantify how the ocean works;
- describe and explain physical principles of marine geophysical techniques such as acoustics, gravity, and magnetics;
- operate and test selected geophysical instruments and apply essential field data acquisition techniques;
- compare and contrast different geophysical methods, describe weaknesses, strengths, and applicability to different problems, scenarios and environments;
- extend fundamental practical skills and concepts in biological, geological, geochemical, and geophysical fields to oceangoing field (lab) research.

Indicative Literature

Open University (2001). Ocean Circulation, 2nd Edition. Oxford: Butterworth-Heinemann.

Jones, E. J. W. (1999). Marine Geophysics. Hoboken: John Wiley & Sons.

Fowler, C. M. R. (2004). The Solid Earth: An Introduction to Global Geophysics. New York : Cambridge University Press.

Usability and Relationship to other Modules

- Pre-requisite for EES- CA-S-EES-801
- Mandatory elective for a major in EES
- Mandatory for a minor in EES.
- Elective for all other undergraduate study programs.
- This module is related to modules CH-130, CH-131, CO-460.

Examination Type: Module Examination

Assessment Type:: Written examination — Duration: 120 min — Weight: 100%

Scope: All intented learning outcomes of the module

Module achievement: Attendance during the field trip and submission of the Cruise report are pre-requisites, ("Studienbegleitleistung") for being admitted to the written examination.

7.5 Geochemistry of Igneous and Aqueous Systems

Module Name	*Module Code*	*Level (type)*	*CP*
Geochemistry of Igneous and Aqueous Systems	CO-462	Year 2 (CORE)	7.5

Module Components

Number	*Name*	*Type*	*CP*
CO-462-A	Trace Element and Radiogenic Isotope Geochemistry	Lecture + tutorials	2.5
CO-462-B	Aqueous and Marine Geochemistry	Lecture + tutorials	2.5
CO-462-C	Stable Isotope Geochemistry	Lecture + tutorials	2.5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Michael Bau, Andrea Koschinsky	• Earth and Environmental Sciences (EES)	Mandatory elective for EES

Entry Requirements

Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*
☒ General Geoscience Or ☒ Chemistry - General and Inorganic Chemistry	☒ None	• None beyond formal pre-requisites

Frequency	*Forms of Learning and Teaching*
Annually (Spring)	• lectures (37.5 hours) • tutorials (15.0 hours) • homework, self-study (135hrs)

Duration	*Workload*
1 semester	187.5 hours

Recommendations for Preparation

Please review the content of the EES CHOICE modules: CH-130 and CH-131.

Content and Educational Aims

This module provides an introduction to the geochemistry of igneous (and clastic sedimentary) and aqueous (seawater and other natural waters) systems with respect to major and trace elements as well as stable and radiogenic isotopes. The theoretical framework will be provided by lectures that are complemented by tutorials and homework in which students will apply trace element and isotope geochemical tools in a quantitative way to solve basic geochemical problems related to, for example, trace element behavior during partial melting and the fractional crystallization of magmas, age and provenance of igneous and sedimentary rocks, the marine residence times of elements, or trace element behavior during water-rock interaction during weathering and hydrothermal alteration.

Intended Learning Outcomes

By the end of this module, students will be able to

- classify elements according to their physico-chemical characteristics and behavior in natural systems;
- derive and work with mineral/melt partition coefficients and use them to predict and quantify the behavior of trace elements in igneous systems during partial melting and fractional crystallization;
- characterize the fundamental parameters and processes that control the behavior of elements in aqueous natural systems;
- predict and quantify the behavior of trace elements in natural aqueous systems;
- characterize and apply the radiogenic isotope systems commonly used in geochronology and as source proxies;
- characterize and apply the stable isotope systems commonly used in biogeochemistry;
- assess the potential environmental impact of different elements based on their specific geochemical behavior.

Indicative Literature

Hugh R. Rollinson (1993). Using Geochemical Data: Evaluation, Presentation, Interpretation. Abingdon: Routledge.

Langmuir, D. (1997). Aqueous Environmental Geochemistry. New Jersey: Prentice Hall

White, W.M. (2013). Geochemistry Chapter 6: Aquatic Chemistry, Chapter 15: The Ocean as a Chemical System. Hoboken: Wiley-Blackwell.

Faure, G. and Mensing, T.M. (2005). Isotopes. Principles and applications. 3rd Ed. Hoboken: John Wiley and Sons.

Hoefs, J. (1997). Stable Isotope Geochemistry. Berlin: Springer-Verlag.

Ruddiman, W. F. (2013). Earth‘s Climate. Past and Future, 3rd edition. Stuttgart: W.H. Freeman.

Usability and Relationship to other Modules

- Pre-requisite for CO-463 and CA-S-EES-801.
- Mandatory elective for a major in EES
- Serves as a mandatory elective specialization module for 3rd year Chemistry major students.
- Elective for all other undergraduate study programs.
- This module builds on the EES CHOICE modules CH-130 and CH-131, but only CH-131 General Geoscience is a pre-requisite.

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 180 min
Weight: 100%

Scope: All indented learning outcomes of the module

7.6 Mineral, Metal and Water Resources

<table>
<tr><td colspan="2">Module Name
Mineral, Metal and Water Resources</td><td>Module Code
CO-463</td><td>Level (type)
Year 2 (CORE)
4th Semester</td><td>CP
7.5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>CO-463-A</td><td colspan="2">Economic Geology: Mineral Resources</td><td>Lecture + tutorials</td><td>2.5</td></tr>
<tr><td>CO-463-B</td><td colspan="2">Critical High-Technology Metals: Resources and Environmental Impact</td><td>Lecture + tutorials</td><td>2.5</td></tr>
<tr><td>CO-463-C</td><td colspan="2">FieldCamp: Geology, Resources and Water</td><td>Lecture + Fieldlab/excursion</td><td>2.5</td></tr>
<tr><td>Module Coordinator
Michael Bau, Andrea Koschinsky</td><td colspan="2">Program Affiliation
• Earth and Environmental Sciences (EES)</td><td colspan="2">Mandatory Status
Mandatory elective for EES</td></tr>
<tr><td colspan="2" rowspan="2">Entry Requirements
Pre-requisites
☒ General Geoscience
☒ Geochemistry of Igneous and Aqueous Systems

Co-requisites
☒ None

Knowledge, Abilities, or Skills
• None beyond formal pre-requisites</td><td>Frequency
Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching
• Lectures and Tutorials (40.0 hours)
• Off-Campus FieldCamp (57.5 hours)
• Homework + private study (90.0 hours)</td></tr>
<tr><td>Duration
1 semester</td><td colspan="2">Workload
187.5 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation
Please review the content of the EES CHOICE modules CH-130 and CH-131.</td></tr>
<tr><td colspan="5">Content and Educational Aims
This module provides an introduction to the field of mineral resources with special emphasis on resources of critical high-technology metals (e.g., rare earth elements, niobium, gallium, and lithium) and their environmental behavior and impacts, and on the appreciation of potable and mineral water as precious natural resources. The important different types of mineralization and ore deposits in the terrestrial as well as marine environment, their geological and mineralogical characteristics, and processes of formation, and their world-wide distribution, as well as the environmental impact of their mining and ore processing are addressed. Students are made familiar with the evolving topic of the resources and environmental behavior of critical high-technology metals. The module is complemented by a FieldLab/excursion during which students learn how to recognize specific geological environments and apply geological and geochemical field techniques, including those employed during geochemical exploration, and understand the relationship between geology and metal and freshwater resources.</td></tr>
<tr><td colspan="5">Intended Learning Outcomes
By the end of this module, students will be able to:
• recognize and characterize the major different types of mineral deposits and their genesis;
• relate specific mineral assemblages and geological structures with specific mineral deposits;</td></tr>
</table>

- appraise and apply the concept of "criticality" and evaluate the basic geology, biogeochemistry, resources and environmental impact of critical metals;
- apply geological and geochemical field methods to characterize geological settings and their potential mineralization and as exploration tools;
- critically assess the role of potable water and mineral water as a resource;
- appraise and critically assess the environmental and societal impact of the resource sector (including the role of water).

Indicative Literature

Robb, L. (2005). Introduction to Ore-Forming Processes. Hoboken: Blackwell.

Usability and Relationship to other Modules

- Pre-requisite for CA-S-EES-801.
- Mandatory elective for a major in EES.
- Elective for all other undergraduate study programs.
- This module is related to CH-130, CH-131, and CO-462.

Examination Type: Module Examination

Assessment Type: Written examination | Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of the module.

Module achievement: Accepted Field-Lab report is a prerequisite, ("Studienbegleitleistung") for being admitted to the exam.

7.7 Earth Data Science

Module Name	*Module Code*	*Level (type)*	*CP*
Earth Data Science	CO-464	Year 2 (CORE)	7.5

Module Components			
Number	*Name*	*Type*	*CP*
CO-464-A	Surface and Subsurface Systems: Data, Models, and Processes	Lecture	2.5
CO-464-B	Marine and Atmospheric Systems: Data, Models, and Processes	Lecture	2.5
CO-464-C	Introduction to Geographic Information Systems	Lecture	2.5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Vikram Unnithan, Joachim Vogt	• Earth and Environmental Sciences (EES)	Mandatory elective for EES

<table>
<tr><td colspan="3">Entry Requirements</td><td>Frequency
Annually (Spring)</td><td>Forms of Learning and Teaching
• Lectures (52.5 hours)
• Private study (135 hours)</td></tr>
<tr><td>Pre-requisites
☒ None</td><td>Co-requisites
☒ None</td><td>Knowledge, Abilities, or Skills
• Knowledge of Earth and Environmental Science, Geosciences and Geochemistry as taight in the Choice and Core modules</td><td>Duration
1 semester</td><td>Workload
187.5 hours</td></tr>
</table>

Recommendations for Preparation

Please review the content of the EES CHOICE modules CH-130 and CH-131.

Content and Educational Aims

A general introduction to datasets, models, and tools in Earth and Environmental Sciences (EES) is provided in this module. Students learn to find, access, and display EES data and models of different types and formats, and to perform basic processing and visualization operations. Relevant EES structures and processes reflected in the data and models are explained and discussed in an innovative learning environment that combines traditional classroom instruction with hands-on computer exercises and group work. Of importance are geographic information systems (GIS) that are fundamental to many EES disciplines.

Intended Learning Outcomes

By the end of this module, students will be able to

- access and display time series, maps, and images in Earth and Environmental Sciences (EES);
- select and use important empirical and numerical models in EES;
- explain the concepts of global positioning systems (GPS) and geographical information systems (GIS);
- apply GIS tools to visualize surface structures and processes;
- perform basic processing and analysis of EES datasets and models;
- discuss essential EES structures and processes reflected in datasets and models.

Indicative Literature

Mussett, A.E. (2000) Looking Into the Earth: An Introduction to Geological Geophysics, Cambridge: Cambridge University Press.

VanderPlas, J. (2016). A Whirlwind Tour of Python. Newton: O'Reilly.

VanderPlas, J. (2016). Python Data Science Handbook.Newton: O'Reilly.

Longley, P.A., Goodchild, M.F., Maguire,D.J., Rhind, D.W. (2005). Geographic Information Systems and Science, 2nd Edition. Hoboken: Wiley.

Lo, C.P., Yeung, A.K.W. (2002). Concepts and Techniques of Geographic Information Systems. New Jersey: Prentice Hall.

Usability and Relationship to other Modules

- Pre-requisite for CO-465 and CA-S-EES-803
- This module prepares and relates to CO-461 and CA-S-EES-801.
- Mandatory elective for a major in EES.
- Elective for all other undergraduate study programs.

Examination Type: Module Examination

Assessment Type:: Project examination (on-site data analysis) Duration: 180 minutes

Weight: 100%

Scope: All intented learning outcomes of the module

7.8 Geophysical Remote Sensing

Module Name	*Module Code*	*Level (type)*	*CP*
Geophysical Remote Sensing	CO-465	Year 2 (CORE)	7.5

Module Components

Number	*Name*	*Type*	*CP*
CO-465-A	Earth and Planetary Surfaces in Remote Sensing Data	Lecture	2.5
CO-465-B	Climate System Dynamics Observed from Space	Lecture	2.5
CO-465-C	Global Geophysical Fields and Models	Lecture	2.5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Joachim Vogt, Vikram Unnithan	• Earth and Environmental Sciences (EES)	Mandatory elective for EES

Entry Requirements

Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*
☒ Earth Data Science	☒ None	• None beyond formal pre-requisites

Frequency	*Forms of Learning and Teaching*
Annually (Fall)	• Lectures (52.5 hours) • Private study (135 hours)

Duration	*Workload*
1 semester	187.5 hours

Recommendations for Preparation

EES CORE modules CO-464 and CO-461.

Content and Educational Aims

Earth, environmental, and planetary systems are monitored routinely from space using scientific instrumentation on satellites. Of particular importance are remote-sensing instruments that observe e.g. surface structures, ocean dynamics, and atmospheric processes. Spacecraft measurements of various types and different formats are made accessible to the public for scientific analysis, interpretation, and modeling on repositories and archives hosted by ESA, NASA, and other space agencies. In this module students are introduced to space-borne observations of Earth and planetary system compartments and of global geophysical fields. Of relevance are surface processes, ocean and climate dynamics, and the Earth's gravity and magnetic fields. Analysis and modeling techniques for satellite data are also compared with classical geophysical remote-sensing of the subsurface using seismic measurements. We discuss opportunities and implications of special orbit geometries, remote-sensing principles and instrument types, data organization and structure, data-processing workflows including archival, retrieval, preprocessing, display and preparation for further analysis, as well as data interpretation in light of spatial structures, relevant processes, and important numerical models.

Intended Learning Outcomes

By the end of this module, students will be able to:

- distinguish and explain different measurement principles in remote-sensing and in-situ instrumentation;
- identify and select tools and data repositories to answer topical questions in the Earth sciences;
- access, process, and display satellite observations of the Earth's surface, ocean, and atmosphere;
- analyze and interpret satellite observations of the Earth's surface, ocean, and atmosphere;
- explain classical geophysical remote-sensing methods such as seismology;
- compare remote-sensing data and observations with the relevant numerical models;
- evaluate remote-sensing data and observations in light of key processes and structures.

Indicative Literature

Campbell, J. B. (2011). Introduction to Remote Sensing, 5th edition. New York: The Guilford Press.

Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote sensing and image interpretation. Hoboken: John Wiley & Sons.

Barrett, E. C., Curtis, L. F. (2013). Introduction to environmental remote sensing. Abingdon: Routledge.

Usability and Relationship to other Modules

- Pre-requisite for CA-S-EES-803.
- This module relates to CO-464, CO-461, CA-S-EES-801, and CA-S-EES-801.
- Mandatory elective for a major in EES.
- Elective for all other undergraduate study programs.

Examination Type: Module Examination

Assessment Type:: Term-paper

Length: 20 pages or 10000 words
Weight: 100%

Scope: All intented learning outcomes of the module

7.9 Advanced Earth and Environmental Sciences Field lab

Module Name Advanced Earth and Environmental Sciences Field lab			*Module Code* CA-S-EES-801	*Level (type)* Year 3 (Specialization)	*CP* 5
Module Components					
Number	*Name*			*Type*	*CP*
CA-EES-801	Advanced Earth and Environmental Sciences Field lab			Field Lab	5
Module Coordinator Michael Bau, Laurenz Thomsen	*Program Affiliation* • Earth and Environmental Science (EES)			*Mandatory Status* Mandatory elective for EES	
Entry Requirements *Pre-requisites* ☒ Both EES CHOICE modules, and two EES CORE modules	 *Co-requisites* ☒ None	*Knowledge, Abilities, or Skills* • None beyond formal pre-requisites	*Frequency* Annually (Spring)	*Forms of Learning and Teaching* • Field Lab (80 hours) • Private study (45 hours)	
			Duration 1 semester	*Workload* 125 hours	
Recommendations for Preparation • Review content of previous EES modules especially CO-465, CO-464, CA-S-EES-803, CO-462, CO-461, CH-131.					
Content and Educational Aims This module consists of an extended field laboratory with evening seminars and lectures on either (i) Resource and Environmental Geology and Geochemistry (IoR: Michael Bau) or (ii) Geophysics and Oceanography (IoR: Laurenz Thomsen, Vikram Unnithan) depending on student need and demand. In track (i), students will be made familiar with geological features at various scales and with techniques applied in geological and geochemical field work. It focuses on geological sequences that illustrate the chemical evolution of the Earth's lithosphere, oceans and atmosphere, water chemistry, and (depending on the region visited) the formation of metal deposits and their environmental impact. A six-day geological mapping project forms part of this track. Track (ii) focuses on Oceanography, Marine Resources and Environments, and Geophysics, and includes a field laboratory to a coastal research station with daily cruises on board a research boat where students will learn to handle oceanographic instrumentation (CTD, water sampling, magnetometer, current meter,and fluorometer), geophysical tools, characterize sediment and water samples, acquire and analyze data, create GIS maps, and interpret and present the data.					
Intended Learning Outcomes By the end of this module, students will be able to • review, research and discuss relevant literature on the field topic; • apply concepts, methods and analyses to real world problems including anthropogenic impact; • perform and actively contribute to geological and oceanographic field studies; • demonstrate the ability to work individually but also as part of a group in a field situation;					

- professionally communicate the results to experts and non-experts

Indicative Literature

R.R. Compton (2016). Geology in the Field. Earthspun Books.

Usability and Relationship to other Modules

- Applies the content of all EES modules, especially CO-465, CO-464, CA-S-EES-803, CO-462, CO-461, CH-131.
- Mandatory elective specialization module for 3rd year EES major students

Examination Type: Module Examination

Assessment Type:: Report   Length: 10 pages
Scope: All intended learning outcomes of the module.   Weight: 100%

Module achievement: Attendance of the field trip is a pre-requisites, ("Studienbegleitleistung") for submission of the report.

7.11 Global Change and Systems Thinking

<table>
<tr><td colspan="3">Module Name
Global Change and Systems Thinking</td><td>Module Code
CA-S-EES-802</td><td>Level (type)
Year 3
(Specialization)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>CA-EES-802</td><td colspan="3">Global Change and Systems Thinking</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Andrea Koschinsky, Joachim Vogt</td><td colspan="3">Program Affiliation

• Earth and Environmental Sciences (EES)</td><td colspan="2">Mandatory Status

Mandatory elective for EES</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ Both EES CHOICE modules, and two EES CORE modules
Co-requisites: ☒ None
Knowledge, Abilities, or Skills: • None beyond formal pre-requisites</td><td>Frequency

Annually
(Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures and Seminars (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload
125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Review all previous EES modules.</td></tr>
<tr><td colspan="6">Content and Educational Aims
Planet Earth is a system of interconnected compartments or spheres. Their complex interplay is influenced by external drivers such as solar radiation and by internal processes on a wide range of temporal and spatial scales. This course studies the temporal evolution of near-surface compartments, namely, the atmosphere, oceans, and pedosphere. Using key concepts from systems thinking such as positive and negative feedback loops, stability, complexity, emergence and resilience, we study global environmental changes of the Earth's climate and critical zones over geological timescales, e.g, the evolution of an oxic atmosphere and ocean, the onset of early life,the snowball Earth, and modern glaciation cycles. Furthermore, the course emphasizes 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 the possibilities of climate mitigation (geo-engineering) and the 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.</td></tr>
</table>

Intended Learning Outcomes

By the end of this module, students will be able to

- numerate and describe key concepts of systems thinking such as feedback loops, stability, complexity, emergence, and resilience;
- list and characterize the different compartments of system Earth and their interactions;
- explain the natural causes and consequences of climate change through Earth history, on biological processes, biodiversity, and extinction;
- describe anthropogenic activities on the climate and important climate mitigation strategies;
- discern and select climate models as tools to predict future climate change;
- contribute to discussions on the scientific consensus, the complexities, and uncertainties of climate science.

Indicative Literature

- Meadows, D.H. (2008). Thinking in Systems, White River: Chelsea Green Publishing.
- Ruddiman, W.F. (2013) Earth's Climate - Past and Future, 3rd edition. Stuttgart: WH Freeman.

Usability and Relationship to other Modules

- CAREER module of the EES program.
- This module makes use of the knowledge and skills acquired in module CO-460.
- Mandatory elective specialization module for third year EES major students
- Elective for all other undergraduate study programs.

Examination Type: Module Examination

Assessment Type: Oral assessment Duration: 40 min

Weight: 100%

Scope: All intended learning outcomes of the module

7.12 Modeling of Earth System Data

<table>
<tr><td colspan="3">Module Name
Modeling of Earth System Data</td><td>Module Code
CA-S-EES-803</td><td>Level (type)
Year 3
(Specialization)</td><td>CP
5.0</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>CA-EES-803</td><td colspan="3">Modeling of Earth System Data</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Joachim Vogt, Vikram Unnithan</td><td colspan="3">Program Affiliation

• Earth and Environmental Sciences (EES)</td><td colspan="2">Mandatory Status

Mandatory elective for EES</td></tr>
<tr><td rowspan="2">Entry Requirements

Pre-requisites

☒ Both EES CHOICE modules, and two EES CORE modules</td><td rowspan="2">

Co-requisites

☒ None</td><td rowspan="2">

Knowledge, Abilities, or Skills

• None beyond formal pre-requisites</td><td>Frequency

Annually
(Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Review all previous EES modules.</td></tr>
<tr><td colspan="6">Content and Educational Aims
In many Earth and Environmental Sciences (EES) disciplines, large sets of observations are regularly distilled into quantitative models, e.g., structural models emphasizing spatial dimensions, or dynamical models based on predictive principles in time. This module introduces students to the logic and methodological basis of data modeling in EES, typical workflows, limitations, and caveats. The topics are taught in an integrated classroom setting with introductory examples, hands-on exercises, and discussion of the underlying theory. After a review of essential statistics, we introduce basic concepts of inverse theory to first study linear parameter estimation problems, then discuss regularization aspects, and briefly touch on nonlinear estimation problems. The methods are applied to data sets in various formats ranging from time series and spatial profiles to maps and images. The module is concluded with a project phase and a report.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes
By the end of this module, students will be able to

• enumerate and describe models in Earth and Environmental Sciences (EES);
• differentiate and explain model categories in EES;
• discern and explain data modeling approaches in EES;
• select data modeling tools and apply them to observations in EES.</td></tr>
</table>

Indicative Literature

Gubbins, D. (2002). Time Series Analysis and Inverse Theory for Geophysicists. Cambridge: Cambridge University Press.

VanderPlas, J. (2016) Python Data Science Handbook. Newton: O'Reilly.

Usability and Relationship to other Modules

- CAREER module of the EES program.
- The module builds on the EES CORE modules CO-460 and CO-465.
- Mandatory elective specialization module for third year EES major students
- Elective for other undergraduate study programs

Examination Type: Module Examination

Assessment Type: Term-paper Length: 15 pages

Weight: 100%

Scope: All intended learning outcomes of the module

7.13 Current Topics in Earth and Environmental Sciences

Module Name	*Module Code*	*Level (type)*	*CP*
Current Topics in Earth and Environmental Sciences	CA-S-EES-804	Year 3 (Specialization)	5.0

Module Components

Number	*Name*	*Type*	*CP*
CA-EES-804	Current Topics in Earth and Environmental Sciences	Seminar	5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Vikram Unnithan, Laurenz Thomsen	• Earth and Environmental Sciences (EES)	Mandatory elective for EES

Entry Requirements

Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*
☒ Both EES CHOICE modules, and two EES CORE modules	☒ None	• None beyond formal pre-requisites

Frequency	*Forms of Learning and Teaching*
Annually (Fall)	• Lectures and seminars (35 hours) • Private study (90 hours)

Duration	*Workload*
1 semester	125 hours

Recommendations for Preparation

Review all previous EES modules.

Content and Educational Aims

In this module, topics currently (controversially) discussed in Earth and Environmental Sciences (EES) will be presented, discussed, and analyzed. The underlying scientific background will be explained to allow students to understand the controversy and/or importance and relevance of the debated issues for the EES community. The students will also be made familiar with important unsolved problems, key current issues, and researchers in the field, allowing them to better critically read, and evaluate high-impact scientific papers and presentations.

Intended Learning Outcomes

By the end of this module, students will be able to

- critically assess scientific literature on a wide range of topical research in Earth and Environmental Sciences (EES);
- familiarize themselves with current much-debated topics in selected EES disciplines and subject areas;
- summarize and describe topical research questions in selected EES disciplines and subject areas;
- synthesize a body of knowledge on a given EES subject;
- participate in scientific discussions on topical and possibly controversial EES subjects.

Indicative Literature

Not specified- topical literature, varies from year to year.

Usability and Relationship to other Modules

- CAREER module of the EES program, depending on the topic, it draws on knowledge and skills acquired in all prior modules.
- Mandatory elective specialization module for third year EES major students
- Elective for all other undergraduate study programs.

Examination Type: Module Examination

Assessment Type: Term-paper

Length: 20 pages
Weight: 100%

Scope: All intended learning outcomes of the module

7.14 Internship / Startup and Career Skills

Module Name		*Module Code*	*Level (type)*	*CP*
Internship / Startup and Career Skills		CA-INT-900	Year 3 (CAREER)	15
Module Components				
Number	*Name*		*Type*	*CP*
CA-INT-900-0	Internship		Internship	15
Module Coordinator Sinah Vogel & Dr. Tanja Woebs (CSC Organization); SPC / Faculty Startup Coordinator (Academic responsibility)	***Program Affiliation*** • CAREER module for undergraduate study programs		***Mandatory Status*** Mandatory for all undergraduate study programs except IEM	

Entry Requirements			*Frequency*	*Forms of Learning and Teaching*
Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	Annually (Spring/Fall)	• Internship/Start-up • Internship event • Seminars, info-sessions, workshops and career events • Self-study, readings, online tutorials
☒ at least 15 CP from CORE modules in the major	☒ None	• Information provided on CSC pages (see below) • Major specific knowledge and skills	***Duration*** 1 semester	***Workload*** 375 Hours consisting of: • Internship (308 hours) • Workshops (33 hours) • Internship Event (2 hours) • Self-study (32 hours)

Recommendations for Preparation

- Please see the section "Knowledge Center" at JobTeaser Career Center for information on Career Skills seminar and workshop offers and for online tutorials on the job market preparation and the application process. For more information, please see https://www.jacobs-university.de/employability/career-services
- Participating in the internship events of earlier classes

Content and Educational Aims

The aims of the internship module are reflection, application, orientation, and development: for students to reflect on their interests, knowledge, skills, their role in society, the relevance of their major subject to society, to apply these skills and this knowledge in real life whilst getting practical experience, to find a professional orientation, and to develop their personality and in their career. This module supports the programs' aims of preparing students for gainful, qualified employment and the development of their personality.

The full-time internship must be related to the students' major area of study and extends lasts a minimum of two consecutive months, normally scheduled just before the 5th semester, with the internship event and submission of the internship report in the 5th semester. Upon approval by the SPC and CSC, the internship may take place at other times, such as before teaching starts in the 3rd semester or after teaching finishes in the 6th semester. The Study Program Coordinator or their faculty delegate approves the intended internship a priori by reviewing the tasks in either the Internship Contract or Internship Confirmation from the respective internship institution or company. Further regulations as set out in the Policies for Bachelor Studies apply.

Students will be gradually prepared for the internship in semesters 1 to 4 through a series of mandatory information sessions, seminars, and career events.
The purpose of the Career Services Information Sessions is to provide all students with basic facts about the job market in general, and especially in Germany and the EU, and services provided by the Career Services Center.
In the Career Skills Seminars, students will learn how to engage in the internship/job search, how to create a competitive application (CV, Cover Letter, etc.), and how to successfully conduct themselves at job interviews and/or assessment centers. In addition to these mandatory sections, students can customize their skill set regarding application challenges and their intended career path in elective seminars.
Finally, during the Career Events organized by the Career Services Center (e.g. the annual Jacobs Career Fair and single employer events on and off campus), students will have the opportunity to apply their acquired job market skills in an actual internship/job search situation and to gain their desired internship in a high-quality environment and with excellent employers.

As an alternative to the full-time internship, students can apply for the StartUp Option. Following the same schedule as the full-time internship, the StartUp Option allows students who are particularly interested in founding their own company to focus on the development of their business plan over a period of two consecutive months. Participation in the StartUp Option depends on a successful presentation of the student's initial StartUp idea. This presentation will be held at the beginning of the 4th semester. A jury of faculty members will judge the student's potential to realize their idea and approve the participation of the students. The StartUp Option is supervised by the Faculty StartUp Coordinator. At the end of StartUp Option, students submit their business plan. Further regulations as outlined in the Policies for Bachelor Studies apply.

The concluding Internship Event will be conducted within each study program (or a cluster of related study programs) and will formally conclude the module by providing students the opportunity to present on their internships and reflect on the lessons learned within their major area of study. The purpose of this event is not only to self-reflect on the whole internship process, but also to create a professional network within the academic community, especially by entering the Alumni Network after graduation. It is recommended that all three classes (years) of the same major are present at this event to enable networking between older and younger students and to create an educational environment for younger students to observe the "lessons learned" from the diverse internships of their elder fellow students.

Intended Learning Outcomes

By the end of this module, students should be able to

- describe the scope and the functions of the employment market and personal career development;
- apply professional, personal, and career-related skills for the modern labor market, including self-organization, initiative and responsibility, communication, intercultural sensitivity, team and leadership skills, etc.;
- independently manage their own career orientation processes by identifying personal interests, selecting appropriate internship locations or start-up opportunities, conducting interviews, succeeding at pitches or assessment centers, negotiating related employment, managing their funding or support conditions (such as salary, contract, funding, supplies, work space, etc.);
- apply specialist skills and knowledge acquired during their studies to solve problems in a professional environment and reflect on their relevance in employment and society;
- justify professional decisions based on theoretical knowledge and academic methods;
- reflect on their professional conduct in the context of the expectations of and consequences for employers and their society;
- reflect on and set their own targets for the further development of their knowledge, skills, interests, and values;
- establish and expand their contacts with potential employers or business partners, and possibly other students and alumni, to build their own professional network to create employment opportunities in the future;
- discuss observations and reflections in a professional network.

Indicative Literature

Not specified

Usability and Relationship to other Modules

- Mandatory for a major in BCCB, CBT, CS, EES, GEM, IBA, IRPH, ISCP, Math, MCCB, Physics, RIS, and SMP.
- This module applies skills and knowledge acquired in previous modules to a professional environment and provides an opportunity to reflect on their relevance in employment and society. It may lead to thesis topics.

Examination Type: Module Examination

Assessment Type: Internship Report or Business Plan and Reflection	Length: approx. 3.500 words
Scope: All intended learning outcomes	Weight: 100%

7.15 Bachelor Thesis and Seminar

<table>
<tr><td colspan="3">Module Name

Bachelor Thesis and Seminar</td><td>Module Code

CA-EES-800</td><td>Level (type)

Year 3 (CAREER)</td><td>CP

15</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>CA-EES-800-T</td><td colspan="3">Thesis</td><td>Thesis</td><td>12</td></tr>
<tr><td>CA-EES-800-S</td><td colspan="3">Thesis Seminar</td><td>Seminar</td><td>3</td></tr>
<tr><td>Module Coordinator

Study Program Chair</td><td colspan="3">Program Affiliation

• All undergraduate programs</td><td colspan="2">Mandatory Status

Mandatory for all undergraduate programs</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ Students must be in the third year and have taken at least 30 CP from CORE modules of their major.

Co-requisites: ☒ None

Knowledge, Abilities, or Skills:
• Comprehensive knowledge of the subject and deeper insight into the chosen topic;
• ability to plan and undertake work independently;
• skills to identify and critically review literature.</td><td>Frequency

annually</td><td colspan="2">Forms of Learning and Teaching

• Self-study/lab work (350 hours)
• Seminars (25 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

375 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

• Identify an area or a topic of interest and discuss this with your prospective supervisor in good time.
• Create a research proposal including a research plan to ensure timely submission.
• Ensure you possess all required technical research skills or are able to acquire them on time.
• Review the University's Code of Academic Integrity and Guidelines to Ensure Good Academic Practice.</td></tr>
</table>

Content and Educational Aims

This module is a mandatory graduation requirement for all undergraduate students to demonstrate their ability to deal with a problem from their respective major subject independently by means of academic/scientific methods within a set period. Although supervised, the module requires students to be able to work independently and regularly and set their own goals in exchange for the opportunity to explore a topic that excites and interests them personally and which a faculty member is interested to supervise. Within this module, students apply their acquired knowledge about the major discipline, skills, and methods to conduct research, ranging from the identification of suitable (short-term) research projects, preparatory literature searches, the realization of discipline-specific research, and the documentation, discussion, interpretation and communication of the results.

This module consists of two components, an independent thesis and an accompanying seminar. The thesis component must be supervised by a Jacobs University faculty member and requires short-term research work, the results of which must be documented in a comprehensive written thesis including an introduction, a justification of the methods, results, a discussion of the results, and conclusions. The seminar provides students with the opportunity to present, discuss and justify their and other students' approaches, methods and results at various stages of their research to practice these skills to improve their academic writing, receive and reflect on formative feedback, thereby growing personally and professionally.

Intended Learning Outcomes

On completion of this module, students should be able to

1. independently plan and organize advanced learning processes;
2. design and implement appropriate research methods taking full account of the range of alternative techniques and approaches;
3. collect, assess and interpret relevant information;
4. draw scientifically founded conclusions that consider social, scientific and ethical insights;
5. apply their knowledge and understanding to a context of their choice;
6. develop, formulate and advance solutions to problems and arguments in their subject area, and defend these through argument;
7. discuss information, ideas, problems and solutions with specialists and non-specialists.

Usability and Relationship to other Modules

- This module builds on all previous modules of the program. Students apply the knowledge, skills and competencies they acquired and practiced during their studies, including research methods and the ability to acquire additional skills independently as and if required.

Examination Type: Module Component Examinations

Module Component 1: Thesis
Assessment Type:: Thesis
Scope: All intended learning outcomes, mainly 1-6.
Weight: 80%

Length: approx. 6.000 – 8.000 words (15 – 25 pages), excluding front and back matter.

Module Component 2: Seminar
Assessment Type:: Presentation

Duration: approx. 15 to 30 minutes
Weight: 20%

Scope: The presentation focuses mainly on ILOs 6 and 7, but by nature of these ILOs it also touches on the others.

Completion: To pass this module, both module component examinations have to be passed with at least 45%.

Two separate assessments are justified by the size of this module and the fact that the justification of solutions to problems and arguments (ILO 6) and discussion (ILO 7) should at least have verbal elements. The weights of the types of assessments are commensurate with the sizes of the respective module components.

7.16 Jacobs Track Modules

7.16.1 Methods and Skills Modules

7.16.1.1 Mathematical Concepts for the Sciences

Module Name			*Module Code*	*Level (type)*	*CP*
Mathematical Concepts for the Sciences			JTMS-MAT-07	Year 1 (Methods)	5
Module Components					
Number	*Name*			*Type*	*CP*
JTMS-07	Mathematical Concepts for the Sciences			Lecture	5
Module Coordinator(s) Marcel Oliver, Tobias Preußer	*Program Affiliation* • •Jacobs Track – Methods and Skills			*Mandatory Status* Mandatory for BCCB; CBT, EES and MCCB	
Entry Requirements *Pre-requisites* ☒ None	*Co-requisites* ☒ None	*Knowledge, Abilities, or Skills* • none	*Frequency* Annually (Fall)	*Forms of Learning and Teaching* • Lectures (35 hours) • Private study (90 hours)	
			Duration 1 semester	*Workload* 125 hours	
Recommendations for Preparation Review basic mathematical concepts and tools.					
Content and Educational Aims In this module, students develop and strengthen quantitative problem-solving skills that are important in the natural sciences. Hands-on exercises and group work are integrated in the lectures to maximize feedback between the students and the instructor. The module starts with a review of elementary mathematical concepts such as functions and their graphs, units and dimensions, and series and convergence. Vectors and matrices are introduced using linear equations, and then motivated further in the context of basic analytical geometry. An extended section on calculus proceeds from basic differentiation and integration to the solution of differential equations, always guided by applications in the natural sciences. The module is concluded by a data-oriented introduction to descriptive statistics and basic statistical modeling applied to laboratory measurements and observations of natural systems.					

Intended Learning Outcomes

By the end of this module, students will be able to

- identify important types of quantitative problems in the natural sciences;
- select and use key solution strategies, methods, and tools;
- explain and apply linear algebra concepts and techniques;
- analyze models and observations of natural systems using derivatives and integrals;
- classify differential equations, find equilibria, and apply standard solution methods;
- process data by means of descriptive statistics and basic regression techniques.

Indicative Literature

E. N. Bodine, S. Lenhart, and L. J. Gross (2014). Mathematics for the Life Sciences. Princeton: Princeton University Press.

D. Cherney, T. Denton, A. Waldron (2013, June). Linear Algebra. Retrieved from: https://www.math.ucdavis.edu/~linear/.

K.F. Riley, M.P. Hobson, and S.J. Bence (2002). Mathematical methods for physics and engineering, Cambridge: Cambridge University Press.

M. Corral. Vector Calculus (2008). Retrieved from: http://www.mecmath.net/calc3book.pdf.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Mandatory for a major in BCCB, CBT, EES, and MCCB
- Elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of this module.

7.16.1.2 Chemistry for Natural Scientists

Module Name		*Module Code*	*Level (type)*	*CP*
Chemistry for Natural Scientists		JTMS-SCI-15	Year 1 (Methods)	*5*

Module Components			
Number	*Name*	*Type*	*CP*
JTMS-15	Chemistry for Natural Scientists	Lecture	5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Andrea Koschinsky-Fritsche	• Jacobs Track – Methods and Skills	Mandatory for EES

Entry Requirements			*Frequency*	*Forms of Learning and Teaching*
Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	Annually (Spring)	• Lectures (17.5 hours) • Lab sessions (17.5 hours) • Private study (90 hours)
☒None	☒None	• none	*Duration*	*Workload*
			1 semester	125 hours

Recommendations for Preparation
None.

Content and Educational Aims
This module is comprised of general, inorganic and organic chemistry at an introductory level, with a focus on inorganic chemistry. The module objectives are to provde a basic understanding of the fundamental principles and theories of chemistry. This includes an introduction to matter, molecules, atomic theory, stoichiometry, intermolecular forces and solids, as well as chemical thermodynamics and kinetics, redox chemistry, electrochemistry and equilibrium chemistry. The organic chemistry component incorporates a systematic examination of the physical properties and reactivity of simple organic compounds. Subsequently, these theories and principles are applied to chemical concepts in natural systems. It will be demonstrated how chemical reactions and equilibria interact with changes in the environment. Furthermore, the module introduces compartments, components, and chemical processes including interactions with the biosphere in natural systems. The module also introduces students to basic safety requirements and techniques used in a chemistry laboratory as well as sampling methods of natural materials to be analyzed. The material covered in the lecture is reinforced in the laboratory practical sessions.

Intended Learning Outcomes

By the end of this module, students should be able to

- describe the basis of atomic theory and explain the structure of an atom, ions and electronic configuration;
- describe periodic trends for groups and periods;
- calculate molecules, molar mass, moles and molarity;
- identify the types of chemical reactions in natural systems;
- relate bonding and intermolecular forces to the structure of solids and molecules;
- apply the principles of pH, acids and bases as well as the action of buffers;
- balance chemical reactions;
- explain and calculate equilibrium constants for different types of reactions;
- name simple organic compounds and identify common functional groups;
- describe the chemical reactions and physical properties of hydrocarbons;

- apply their knowledge of common organic functional groups to predict simple reaction products.
- participate effectively in group work and problem solving through participation in lab practical sessions;
- work safely in the laboratory under supervision;
- carry out simple sample preparation techniques including grinding, weighing, drying, filtration, and performing dilutions;
- determine pH, redox potential and conductivity in water samples;
- analyze key components such as nutrients in natural water samples using photometry and other simple analytical tools;
- identify the aims of a laboratory experiment, record procedures and results accurately, interpret them, and draw conclusions;
- critically assess accuracy and errors in lab techniques.

Indicative Literature

Schwedt, The Essential Guide to Analytical Chemistry, Wiley, 1997.

Timberlake, Basic Chemistry, Global Edition , 5th edition, Pearson, 2016.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Mandatory for a major in EES.
- It is elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination Duration: 120 min
Weight: 100%

Scope: All indented learning outcomes of the module.

Module achievement: participation in the lab sessions is a prerequisite ("Studienbegleitleistung") for being admitted to the exam

7.16.1.3 Physics for the Natural Sciences

Module Name	*Module Code*	*Level (type)*	*CP*
Physics for the Natural Sciences	JTMS-SCI-17	Year 1 (Methods)	*5*

Module Components

Number	*Name*	*Type*	*CP*
JTMS-17	Physics for the Natural Sciences	Lecture	5.0

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Jürgen Fritz	• Jacobs Track – Methods and Skills	Mandatory for BCCB, CBT, EES and MCCB

Entry Requirements

Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*
☒ None	☒ None	• High school math • Basic high school physics

Frequency	*Forms of Learning and Teaching*
Annually (Spring)	• Lecture (35 hours) • Private study including homework (90 hours)

Duration	*Workload*
1 semester	125 hours

Recommendations for Preparation

Review high school math (especially calculus, geometry and vector analysis) and high school physics (basics of motion, forces and energy). Level and content follows the along standard textbooks for calculus-based first year general university physics, such as Young & Freedman: University Physics; Halliday, Resnick & Walker: Fundamentals of Physics; or others.

Content and Educational Aims

Physics is the most fundamental of all natural sciences and serves as a basis for other sciences and engineering disciplines. This module introduces non-physics majors to the basic principles, facts, and experimental evidence from physics, as it is needed especially for the life sciences, geosciences, and chemistry.
Emphasis is placed on general principles and general mathematical concepts for a basic understanding of physical phenomena. Basic mathematics (geometry, calculus, vector analysis) is used to develop a quantitative and scientific description of physical phenomena. A voluntary tutorial is offered to discuss homework or topics of interest in more detail.
The lecture provides an overview of the basic fields of physics such as mechanics (motion, force, energy, momentum, oscillations, fluid mechanics), thermodynamics (temperature, heat, 1st law, ideal gas and kinetic gas theory, thermodynamic processes, entropy), electromagnetism (charge, electric field, potential, current, magnetic field, induction), optics (oscillations, waves, sound, reflection and refraction, lenses and optical instruments, interference and diffraction), and modern physics (particle-wave duality, atoms and electrons, absorption and emission, spin, NMR, ionizing radiation, radioactivity).

Intended Learning Outcomes

By the end of the module, students will be able to:

- recall the basic facts and experimental evidence in mechanics, thermodynamics, electromagnetism, optics and modern physics;
- use the basic concepts of motion, force, energy, oscillations, heat, and light to describe natural and technical phenomena;
- apply basic problem-solving strategies from physics to test the plausibility of ideas or arguments, such as reducing different natural phenomena to their underlying physical principles, or using analogies, approximations, estimates or extreme cases;

- apply basic calculus, geometry, and vector analysis for a quantitative description of physical systems.

Indicative Literature

Young & Freedman, University Physics, with Modern Physics, Pearsson, latest edition.

Halliday, Resnick, Walker, Fundamentals of Physics, Extended Version, Wiley, latest edition.

Zinke-Allmang et al., Physics for the Life Sciences, Nelson Education, latest edition.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Mandatory for a major in BCCB, CHEM, EES, and MCCB.
- Elective for all other study programs except physics majors.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of the module.

7.16.1.4 Qualitative Research Methods

<table>
<tr><td colspan="2">Module Name
Qualitative Research Methods</td><td>Module Code
JTMS-MET-04</td><td>Level (type)
Year 2 (Methods)</td><td>CP
5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTMS-04</td><td colspan="2">Qualitative Research Methods</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Margrit Schreier</td><td colspan="2">Program Affiliation

• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status

Mandatory for GEM, IBA, IRPH, ISCP, SMP
Mandatory elective for EES</td></tr>
<tr><td colspan="2" rowspan="2">Entry Requirements

Pre-requisites

☒ None

Co-requisites

☒ None

Knowledge, Abilities, or Skills

• none</td><td>Frequency

Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching

• In-class contact time (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation

Patton, Michael Quinn (2015). Qualitative evaluation and research methods (4th ed.). Thousand Oaks etc.: Sage, chapter 2</td></tr>
<tr><td colspan="5">Content and Educational Aims
Qualitative researchers explore the structure of everyday life and the meaning that events, other persons and their actions hold for us. To do so, they take an in-depth look at a few selected cases, such as organizations, campaigns, or people. We will look at the rationale and constructivist and interpretivist principles underlying qualitative research and from there move on to specific designs (such as grounded theory or ethnography), design principles (such as purposive strategies for selecting cases), and research methods. The focus of the module will be on learning about and trying out methods for collecting and analyzing qualitative data. Among methods for collecting qualitative data, relevant topics include semi-structured and narrative interviews, focus groups, observation, working with documents and with visual elements. Methods for analyzing qualitative data include, for example, coding, qualitative content analysis, discourse analysis, visual analysis, semiotics or iconography.
The module has a strong hands-on component. It is held in part as a seminar and in part as a lab where students apply the methods to data from their own fields of study. During the lab sessions, students are required to participate in and report on activities involving the application and testing of selected methods. For assessment and grading, students will carry out their own small research project, in which they bring to bear different methods to a topic of their choice.</td></tr>
<tr><td colspan="5">Intended Learning Outcomes
By the end of this module, students should be able to:

• explain the principles underlying qualitative research;
• apply basic qualitative approaches and designs;
• identify and address ethical issues arising in qualitative research;
• apply strategies for purposefully selecting participants and cases;
• apply methods for collecting qualitative data;
• apply methods for analyzing qualitative data;
• know what to look for in evaluating qualitative research.</td></tr>
<tr><td colspan="5">Indicative Literature</td></tr>
</table>

Dresing, T., Pehl, T., & Schmieder, C. (2015). Manual (on) transcription. Transcription conventions, software guides, and practical hints for qualitative researchers. 3rd English edition. Marburg. Available under: http://www.audiotranskription.de/english/transcription-practicalguide.htm
Flick, U. (2018) (ed.). The SAGE handbook of qualitative data collection. Los Angeles, CA: Sage.
Flick, U. (2019). Introduction to qualitative research. 6th edition. London etc.: Sage.
Patton, M.Q. (2015). Qualitative evaluation and research methods. 4th edition. Thousand Oaks etc.: Sage.
Rose, G. (2016). Visual methodologies. 4th edition. London: Sage.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Complements Method and Skills module Data Collection and Empirical Research Methodologies.
- This module prepares students for the GEM and IBA 2nd year module on organization and HRM as well as Marketing, the GEM 3rd year module on public and nonprofit management, the IBA 3rd year module on Contemporary Topics in Marketing, and the thesis.
- Mandatory for a major in GEM, IBA IRPH, ISCP, SMP.
- Mandatory elective for a major in EES.
- Elective for all other study programs.

Examination Type: Module Examination

Assessment type: Research project (including abstract, ethics statement, and lab report on methods implementation, findings, and evaluation) Length: 5.000 words (for groups of three students)

Weight: 100%

Scope: All intended learning outcomes of the module.

7.16.1.5 Applied Calculus

Module Name		*Module Code*	*Level (type)*	*CP*
Applied Calculus		JTMS-MAT-08	Year 1 (Methods)	5
Module Components				
Number	*Name*		*Type*	
JTMS-08	Applied Calculus		Lecture	5
Module Coordinator Marcel Oliver, Tobias Preußer	*Program Affiliation* • Jacobs Track – Methods and Skills		*Mandatory Status* Mandatory for GEM, IBA and IEM Mandatory elective for EES	
Entry Requirements *Pre-requisites* ☒ None	*Co-requisites* ☒ None *Knowledge, Abilities, or Skills* • Knowledge of Mathematics at high school level (Functions, graphs of functions, linear and polynomial functions, logarithms and exponential function, basic trigonometric functions, elementary methods for solving systems of linear and nonlinear equations) • Some familiarity with elementary calculus (limits, derivatives) is helpful, but not required.	*Frequency* Annually (Fall) *Duration* 1 semester	*Forms of Learning and Teaching* • Lectures (35 hours) • Private study (90 hours) *Workload* 125 hours	
Recommendations for Preparation None.				

Content and Educational Aims

This module is an introduction to Calculus for students in life sciences, applied engineering, humanities and social science majors. It gives a broad overview of the methods of Calculus, putting more emphasis on applications, rather than on mathematical rigor. Most of the concepts and methods are backed up by examples from chemistry, biology, economics and/or other sciences. In this module students enhance both their quantitative problem-solving skills as well as their conceptual understanding of mathematical methods.

The lecture comprises the following topics:

- Brief review of elementary functions and their graphs
- Intuitive understanding of limits; horizontal and vertical asymptotes
- Derivatives and their computation

- Applications of derivatives (interpretation of derivatives, their units, local linear approximation, error propagation, optimization problems)
- Brief introduction to functions of several variables, partial derivatives, local minima and maxima
- Integrals and their computation
- Applications of integrals (accumulated change, average value, applications in probability: density functions and cumulative distribution functions)
- Brief introduction to differential equations.

Intended Learning Outcomes

By the end of the module, students will be able to

- apply the fundamental concepts of Calculus in structured situations;
- command the methods described in the content section of this module description to the extent that they can solve standard text-book problems reliably and with confidence;
- explain importance of the methods of Calculus in problems arising from applications;
- understand the methods of Calculus, used in other modules, as well as in scientific literature.

Indicative Literature

D. Hughes-Hallett, A. Gleason, P. Lock, D. Flath, et al. (2010/2013). Applied Calculus, 4th or 5th edition. Hoboken: Wiley.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- The module serves as preparation for the 2nd year IEM CORE module Operations Research.
- This serves as preparation for the 1st year GEM and IBA modules Microeconomics, Macroeconomics and Introduction to Finance and Accounting
- A mathematically rigorous treatment of Calculus is provided in the module “Analysis I”.
- The first year modules *Calculus and Elements of Linear Algebra I+II* can be used in place of the modules *Applied Calculus* and *Finite Mathematics*, respectively, to satisfy the graduation requirements in majors in which they are mandatory.
- Mandatory for GEM, IBA and IEM.
- Mandatory elective for EES.
- Elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination — Duration: 120 min, Weight: 100%

Scope: All intended learning outcomes of this module

7.16.1.6 Calculus and Elements of Linear Algebra I

<table>
<tr><td colspan="3">Module Name
Calculus and Elements of Linear Algebra I</td><td>Module Code
JTMS-MAT-09</td><td>Level (type)
Year 1 (Methods)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTMS-09</td><td colspan="3">Calculus and Elements of Linear Algebra I</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Marcel Oliver, Tobias Preußer</td><td colspan="3">Program Affiliation

• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status

Mandatory for CS, ECE, RIS, MATH and Physics
Mandatory elective for EES</td></tr>
<tr><td rowspan="2">Entry Requirements

Pre-requisites

☒ None</td><td rowspan="2">Co-requisites

☒ None</td><td rowspan="2">Knowledge, Abilities, or Skills

• Knowledge of Pre-Calculus at High School level (Functions, inverse functions, sets, real numbers, polynomials, rational functions, trigonometric functions, logarithm and exponential function, parametric equations, tangent lines, graphs, elementary methods for solving systems of linear and nonlinear equations)
• Knowledge of Analytic Geometry at High School level (vectors, lines, planes, reflection, rotation, translation, dot product, cross product, normal vector, polar coordinates)
• Some familiarity with elementary Calculus (limits, derivative) is helpful, but not strictly required.</td><td>Frequency

Annually
(Fall)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Review all of higher-level High School Mathematics, in particular the topics explicitly named in “Entry Requirements – Knowledge, Ability, or Skills” above.</td></tr>
<tr><td colspan="6">Content and Educational Aims
This module is the first in a sequence introducing mathematical methods at the university level in a form relevant for study and research in the quantitative natural sciences, engineering, Computer Science, and Mathematics. The emphasis in these modules is on training operational skills and recognizing mathematical structures in a problem context. Mathematical rigor is used where appropriate. However, a full axiomatic treatment of the subject is provided in the first-year modules “Analysis I” and “Linear Algebra”.

The lecture comprises the following topics
• Brief review of number systems, elementary functions, and their graphs</td></tr>
</table>

- Brief introduction to complex numbers
- Limits for sequences and functions
- Continuity
- Derivatives
- Curve sketching and applications (isoperimetric problems, optimization, error propagation)
- Introduction to Integration and the Fundamental Theorem of Calculus
- Review of elementary analytic geometry
- Vector spaces, linear independence, bases, coordinates
- Matrices and matrix algebra
- Solving linear systems by Gauss elimination, structure of general solution
- Matrix inverse

Intended Learning Outcomes

By the end of the module, students will be able to

- apply the methods described in the content section of this module description to the extent that they can solve standard text-book problems reliably and with confidence;
- recognize the mathematical structures in an unfamiliar context and translate them into a mathematical problem statement;
- recognize common mathematical terminology used in textbooks and research papers in the quantitative sciences, engineering, and mathematics to the extent that they fall into the content categories covered in this module.

Indicative Literature

S.I. Grossman (2014). Calculus of one variable, 2nd edition. Cambridge: Academic Press.
S.A. Leduc (2003). Linear Algebra. Hoboken: Wiley.
K. Riley, M. Hobson, S. Bence (2006). Mathematical Methods for Physics and Engineering, third edition. Cambridge: Cambridge University Press.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- The module is followed by “Calculus and Elements of Linear Algebra II”. All students taking this module are expected to register for the follow-up module.
- A rigorous treatment of Calculus is provided in the module “Analysis I”. All students taking “Analysis I” are expected to either take this module or exceptionally satisfy the conditions for advanced placement as laid out in the Jacobs Academic Policies for Undergraduate Study.
- The second-semester module “Linear Algebra” will provide a complete proof-driven development of the theory of Linear Algebra. Students enrolling in “Linear Algebra” are expected to have taken this module; in particular, the module “Linear Algebra” will assume that students are proficient in the operational aspects of Gauss elimination, matrix inversion, and their elementary applications.
- This module is a prerequisite for the module “Applied Mathematics” which develops more advanced theoretical and practical mathematical tools essential for any physicist or mathematician.
- Mandatory for a major in CS, ECE, RIS, MATH and Physics
- Mandatory elective for a major in EES.
- Pre-requisite for Calculus and Elements of Linear Algebra II
- Elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of this module

7.16.1.7 Plant Metabolism and Natural Products

<table>
<tr><td colspan="3">Module Name
Plant Metabolism and Natural Products</td><td>Module Code
JTMS-SCI-18</td><td>Level (type)
Year 2
(Methods)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTMS-18</td><td colspan="3">Plant Metabolism and Natural Products</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Matthias Ullrich</td><td colspan="3">Program Affiliation

• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status

Mandatory for BCCB, MCCB and CBT
Mandatory elective for EES</td></tr>
<tr><td rowspan="2" colspan="3">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• Comprehensive high school knowledge of chemistry, mathematics, physics, biochemistry, and cell biology</td><td>Frequency

Annually
(Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lecture (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Students should have a sound background knowledge in chemistry, mathematics, physics, biochemistry and cell biology.

Read the chapter “Plant Form and Function” (Joanne Chory) in the recommended textbook of Neil A. Campbell and Jane B. Reece, BIOLOGY, Benjamin Cummings, Pearson Education, current edition.</td></tr>
<tr><td colspan="6">Content and Educational Aims
Understanding general principles of biochemical processes in living cells requires a rigorous and robust knowledge of nature’s ways and capacities to form and use primary and secondary metabolites from inorganic materials via the autotrophic (producer) mode of algae and plants. This module introduces methods to assess and understand the breath-taking diversity of plant biochemical and cellular processes, plant metabolism, as well as plant-borne substances including their purposes and functions. An array of compounds produced by plants that are relevant to human health and nutrition will be introduced. This is done by demonstrating natural functions of biomolecules in plant metabolism or during regulation of biochemical processes. Methods to asses and quantify photosynthesis and the Calvin cycle will be introduced, as will be those needed to understand the phytohormone-based language of plants. State-of-the-art methods on how to analyze the fascinating types of interactions with other organisms is explained. Plant genetic engineering is introduced, and its methodology are explained in detail. Modern aspects of agriculture, food production, and the application of natural products in medicine will complete this methods survey of plant metabolism and natural products.</td></tr>
</table>

Intended Learning Outcomes

By the end of this module, students will be able to

- apply knowledge of biochemical and cellular processes to understand principles in the world of plants and algae;
- illustrate a plant's basic metabolic and biochemical features of plants;
- describe plant cells and plant tissue characteristics;
- explain how photosynthesis and the Calvin cycle enable autotrophic life;
- delineate how plants interact with their biotic and abiotic environment;
- explain the basic principles of Environmental Biochemistry;
- classify plant hormones, their roles, and the importance of their homeostasis;
- interpret the bioactivity potential of natural products;
- outline processes in plant biochemistry and plant genetics;
- describe natural product biosynthesis;
- illustrate how plants use basic building blocks to create complex structures;
- relate biological activities of natural products with their use for medicinal purposes;
- transfer the acquired knowledge to novel natural products;
- explain the importance of functional groups in natural products for bioactivity.

Indicative Literature

Urry et. al., Campell Biology, Pearson, latest edition.

Buchanan, Biochemistry and Molecular Biology of Plants, Wiley, latest edition.

Madigan et.al., Brock Biology of Microorganisms, latest edition.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- This Methods module is mandatory for BCCB, MCCB, and CBT major students.
- Mandatory elective for a major in EES.
- It complements the non-photosynthesis learning components of BCCB's general education. It furthermore provides essential background knowledge for medicinal chemistry, chemical biology, chemistry, and biotechnology.
- For CBT major students: the module can be replaced with a CORE module from another study program to pursue a minor.
- It is elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of the module.

7.16.1.8 Probability and Random Processes

<table>
<tr><td colspan="3">Module Name
Probability and Random Processes</td><td>Module Code
JTMS-MAT-12</td><td>Level (type)
Year 2
(Methods)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTMS-12</td><td colspan="3">Probability and random processes</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Marcel Oliver, Tobias Preußer</td><td colspan="3">Program Affiliation

• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status

Mandatory for CS, ECE, MATH, Physics, RIS
Mandatory elective for EES</td></tr>
<tr><td rowspan="2">Entry Requirements

Pre-requisites

☒ Calculus and Elements of Linear Algebra I & II</td><td rowspan="2">

Co-requisites

None</td><td rowspan="2">

Knowledge, Abilities, or Skills

• Knowledge of calculus at the level of a first year calculus module (differentiation, integration with one and several variables, trigonometric functions, logarithms and exponential functions).
• Knowledge of linear algebra at the level of a first year university module (eigenvalues and eigenvectors, diagonalization of matrices).
• Some familiarity with elementary probability theory at the high school level.</td><td>Frequency

Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Review all of the first year calculus and linear algebra modules as indicated in “Entry Requirements – Knowledge, Ability, or Skills” above.</td></tr>
<tr><td colspan="6">Content and Educational Aims

This module aims to provide a basic knowledge of probability theory and random processes suitable for students in engineering, Computer Science, and Mathematics. The module provides students with basic skills needed for formulating real-world problems dealing with randomness and probability in mathematical language, and methods for applying a toolkit to solve these problems. Mathematical rigor is used where appropriate. A more advanced treatment of the subject is deferred to the third-year module Stochastic Processes.

The lecture comprises the following topics
• Brief review of number systems, elementary functions, and their graphs
• Outcomes, events and sample space.
• Combinatorial probability.
• Conditional probability and Bayes’ formula.
• Binomials and Poisson-Approximation
• Random Variables, distribution and density functions.
• Independence of random variables.
• Conditional Distributions and Densities.</td></tr>
</table>

- Transformation of random variables.
- Joint distribution of random variables and their transformations.
- Expected Values and Moments, Covariance.
- High dimensional probability: Chebyshev and Chernoff bounds.
- Moment-Generating Functions and Characteristic Functions,
- The Central limit theorem.
- Random Vectors and Moments, Covariance matrix, Decorrelation.
- Multivariate normal distribution.
- Markov chains, stationary distributions.

Intended Learning Outcomes

By the end of the module, students will be able to

- command the methods described in the content section of this module description to the extent that they can solve standard text-book problems reliably and with confidence;
- recognize the probabilistic structures in an unfamiliar context and translate them into a mathematical problem statement;
- recognize common mathematical terminology used in textbooks and research papers in the quantitative sciences, engineering, and mathematics to the extent that they fall into the content categories covered in this module.

Indicative Literature

J. Hwang and J.K. Blitzstein (2019). Introduction to Probability, second edition. London: Chapman & Hall.

S. Ghahramani. Fundamentals of Probability with Stochastic Processes, fourth edition. Upper Saddle River: Prentice Hall.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students taking this module are expected to be familiar with basic tools from calculus and linear algebra.
- Mandatory for a major in CS, ECE, MATH, Physics and RIS.
- Mandatory elective for a major in EES (if pre-requisites are met).
- Elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min
Weight: 100%

Scope: All intended learning outcomes of this module

7.16.1.9 Programming in Python

<table>
<tr><td colspan="2">Module Name
Programming in Python</td><td>Module Code
JTMS-SKI-14</td><td>Level (type)
Year 1 (Methods)</td><td>CP
5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTMS-14</td><td colspan="2">Programming in Python</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Kinga Lipskoch</td><td colspan="2">Program Affiliation

• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status

Mandatory for IEM
Mandatory elective for EES and Physics</td></tr>
<tr><td colspan="2" rowspan="2">Entry Requirements

Pre-requisites
☒ None

Co-requisites
☒ None

Knowledge, Abilities, or Skills
• none</td><td>Frequency

Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching

• Class attendance (35 hours)
• Private study (85 hours)
• Exam preparation (5 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation

It is recommended that students install a suitable programming environment (simple editor or Integrated Development Environment) and a new stable version of Python on their notebooks.</td></tr>
<tr><td colspan="5">Content and Educational Aims
This module offers an introduction to programming using the programming language Python. The module presents the basics of Python programming and provides a short overview of the program development cycle. It covers fundamental programming components and constructs in a hands-on manner. The beginning of the module covers the concepts of data types, variables, operators, strings and basic data structures. Next, other programming constructs such as branching, iterations, and data structures such as strings, lists, tuples, and dictionaries are introduced. The module also gives an introduction to functions, as well as simple file handling by introducing reading data from files, processing the data and writing the results to files. Later, object-oriented programming concepts such as constructors, methods, overloaded operators and inheritance are presented. Retrieving data from URLs and processing of larger amounts of data and their queries and storage in files are addressed. Simple interactive graphics and operations are also presented with the help of an object-oriented graphics library.</td></tr>
<tr><td colspan="5">Intended Learning Outcomes
By the end of this module, students should be able to
• explain basic concepts of imperative programming languages such as variables, assignments, loops, function calls, data structures;
• work with user input from the keyboard, and write interactive Python programs;
• write, test, and debug programs;
• illustrate basic object-oriented programming concepts such as objects, classes, information hiding, and inheritance;
• give original examples of function and operator overloading;
• retrieve data and process and generate data from/to files;
• use some available Python modules and libraries such as those related to data or graphics.</td></tr>
</table>

Indicative Literature

Kenneth A. Lambert (2014). Fundamentals of Python Data Structures. Boston: Cengage Learning PTR.

Mark Summerfield (2010). Programming in Python: A complete introduction to the Python language, second edition. London: Pearson Education.

John Zelle (2009). Python Programming: An introduction to Computer Science, second edition. Portland: Franklin, Beedle & Associates.

Igor Milovanovic (2013). Python Data Visualization Cookbook. Birmingham: Packt Publishing.

Cay Horsmann, Rance D. Necaise (2014). Python for Everyone. Hoboken: Wiley.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Mandatory for a major in IEM.
- Mandatory elective for a major in EES and Physics.
- Elective for all other study programs.

Examination Type: Module Examination

Assessment type: Written examination

Duration 120 min
Weight: 100%

Scope: All intended learning outcomes of the module
Module achievements: 50% of the assignments passed

7.16.1.10 Analytical Methods

Module Name Analytical Methods		*Module Code* JTMS-SCI-16	*Level (type)* Year 2 (Methods)	*CP* 5
Module Components				
Number	*Name*		*Type*	*CP*
JTMS-16	Analytical Methods		Lecture	5
Module Coordinator Nikolai Kuhnert	***Program Affiliation*** • Jacobs Track – Methods and Skills		***Mandatory Status*** Mandatory for MCCB and CBT Mandatory elective for BCCB and EES	
Entry Requirements *Pre-requisites* ☒ None	*Co-requisites* ☒ None	*Knowledge, Abilities, or Skills* • Basic knowledge in Life Sciences	***Frequency*** Annually (Fall)	***Forms of Learning and Teaching*** • Lecture (35 hours) • Tutorial (10 hours) • Private study (80 hours)
			Duration 1 semester	***Workload*** 125 hours

Recommendations for Preparation

Students should have a sound background knowledge in general chemistry and MCCB as well as organic chemistry acquired by attending the respective CHOICE courses. They should have understood the basic principles of chemical bonding and chemical structures as well as the basic concepts of quantification and experimental measurement.

Content and Educational Aims

Analytical science is an important applied area of all chemical and life sciences. Analytical science deals with the separation, identification, and quantification of any chemical compound. It therefore provides an interface between the traditional areas of organic, inorganic, and physical chemistry with life sciences and all other areas of science requiring the identification and quantification of chemical compounds. It provides the methods and toolbox for all experimental sciences. Analytical chemistry provides the tools for all areas of experimental chemistry and a good foundation of analytical techniques is not only expected of any chemist but also for scientists at the interface to the life sciences. The course will give an introduction to analytical chemistry with selected applications. This will include an introduction to analytical terms and definitions, basic statistic treatment of experimental data, qualitative and quantitative analysis and instrumental analysis with an emphasis on spectroscopic techniques such as UV/Vis, NMR, mass spectrometry, IR and Raman spectroscopy, and fluorimetry. Furthermore, separation techniques such as HPLC and GC will be introduced. A series of lectures covering application in drug analysis, clinical chemistry, forensics, and toxicology will complement the course.

Intended Learning Outcomes

By the end of this module, students will be able to

- illustrate knowledge of instrumental methods including spectroscopic techniques and separation techniques;
- explain and understand physical principles behind spectroscopic techniques and separation techniques and apply them to practically-orientated issues;
- apply knowledge of instrumental techniques to solve qualitative and quantitative analytical problems;
- interpret spectroscopic data and deduce chemical structures from these data;
- compare spectroscopic data and predict spectral properties from chemical structures;
- calculate quantitative values from analytical results;

- plan analytical experiments to solve chemical problems;
- calculate and estimate errors in analytical procedures by applying statistical methods;
- test scientific hypotheses;
- prepare scientific reports and critical analysis on experimental findings of analytical results.

Indicative Literature

Clayden, Greeves, Warren, Organic Chemistry, 2nd Edition, 2012 (ISBN 978-0-19-927029-3).

P.W. Atkins, Physical Chemistry 9th edition, 2006 (ISBN 9780198700722).

R. Kellner, J. Mermet, M. Otto, M. Valcarel, M. Widmer, Analytical Chemistry: A Modern Approach to Analytical Science, 2nd ed., 2004(ISBN: 978-3-527-30590-2).

Usability and Relationship to other Modules

- It complements the Analytical Chemistry laboratory course and provides the experimental tool box for all fields of chemistry and the associated life sciences.
- Mandatory for a major in CBT and MCCB.
- Mandatory elective for a major in BCCB and EES.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 180 min
Weight: 100%

Scope: All intended learning outcomes of the module

7.16.2 Big Questions Modules

7.16.2.1 Water: The Most Precious Substance on Earth

<table>
<tr><td colspan="3">Module Name
Water: The Most Precious Substance on Earth</td><td>Module Code
JTBQ-BQ-002</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-002</td><td colspan="3">Water: The Most Precious Substance on Earth</td><td>Lecture/Tutorial</td><td>5</td></tr>
<tr><td>Module Coordinator

Prof. Dr. Michael Bau and Dr. Doris Mosbach</td><td colspan="3">Program Affiliation

• Big Questions Area: All undergraduate study programs except IEM</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking, and a proficient handling of data sources</td><td>Frequency

Annually (part I: Fall; part II: Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (17.5 hours)
• Project work (90 hours)
• Private study (17.5 hours)</td></tr>
<tr><td>Duration

2 semesters</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Critically following media coverage on the module’s topics in question.</td></tr>
</table>

Content and Educational Aims

All "Big Questions" (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students' horizons with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.
Water is the basic prerequisite for life on our planet, but it has become a scarce resource and a valuable commodity. Water is of fundamental importance to the world's economy and global food supply, in addition to being a driving force behind geopolitical conflict. In this module, the profound impact of water on all aspects of human life will be addressed from very different perspectives: from the natural and environmental sciences and engineering, and from the social and cultural sciences.
Following topical lectures in the Fall semester, students will work on projects on the occasion of the World Water Day (March 22) in small teams comprised of students from various disciplines and with different cultural backgrounds. This teamwork will be accompanied by related tutorials.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, students will be able to

- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- advance a knowledge-based opinion on the complex module topics: on the physio-chemical properties of water, its origin and history, on the importance of water as a resource, on physical and economic freshwater scarcity, on the risks of water pollution and the challenges faced by waste water treatment, on the concept of virtual water, on the bottled water industry, and on the cultural values and meanings of water;
- formulate coherent written and oral contributions (e.g., to panel discussions) on the topic;
- perform well-organized teamwork;
- present a self-designed project in a university-wide context.

Indicative Literature

Finney, John (2015). Water. A Very Short Introduction. Oxford: Oxford University Press.

Zetland, David (2011). The End of Abundance: Economic Solutions to Water Scarcity. California: Aguanomics Press.

United Nation (January 2016): Sustainable Development Goals. Retrieved from https://www.ipcc.ch

Usability and Relationship to other Modules

- This module is a mandatory elective module in the Big Questions area, which is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Component 1: Written examination — Duration: 60 min, Weight: 50%

Assessment Component 2: Team project — Weight: 50%

Scope: All intended learning outcomes of the module

Completion: This module is passed with an assessment-component weighted average grade of 45% or higher.

7.16.2.2 Ethics in Science and Technology

<table>
<tr><td colspan="3">Module Name
Ethics in Science and Technology</td><td>Module Code
JTBQ-BQ-003</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-003</td><td colspan="3">Ethics in Science and Technology</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Prof. Dr. Alexander Lerchl</td><td colspan="3">Program Affiliation

• Big Questions Area: All undergraduate study programs, except IEM</td><td colspan="2">Mandatory Status

Mandatory for CBT
Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking, and a proficient handling of data sources</td><td>Frequency

Each semester (Fall & Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (35 hours)
• Private study (90 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Critically following media coverage of the scientific topics in question.</td></tr>
<tr><td colspan="6">Content and Educational Aims

All “Big Questions” (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students’ horizons with applied problem solving that extends beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.
Ethics is an often neglected, yet essential part of science and technology. Our decisions about right and wrong influence the way in which our inventions and developments change the world. A wide array of examples will be presented and discussed, e.g., the foundation of ethics, individual vs. population ethics, artificial life, stem cells, animal rights, abortion, pre-implantation diagnostics, legal and illegal drugs, the pharmaceutical industry, gene modification, clinical trials and research with test persons, weapons of mass destruction, data fabrication, and scientific fraud.</td></tr>
</table>

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, students will be able to

- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- summarize and explain ethical principles;
- critically look at scientific results that seem too good to be true;
- apply the ethical concepts to virtually all areas of science and technology;
- discover the responsibilities of society and of the individual for ethical standards;
- understand and judge the ethical dilemmas in many areas of the daily life;
- discuss the ethics of gene modification at the level of cells and organisms;
- reflect on and evaluate clinical trials in relation to the Helsinki Declaration;
- distinguish and evaluate the ethical guidelines for studies with test persons.

Indicative Literature

Not specified.

Usability and Relationship to other Modules

- Mandatory for CBT
- This module is a mandatory elective module in the Big Questions area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 120 min

Weight: 100%

Scope: All intended learning outcomes of the module.

7.16.2.3 Global Health – Historical context and future challenges

Module Name	*Module Code*	*Level (type)*	*CP*
Global Health – Historical context and future challenges	JTBQ-BQ-004	Year 3 (Jacobs Track)	5

Module Components

Number	*Name*	*Type*	*CP*
JTBQ-004	Global Health – Historical context and future challenges	Lecture	5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Dr. Andreas M. Lisewski	• Big Questions Area: All undergraduate study programs, except IEM	Mandatory elective for students of all undergraduate study programs, except IEM

Entry Requirements

Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	*Frequency*	*Forms of Learning and Teaching*
☒ None	☒ None	• The ability and openness to engage in interdisciplinary issues of global relevance • Media literacy, critical thinking, and a proficient handling of data sources	Annually (Fall)	• Lectures (35 hours) • Private study (90 hours)
			Duration	***Workload***
			1 semester	125 hours

Recommendations for Preparation

Critically following media coverage on the module's topics in question.

Content and Educational Aims

All "Big Questions" (BQ) modules deal with the economic, technological, societal and environmental contexts of the global issues and challenges of the coming decades. The BQ modules intend to raise awareness of those challenges and broaden the students' horizon with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules are relevant for every university graduate in order to become an informed and responsible citizen in a global society.

The module gives a historical, societal, technical, and medicinal overview over the past, present and future milestones and challenges of global health. Main topics include health systems, public health, health/disease monitoring and response, past and recent breakthroughs in medicine and healthcare, as well as recent health-related developments in technology and economy. Special focus is put on children, maternal and adolescent health, as their health is critical to the well-being of next generations. Further topics cover epidemiology and demographics, such as the connection between a society's economic development level and its population health status, demographic and epidemiologic transitions, measures of health status and disease burden, and health-related global development goals. An overall guiding aspect is human health in our increasingly interconnected civilization that is however reaching its global limits on key resources and that is therefore becoming more prone to disruptions. Discussed in this context are today's urgent global health issues, such as newly emergent and re-emergent infectious diseases, biosafety and complex humanitarian crises caused by unforeseen epidemics and pandemics.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, students will be able to

- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- identify the historical context and today's function of global health institutions, surveillance and response systems;
- evaluate and compare global indicators of disease burden, especially by using online databases and repositories
- break down global development goals directly related to global health
- discuss and differentiate present and future challenges of public and global health responses to novel disease outbreaks in a global society network context

Indicative Literature

- Richard Skolnik, Global Health 101, 4th Edition, Jones & Bartlett Publishers, 2019
- Solomon Benatar (*Editor*), Global Health - Ethical Challenges, 2nd Edition, Cambridge University Press, 2021

Usability and Relationship to other Modules

- The module is a mandatory elective module of the Big Questions area, that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules)
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute such knowledge and competences to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Written examination — Duration: 120 min.
Scope: All intended learning outcomes of the module — Weight: 100%

Module achievement: Oral presentation of selected literature and media topics on global health (topics are given but can also be suggested by students for approval).
The module achievement ensures sufficient knowledge about key global health concepts, challenges and current topics

7.16.2.4 Global Existential Risks

<table>
<tr><td colspan="3">Module Name
Global Existential Risks</td><td>Module Code
JTBQ-BQ-005</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-005</td><td colspan="3">Global Existential Risks</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Dr. Andreas M. Lisewski</td><td colspan="3">Program Affiliation

• Big Questions Area: All undergraduate study programs except IEM</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking, and a proficient handling of data sources</td><td>Frequency

Annually (Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (35 hours)
• Tutorial of the lecture (10 hours)
• Private study (80 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Critically following media coverage on the module’s topics in question.</td></tr>
<tr><td colspan="6">Content and Educational Aims

All “Big Questions” (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students’ horizons with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.
The more we develop science and technology, the more we also learn about catastrophic and, in the worst case, even existential global dangers that put the entire human civilization at risk of collapse. These doomsday scenarios therefore directly challenge humanity’s journey through time as an overall continuous and sustainable process that progressively leads to a more complex but still largely stable human society. The module presents the main known varieties of existential risks, including, for example, astrophysical, planetary, biological, and technological events or critical transitions that have the capacity to severely damage or even eradicate earth-based human civilization as we know it. Furthermore, this module offers a description of the characteristic features of these risks in comparison to more conventional risks, such as natural disasters, and a classification of global existential risks based on parameters such as range, intensity, probability of occurrence, and imminence. Finally, this module reviews several hypothetical monitoring and early warning systems as well as analysis methods that could potentially be used in strategies, if not to eliminate, then at least to better understand and ideally to minimize</td></tr>
</table>

imminent global existential risks. This interdisciplinary module will allow students to look across relevant and diverse subject fields, thus enabling them to initiate and to contribute substantially to discussions about these special risks.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, students will be able to

- identify and explain the known spectrum of global existential risks, including physical, biological, and technological risks
- differentiate and classify these risks according to their characteristics in range (scope), intensity (severity), probability of occurrence, and imminence
- distinguish and identify main directions and potential biases in media coverage of global existential risks
- prepare, present, explain and discuss today's key topics in global existential risks from both academic literature and from public media

Indicative Literature

Nick Bostrom, Milan M. Cirkovic (eds.):. Global Catastrophic Risks,Oxford University Press,2011.

Martin Rees: Our Final Hour – A Scientist's Warning,Basic Books,2009.

Martin Rees: On the Future – Prospects for Humanity, Princeton University Press, 2021.

Usability and Relationship to other Modules

- This module is a mandatory elective module in the Big Questions area, which is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Written examination — Duration: 120 min.
Scope: All intended learning outcomes of the module — Weight: 100%

Module achievement: Oral presentation of selected literature and media topics on our civilization's existential risks (topics are given but can also be suggested by students for approval)

The module achievement ensures sufficient knowledge about key risks and challenges for humanity's survival.

7.16.2.5 Future: From Predictions and Visions to Preparations and Actions

<table>
<tr><td colspan="2">Module Name
Future: From Predictions and Visions to Preparations and Actions</td><td>Module Code
JTBQ-BQ-006</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
2.5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-006</td><td colspan="2">Future: From Predictions and Visions to Preparations and Actions</td><td>Lecture</td><td>2.5</td></tr>
<tr><td>Module Coordinator

Prof. Dr. Joachim Vogt</td><td colspan="2">Program Affiliation

• Big Questions Area: All undergraduate study programs, except IEM</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="2" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking, and a proficient handling of data sources</td><td>Frequency

Annually (Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lecture (17.5 hours)
• Private study (45 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

62.5 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation

Critically following media coverage of the module’s topics in question.</td></tr>
<tr><td colspan="5">Content and Educational Aims

All “Big Questions” (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students’ horizons with applied problem solving that extend beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.
This module addresses selected topics related to the future as a general concept in science, technology, culture, literature, ecology, and economy, and it consists of three parts. The first part (Future Continuous) discusses forecasting methodologies rooted in the idea that key past and present processes are understood and continue to operate such that future developments can be predicted. General concepts covered in this context include determinism, uncertainty, evolution, and risk. Mathematical aspects of forecasting are also discussed. The second part (Future Perfect) deals with human visions of the future as reflected in the arts and literature, ranging from ideas of utopian societies and technological optimism to dystopian visions in science fiction. The third part (Future Now) concentrates on important current developments—such as trends in technology, scientific breakthroughs, the evolution of the Earth system, and climate change—and concludes with opportunities and challenges for present and future generations.</td></tr>
</table>

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, student should be able to

- use their factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- distinguish and qualify important approaches to forecasting and prediction;
- summarize the history of utopias, dystopias, and the ideas presented in classical science fiction;
- characterize current developments in technology, ecology, society, and their implications for the future.

Indicative Literature

United Nations (2015, September) Millennium Development Goals. Retrieved from http://www.un.org/millenniumgoals.
United Nation (2016, January): Sustainable Development Goals. Retrieved from http://catalog.jacobs-university.de/search~S0
United Nations University. https://unu.edu
US National Intelligence Council (2017). Global Trends. Retrieved from https://www.dni.gov/index.php/global-trends-home.
International Panel on Climate Change. Retrieved from https://www.ipcc.ch.
World Inequality Lab (2017, December). World Inequality Report 2018. Retrieved from https://wir2018.wid.world.
World Health Organization. Retrieved from http://www.who.int.
World Trade Organization. Retrieved from *https://www.wto.org*
Gapminder. Retrieved from https://www.gapminder.org.
World Bank. Retrieved from http://www.worldbank.org.

Usability and Relationship to other Modules

- This module is a mandatory elective module in the Big Questions area, which is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 60 min
Weight: 100%

Scope: All intended learning outcomes of the module

7.16.2.6 Climate Change

<table>
<tr><td colspan="2">Module Name
Climate Change</td><td>Module Code
JTBQ-BQ-007</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
2.5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-007</td><td colspan="2">Climate Change</td><td>Lecture</td><td>2.5</td></tr>
<tr><td>Module Coordinator
Prof. Dr. Laurenz Thomsen and Prof. Dr. Vikram Unnithan</td><td colspan="2">Program Affiliation
• Big Questions Area: All undergraduate study programs, except IEM</td><td colspan="2">Mandatory Status
Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="2" rowspan="2">Entry Requirements
Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking, and a proficient handling of data sources</td><td>Frequency
Annually (Spring)</td><td colspan="2">Forms of Learning and Teaching
• Lecture (17.5 hours)
• Private study (45 hours)</td></tr>
<tr><td>Duration
1 semester</td><td colspan="2">Workload
62.5 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation
Critically following media coverage of the module’s topics in question.</td></tr>
<tr><td colspan="5">Content and Educational Aims
All “Big Questions” (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students’ horizon with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.
This module will give a brief introduction into the development of the atmosphere throughout Earth's history from the beginning of the geological record up 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, the onset of early life, snowball Earth, and modern glaciation cycles. In the second part, the module will focus on the 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 for climate mitigation (geo-engineering) and adapting our society to climate change (such as coastal protection and adaption of agricultural practices to more arid and hot conditions) will be discussed.</td></tr>
<tr><td colspan="5">Intended Learning Outcomes</td></tr>
</table>

Students acquire transferable and key skills in this module.

By the end of this module, students should be able to

- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- advance a knowledge-based opinion on the complex module topics, including: impact of climate change on the natural environment over geological timescales and since the industrial revolution, and the policy framework in which environmental decisions are made internationally;
- work effectively in a team environment and undertake data interpretation;
- discuss approaches to minimize habitat destruction.

Indicative Literature

The course is based on a self-contained, detailed set of online lecture notes.

Ruddiman, William F. Earth's Climate (2001). Past and future. New York: Macmillan.

Usability and Relationship to other Modules

- This module is a mandatory elective module in the Big Questions area, which is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Written examination	Duration: 60 min.
Scope: All intended learning outcomes of the module	Weight: 100%

7.16.2.7 Extreme Natural Hazards, Disaster Risks, and Societal Impact

<table>
<tr><td colspan="3">Module Name
Extreme Natural Hazards, Disaster Risks, and Societal Impact</td><td>Module Code
JTBQ-BQ-008</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
2.5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-008</td><td colspan="3">Extreme Natural Hazards: Disaster Risks, and Societal Impact</td><td>Lecture</td><td>2.5</td></tr>
<tr><td>Module Coordinator

Prof. Dr. Laurenz Thomsen</td><td colspan="3">Program Affiliation

• Big Questions Area: All undergraduate study programs, except IEM</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking, and a proficient handling of data sources</td><td>Frequency

Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching

• Lecture (17.5 hours)
• Private study (45 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

62.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Critically following media coverage of the module's topics in question.</td></tr>
<tr><td colspan="6">Content and Educational Aims
All "Big Questions" (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students' horizons with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.
Extreme natural events increasingly dominate global headlines, and understanding their causes, risks, and impacts, as well as the costs of their mitigation, is essential to managing hazard risk and saving lives. This module presents a unique, interdisciplinary approach to disaster risk research, combining natural science and social science methodologies. It presents the risks of global hazards and natural disasters such as volcanoes, earthquakes, landslides, hurricanes, precipitation floods, and space weather, and provides real-world hazard and disaster case studies from Latin America, the Caribbean, Africa, the Middle East, Asia, and the Pacific.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes
Students acquire transferable and key skills in this module.
By the end of this module, student should be able to

• use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;</td></tr>
</table>

- advance a knowledge-based opinion on the complex module topics, including how natural processes affect and interact with our civilization, especially those that create hazards and disasters;
- distinguish the methods scientists use to predict and assess the risk of natural disasters;
- discuss the social implications and policy framework in which decisions are made to manage natural disasters;
- work effectively in a team environment.

Indicative Literature

The course is based on a self-contained, detailed set of online lecture notes.

Ismail-Zadeh, Alik, et al., eds (2014). Extreme natural hazards, disaster risks and societal implications. In *Special Publications of the International Union of Geodesy and Geophysics Vol. 1.* Cambridge: Cambridge University Press.

Usability and Relationship to other Modules

- The module is a mandatory elective module of the Big Questions area, that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules)
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute such knowledge and competences to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Written examination — Duration: 60 min.
Scope: All intended learning outcomes of the module — Weight: 100%

7.16.2.8 International Development Policy

Module Name		*Module Code*	*Level (type)*	*CP*
International Development Policy		JTBQ-BQ-009	Year 3 (Jacobs Track)	2.5
Module Components				
Number	*Name*		*Type*	*CP*
JTBQ-009	International Development Policy		Lecture	2.5

Module Coordinator	*Program Affiliation*	*Mandatory Status*
Prof. Dr. Claas Knoop	• Big Questions Area: All undergraduate study programs, except IEM	Mandatory elective for students of all undergraduate study programs, except IEM

Entry Requirements			*Frequency*	*Forms of Learning and Teaching*
Pre-requisites	*Co-requisites*	*Knowledge, Abilities, or Skills*	Annually (Fall)	• Lecture (17.5 hours) • Presentations • Private study (45 hours)
☒ None	☒ None	• The ability and openness to engage in interdisciplinary issues of global relevance • Media literacy, critical thinking, and a proficient handling of data sources	*Duration* 1 semester	*Workload* 62.5 hours

Recommendations for Preparation

Critically following media coverage of the module's topics in question.

Content and Educational Aims

All "Big Questions" (BQ) modules deal with the economic, technological, societal, and environmental contexts of the global issues and challenges of the coming decades. BQ modules intend to raise awareness of those challenges and broaden students' horizon with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become informed and responsible citizens in a global society.

We live in a world where still a large number of people still live in absolute poverty without access to basic needs and services, such as food, sanitation, health care, security, and proper education. This module provides an introduction to the basic elements of international development policy, with a focus on the relevant EU policies in this field and on the Sustainable Development Goals/SDGs of the United Nations. The students will not only learn about the tools applied in modern development policies, but also about the critical aspects of monitoring and evaluating the results of development policy. Module-related oral presentations and debates will enhance the students' learning experience.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the student should be able to

- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- breakdown the complexity of modern development policy;
- identify, explain, and evaluate the tools applied in development policy;
- formulate well-justified criticism of development policy;
- summarize and present a module-related topic in an appropriate verbal and visual form.

Indicative Literature

Francis Fukuyama (2006). The end of history and the last man. New York: Free Press.

Kingsbury, McKay, Hunt (2008). International Development.Issues and challenges. London: Palgrave.

A.Sumner, M.Tiwari (2009) After 2015: International Development Policy at a crossroad. New York: Palgrave Macmillan.

Graduate Institute of International Development, G. Carbonnier eds. (2001). International Development Policy: Energy and Development. New York:Palgrave Macmillan.

John Donald McNeil. International Development: Challenges and Controversy. Sentia Publishing,e-book.

Usability and Relationship to other Modules

- This module is a mandatory elective module in the Big Questions area, which is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Presentation
Duration: 10 minutes per student
Scope: All intended learning outcomes of the module
Weight: 100%

7.16.2.9 Sustainable Value Creation with Biotechnology. From Science to Business

Module Name		*Module Code*	*Level (type)*	*CP*
Sustainable Value Creation with Biotechnology. From Science to Business		JTBQ-BQ-011	Year 3 (Jacobs Track)	2.5
Module Components				
Number	*Name*		*Type*	*CP*
JTBQ-011	Sustainable Value Creation with Biotechnology. From Science to Business		Lecture /Tutorial	2.5
Module Coordinator N.N.	***Program Affiliation*** • Jacobs Track - Big Questions		***Mandatory Status*** Mandatory elective for students of all undergraduate study except IEM	
Entry Requirements *Pre-requisites* ☒ None	*Co-requisites* ☒ None *Knowledge, Abilities, or Skills* • The ability and openness to engage in interdisciplinary issues on bio-based value creation • media literacy, critical thinking and a proficient handling of data sources	***Frequency*** Annually (Spring) ***Duration*** 1 semester	***Forms of Learning and Teaching*** • Lecture and Tutorial (17.5 hours) • Private study (45 hours) ***Workload*** 62.5 hours	
Recommendations for Preparation https://www.ctsi.ucla.edu/researcher-resources/files/view/docs/EGBS4_Kolchinsky.pdf https://link.springer.com/article/10.1057/jcb.2008.27 https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf				

Content and Educational Aims

All "Big Questions" (BQ) modules deal with the economic, technological, societal and environmental contexts of the global issues and challenges of the coming decades. The BQ modules intend to raise awareness of those challenges and broaden the students' horizon with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules support students in their development to become an informed and responsible citizen in a global society.
This module has a particular focus on the role that Biotechnology and Biorefining is expected to play in social, economic and environmental contexts.

To deliver such a vision the module will prepare students to extract value form Biotechnology and associated activities. This will be done in the form of business cases that will be systematically developed by students alongside the development of the module. In this way, students will develop entrepreneurial skills while understanding basic business-related activities that are not always present in a technical curriculum. Case development will also provide students with the possibility of understanding the social, economic, environmental impact that Biotechnology and Biorefining can deliver in a Bio-Based Economy. The knowledge and skills gained through this module are in direct and indirect support of the UN 2030 Agenda for Sustainable Development: "Transforming our World".

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the students should be able to

- design and develop a Business Case based on the tools provided by modern Biotechnology;
- explain the interplay between Science, Technology and Economics / Finance;
- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- work effectively in a team environment and undertake data interpretation and analysis;
- discuss approaches to value creation in the context of Biotechnology and Sustainable Development;
- explain the ethical implications of technological advance and implementation;
- demonstrate presentation skills.

Indicative Literature

Springham, D., V. Moses & R.E. Cape (1999). Biotechnology – The Science and the Business. 2nd. Ed. Boca Raton: CRC Press.

Kornberg, Arthur (2002). The Golden Helix: Inside Biotech Ventures. Sausalito, CA: University Science Books.

UNESCO, Director-General. (2017). UNESCO moving forward the 2030 Agenda for Sustainable Development. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000247785

Usability and Relationship to other Modules

- The module is a mandatory elective module in the Big Questions area, which is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute their knowledge and competencies to class discussions and activities.

Examination Type: Module Examination

Assessment Component 1: Term Paper	Length:1.500 – 3.000 words Weight: 75%
Scope: Intended learning outcomes of the module (1-6)	
Assessment Component 2: Presentation	Duration: 10-15 min.

Weight: 25% Scope: Intended learning outcomes of the module (2-7)

7.16.2.10 Gender and Multiculturalism. Debates and Trends in Contemporary Societies

<table>
<tr><td colspan="2">Module Name
Gender and Multiculturalism. Debates and Trends in Contemporary Societies</td><td>Module Code
JTBQ-BQ-013</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-013</td><td colspan="2">Gender and Multiculturalism: Debates and Trends in Contemporary Societies</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator

Dr. Jessica Price</td><td colspan="2">Program Affiliation

• Big Questions Area: All undergraduate study programs</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="2" rowspan="2">Entry Requirements

Pre-requisites
☒ None

Co-requisites
☒ None

Knowledge, Abilities, or Skills
• The ability and openness to engage in interdisciplinary issues of global relevance
• Media literacy, critical thinking and a proficient handling of data sources</td><td>Frequency

Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching

• Lectures (17.5 hours)
• Project work (90 hours)
• Private study (17.5 hours)</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation

Critical following of the media coverage on the module's topics in question.</td></tr>
<tr><td colspan="5">Content and Educational Aims

All "Big Questions" (BQ) modules deal with the economic, technological, societal and environmental contexts of the global issues and challenges of the coming decades. The BQ modules intend to raise awareness of those challenges and broaden the students' horizon with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules are relevant for every university graduate in order to become an informed and responsible citizen in a global society.
The objective of this module is to introduce and familiarize students with the current debates, trends and analytical frameworks pertaining how gender is socially constructed in different cultural zones. Through lectures, group discussions and reflecting upon cultural cases, students will familiarize themselves with the current trends and the different sides of ongoing cultural and political debates that shape cultural practices, policies and discourses. The module will zoom-in on topics such as: cultural identity; the social construction of gender; gender fluidity and its backlash; gender and human rights; multiculturalism as a perceived threat in plural societies, among others. Students will be provided with opportunities for reflection and to ultimately develop informed opinions concerning topics that are continue to define some of the most contested cultural debates of contemporary societies. Furthermore, participants will engage their ideas in "hands on" projects aimed at moving</td></tr>
</table>

the needle from mere reflection by conducting “action-research” that will inform the outcomes of their course projects.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, students will be able to

- use their disciplinary factual and methodological knowledge to reflect on interdisciplinary questions by comparing approaches from various disciplines;
- summarize and evaluate the current cultural, political and legal debates concerning the social construction of gender in contemporary societies;
- reflect and develop informed opinions concerning the current debates and trends that are shaping ideas of whether multiculturalism ideals are realistic in pluralist western societies, or whether multiculturalism is a failed project;
- identify, explain and evaluate the role that societal forces, such as religion, socio-economic, political and migratory factors play in the construction of gendered structures in contemporary societies;
- develop a well-informed perspective concerning the interplay of science and culture in the debates around gender fluidity;
- deconstruct and reflect on the intersectionality between populist/nationalist discourses and gender discrimination;
- reflect and propose societal strategies and initiatives that attempt to answer the big questions presented in this module regarding gendered and cross-culturally-based inequalities;
- complete a self-designed project, collect and distill information from an “action-research” perspective;summarizing the process in a suitable reporting format;
- consider the application of an algorithm for group formation (not mandatory);
- overcome general teamwork problems in order to perform well-organized project work.

Indicative Literature

Biological Limits of Gender Construction Author(s): J. Richard Udry

Source: American Sociological Review , Jun., 2000, Vol. 65, No. 3 (Jun., 2000), pp. 443- 457. Published by: American Sociological Association Stable URL: https://www.jstor.org/stable/2657466

The Development of Gendered Interests and Personality Qualities From Middle Childhood Through Adolescence: A Biosocial Analysis. Susan M. McHale, Aryn M. Dotterer, Ji-Yeon Kim, Ann C. Crouter and Alan Booth. Child Development, March/April 2009, Volume 80, Number 2, Pages 482–495

Factors influencing attitudes to violence against women. Michael Flood and Bob Pease. Trauma, Violence, & ABuse, Vol. 10, No. 2, April 2009 125-142 dOi: 10.1177/1524838009334131. 2009 sAge Publications

Gender and Anti-immigrant Attitudes in Europe. Aaron Ponce (2017) Socius: Sociological Research for a Dynamic World. Volume 3: 1–17. Reprints and permissions: sagepub.com/journalsPermissions.nav

Usability and Relationship to other Modules

- The module is a mandatory elective module of the Big Questions area, that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules)
- Students are encouraged to relate the content of their previous modules to the topics of this module and contribute such knowledge and competences to class discussions and activities.

Examination Type: Module Examination

Assessment Type: Team Project

Weight: 100%

Scope: All intended learning outcomes of the module

7.16.2.11 The Challenge of Sustainable Energy

<table>
<tr><td colspan="3">Module Name
The Challenge of Sustainable Energy</td><td>Module Code
JTBQ-BQ-014</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
2.5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3"></td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-014</td><td colspan="3">The Challenge of Sustainable Energy</td><td>Lecture</td><td>2.5</td></tr>
<tr><td>Module Coordinator

Prof. Dr. Karen Smith Stegen</td><td colspan="3">Program Affiliation

• Big Questions Area: All undergraduate study programs</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• Ability to read texts from a variety of disciplines</td><td>Frequency

Annually (Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures and Group Exercises</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

62.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Reflect on their own behavior and habits with regard to sustainability.</td></tr>
<tr><td colspan="6">Content and Educational Aims

All “Big Questions” (BQ) modules deal with the economic, technological, societal and environmental contexts of the global issues and challenges of the coming decades. The BQ modules intend to raise awareness of those challenges and broaden the students’ horizon with applied problem solving beyond the borders of their own disciplines. Knowledge and skills offered in the interdisciplinary BQ modules are relevant for every university graduate in order to become an informed and responsible citizen in a global society.
How can wide-scale social, economic and political change be achieved? This module examines this question in the context of encouraging “sustainability”. To address global warming and environmental degradation, humans must adopt more sustainable lifestyles. Arguably, the most important change is the transition from conventional fuels to renewable sources of energy, particularly at the local, country and regional levels. The main challenge to achieving an “energy transition” stems from human behavior and not from a lack of technology or scientific expertise. This module thus examines energy transitions from the perspective of the social sciences, including political science, sociology, psychology, economics and management. To understand the drivers of and obstacles to technology transitions, students will learn the “Multi-Level Perspective”. Some of the key questions explored in this module include: What is meant by sustainability? Are renewable energies “sustainable”? How can a transition to renewable energies be encouraged? What are the main social, economic, and political challenges? How can these (potentially) be overcome? The aim of the course is to provide students with the tools for reflecting on energy transitions from multiple perspectives.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, students will be able to

• articulate the history of the sustainability movement and the major debates;</td></tr>
</table>

- identify different types of renewable energies;
- explain the multi-level perspective (MLP), which models technology innovations and transitions;
- summarize the obstacles to energy transitions;
- compare a variety of policy mechanisms for encouraging renewable energies.

Usability and Relationship to other Modules

- The module is a mandatory elective module of the Big Questions area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- For students interested in sustainability issues, this module complements a variety of modules from different programs, such as "International Resource Politics" (IRPH/SMP), "Environmental Science" (EES), "General Earth and Environmental Sciences" (EES), and "Renewable Energies" (Physics).

Examination Type: Module Examination

Assessment Type: Written Examination

Duration: 60 min
Weight: 100%

Scope: All intended learning outcomes of the module

7.16.2.12 State, Religion and Secularism

<table>
<tr><td colspan="3">Module Name
State, Religion and Secularism</td><td>Module Code
JTBQ-BQ-015</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
2.5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td colspan="4">Number</td><td>Type</td><td>CP</td></tr>
<tr><td>JTBQ-015</td><td colspan="3">State, religion and secularism</td><td>Lecture</td><td>2.5</td></tr>
<tr><td>Module Coordinator

Prof. Dr. Manfred O. Hinz</td><td colspan="3">Program Affiliation

• Big Questions Area: All undergraduate study programs</td><td colspan="2">Mandatory Status

Mandatory elective for students of all undergraduate study programs, except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements

Pre-requisites: ☒ None
Co-requisites: ☒ None
Knowledge, Abilities, or Skills:
• Ability to read texts from a variety of disciplines</td><td>Frequency

Annually (Spring)</td><td colspan="2">Forms of Learning and Teaching

• Lectures and Group Exercises</td></tr>
<tr><td>Duration

1 semester</td><td colspan="2">Workload

62.5 Hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation

Reflect on the situation and role in respective home-country</td></tr>
<tr><td colspan="6">Content and Educational Aims

The relationship between state and religion has been a matter of concern in most if not all societies. Is religion above the state, or is it to the state to determine the place of religion? What does secularity mean? To what extent will religion accept secularity? Where does the idea of secularity come from? The course State, religion, secularism will search for answers to questions of this nature. After introducing to the topic and looking at some legal attempts to regulate the relationship between state and religion, the focus will be, on the one hand, on Christianity and secularity and, on Islam and secularity, on the other. Depending on the interest of participants, other religions and their relationships to states of relevance can be added.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes

By the end of this course, students should be able
• To understand the basic problems that have led to different models to regulate the relationship between the state and religion;
• To reflect critically the situation of state and religion in selected countries;
• To assess the values behind the concept of democracy and human rights;
• To use the acquired knowledge to strengthen the capacity towards respect for others and tolerance.</td></tr>
<tr><td colspan="6">Usability and Relationship to other Modules

• The module is a mandatory elective module of the Big Questions area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).</td></tr>
</table>

- For students interested in State, Religion and secularism, this module complements modules from other programmes, such as IRPH and SMP

Examination Type: Module Examination

Assessment Type: Term paper

Length:1.500 – 3.000 words
Weight: 100%

Scope: All intended learning outcomes of the module.

7.16.3 Community Impact Project

<table>
<tr><td colspan="3">Module Name
Community Impact Project</td><td>Module Code
JTCI-CI-950</td><td>Level (type)
Year 3 (Jacobs Track)</td><td>CP
5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>JTCI-950</td><td colspan="3">Community Impact Project</td><td>Project</td><td>5</td></tr>
<tr><td>Module Coordinator
CIP Faculty Coordinator</td><td colspan="3">Program Affiliation
• All undergraduate study programs except IEM</td><td colspan="2">Mandatory Status
Mandatory for all undergraduate study programs except IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements
Pre-requisites: ☒ at least 15 CP from CORE modules in the major
Co-requisites: ☒ None
Knowledge, Abilities, or Skills: • Basic knowledge of the main concepts and methodological instruments of the respective disciplines</td><td>Frequency
Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching
• Introductory, accompanying, and final events: 10 hours
• Self-organized teamwork and/or practical work in the community: 115 hours</td></tr>
<tr><td>Duration
1 semester</td><td colspan="2">Workload
125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation
Develop or join a community impact project before the 5th semester based on the introductory events during the 4th semester by using the database of projects, communicating with fellow students and faculty, and finding potential companies, organizations, or communities to target.</td></tr>
<tr><td colspan="6">Content and Educational Aims
CIPs are self-organized, major-related, and problem-centered applications of students’ acquired knowledge and skills. These activities will ideally be connected to their majors so that they will challenge the students’ sense of practical relevance and social responsibility within the field of their studies. Projects will tackle real issues in their direct and/or broader social environment. These projects ideally connect the campus community to other communities, companies, or organizations in a mutually beneficial way.
Students are encouraged to create their own projects and find partners (e.g., companies, schools, NGOs), but will get help from the CIP faculty coordinator team and faculty mentors to do so. They can join and collaborate in interdisciplinary groups that attack a given issue from different disciplinary perspectives.
Student activities are self-organized but can draw on the support and guidance of both faculty and the CIP faculty coordinator team.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes
The Community Impact Project is designed to convey the required personal and social competencies for enabling students to finish their studies at Jacobs as socially conscious and responsible graduates (part of the Jacobs mission) and to convey social and personal abilities to the students, including a practical awareness of the societal context and relevance of their academic discipline.

By the end of this project, students should be able to
• understand the real-life issues of communities, organizations, and industries and relate them to concepts in their own discipline;</td></tr>
</table>

- enhance problem-solving skills and develop critical faculty, create solutions to problems, and communicate these solutions appropriately to their audience;
- apply media and communication skills in diverse and non-peer social contexts;
- develop an awareness of the societal relevance of their own scientific actions and a sense of social responsibility for their social surroundings;
- reflect on their own behavior critically in relation to social expectations and consequences;
- work in a team and deal with diversity, develop cooperation and conflict skills, and strengthen their empathy and tolerance for ambiguity.

Indicative Literature

Not specified

Usability and Relationship to other Modules

- Students who have accomplished their CIP (6th semester) are encouraged to support their fellow students during the development phase of the next year's projects (4th semester).

Examination Type: Module Examination

Project, not numerically graded (pass/fail)
Scope: All intended learning outcomes of the module

7.16.4 Language Modules

The descriptions of the language modules are provided in a separate document, the “Language Module Handbook” that can be accessed from here: https://www.jacobs-university.de/study/learning-languages

8 Appendix

8.1 Intended Learning Outcomes Assessment-Matrix

Earth and Environmental Science (BSc)					CH1-GenEES	CH2-GenGeo	CO-EnvSci	CO-Ocean	CO-Geochem	CO-MMWRes	CO-DataSci	CO-RemSens	CA1-AdvField	CA2-GlChSysTh	CA3-ModESD	CA4-CurTop	Bachelor Thesis	JT Methods/Skills 1	Internship	JT Bigf Questions	Community Impact	JT Language
Semester					1	2	3	4	3	4	3	4	5	5	5	6	6	6	4/5	5/6	5	1-4
Mandatory/mandatory elective					m	m	me	me	me	me	me	me	me	me	me	me	m	m/me	m	m	m	m
Credits					7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	5	5	5	5	15	20	15	10	5	10
	Competencies*																					
Program Learning Outcomes	A	E	P	S																		
Explain key concepts and processes in geology, oceanography, environmental sciences, geochemistry, Earth data science and geophysical remote sensing	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x					
Describe and discuss marine systems and terrestrial (near-)surface systems, identify and examine their components and interactions	x	x			x	x	x	x	x		x	x	x	x	x	x	x					
Apply fundamental chemical and physical concepts and methods to real-world problems in terrestrial and marine systems	x	x		x	x		x	x	x	x			x			x	x	x				
Identify and differentiate sedimentary, igneous and metamorphic rocks and	x	x			x	x			x	x			x				x					
Apply fundamental field skills, technologies, and concepts in Earth and Environmental Sciences to address topical issues			x	x	x	x		x		x			x				x					
Classify and analyze major anthropogenic disturbances of the natural (near-)surface system;	x	x		x	x		x	x	x	x		x	x	x	x	x	x					
Describe and appraise the interdependencies between resource exploration, responsible resource exploitation and environmental protection;	x	x		x	x	x	x	x	x	x						x	x					
Cooperate and collaborate responsibly and ethically in international and culturally diverse teams and communities;		x	x	x	x	x		x		x		x	x	x	x	x	x	x	x	x	x	x
Professionally communicate their own results in writing and in front of an audience, to both specialists and non-specialists;	x	x	x	x		x		x		x		x	x	x	x	x	x	x	x		x	
Select and apply key data processing and analysis techniques in applied and environmental geosciences;	x	x						x			x	x	x	x	x	x	x		x			
Perform quantitative analyses of materials, processes and systems, and model their dynamics;	x	x					x			x	x	x		x	x	x	x	x	x			
Analyze scientific and technical questions, put them into context to what is known in the literature, and to solve the questions at hand;	x	x	x	x				x			x	x		x	x	x	x	x	x	x		
Evaluate, anticipate, and proactively communicate to society the human impact on the environment, and engage ethically as an environmentally responsible person;	x	x	x	x			x	x		x			x	x		x	x		x	x	x	
Apply research methods appropriate in Earth and Environmental Sciences;	x	x						x		x		x	x	x	x	x	x		x			
Take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis;	x	x	x	x				x		x		x	x	x	x	x		x	x	x	x	x
Actively defend and promote ethical, scientific and professional standards.	x	x	x	x				x		x		x	x	x	x	x	x	x		x	x	x
Assessment Type																						
Oral examination						x								x								
Final written exam					x		x	x	x	x												
Project											x						x				x	
Term paper												x			x	x		x	x			
(Lab) report					(x)					(x)			x									
Poster presentation																						
Presentation																	x					
Various																		x		x		x
Module achievements/bonus achievements					x					x			x									x

*Competencies: A-scientific/academic proficiency; E-competence for qualified employment; P-development of personality; S-competence for engagement in society

Figure 4: Intended Learning Outcomes Assessment-Matrix