CONSTRUCTOR UNIVERSITY

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Study Program Handbook

Earth Sciences and Sustainable Management of Environmental Resources

Bachelor of Science

Subject-specific Examination Regulations for Earth Sciences and Sustainable Management of Environmental Resources (Fachspezifische Prufungsordnung)

The subject-specific examination regulations for Earth Sciences and Sustainable Management of Environmental Resources 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 4 of this handbook).

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Contents

1 Program Overview

1.1 Concept

1.1.1 The Constructor University Educational Concept

Constructor University aims to educate students for both an academic and a professional career by emphasizing three core objectives: academic excellence, personal development, and employability to succeed in the working world. Constructor University offers an excellent research driven education experience across disciplines 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. Through a multi-disciplinary, holistic approach and exposure to cutting-edge technologies and challenges, Constructor University develops and enables the academic excellence, intellectual competences, societal engagement, professional and scientific skills of tomorrows leaders for a sustainable and peaceful future.

In this context, it is Constructor 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 can take responsible roles for the democratic, peaceful, and sustainable development of the societies in which they live. This is achieved through high-quality teaching, 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 Constructor University, both in terms of actual disciplinary subject matter and 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, optional German language and Humanities modules, 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, Constructor University offers professional advising and counseling.

Constructor 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 one of the most widely observed university rankings, the Times Higher Education (THE) ranking. More details on the current ranking positions can be found at https://constructor.university/more/about-us.

1.1.2 Program Concept

The BSc program Earth Sciences and Sustainable Management of Environmental Resources (ESSMER) at Constructor 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 ESSMER program is based on a solid foundation in chemistry, mathematics, physics, and economics. It combines traditional geoscience disciplines such as geology, environmental science, and digital geoscience using key methodological tools and concepts from geochemistry, geodata analysis and data management as well as sustainability economics. The modular curriculum allows for an excellent integration of additional optional complementary courses from the social sciences, e.g., economics and management, and from the life sciences, e.g., biochemistry, cell biology and microbiology. This unique structure underlines the importance of a holistic understanding of environmental topics from different perspectives including chemistry, physics, and economics.

The ESSMER 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 ESSMER 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, while being aware of the economic conseuences of their actions.

1.2 Specific Advantages of Earth Sciences and Sustainable Management of Environmental Resources at Constructor University

The ESSMER 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. Even at the introductory 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 Constructor University's 4C concept, the ESSMER 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 ESSMER capstone modules bring together different strands of the education at Constructor University in case studies and group projects, promoting social, intercultural understanding, and presentation skills as well as raising awareness of topical real-world challenges.

ESSMER instructors emphasize a global and interdisciplinary perspective that is firmly rooted in the natural sciences. We promote a process- and solution-oriented approach to real-world challenges and problem-solving skills that are highly sought by potential employers and graduate schools, thus opening a wide range of possible career paths in academia and industry. Students graduating from ESSMER, 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, consulting firms universities, and research institutions. The excellent quality of past earth sciences program at Constructor 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 Sciences and Sustainable Management of Environmental Resources is fully committed to the mission of Constructor University. With planet Earth and global environment at the heart of the study program, internationality and interdisciplinary learning are key ingredients of the ESSMER program that benefit our graduates and supports them on their journey to become citizens of the world. The ESSMER 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. ESSMER 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 study program, students will be able to

1. explain key concepts and processes in geology, environmental sciences, geochemistry, Earth data science and digital geosciences;
2. describe and discuss (near-)surface systems, identify and examine their components and interactions;
3. apply fundamental chemical and physical concepts and methods to solve real-world problems;
4. apply fundamental field skills, technologies, and concepts in Earth Sciences and Sustainable Management of Environmental Resources to address topical issues;
5. apply fundamental theories, approaches and methods for public policy analysis;
6. distinguish among the economic interests and activities of different stakeholders;
7. classify and analyze major anthropogenic disturbances of the natural (near-)surface system;
8. describe and appraise the interdependencies between resource exploration, responsible resource exploitation and environmental protection;
9. evaluate economic, political, and societal problems with regard to climate change using economics and management theories and scientific reasoning
10. cooperate and collaborate responsibly and ethically in international and culturally diverse teams and communities;
11. professionally communicate their own results in writing and in front of an audience, to both specialists and non-specialists;
12. select and apply key data processing and analysis techniques in applied and environmental geosciences;
13. perform quantitative analyses of materials, processes, and systems, and model their dynamics;
14. analyze scientific and technical questions, put them into context to what is known in the literature, and to solve the questions at hand;
15. evaluate, anticipate, and proactively communicate to society the human impact on the environment, and engage ethically as an environmentally responsible person;
16. apply research methods appropriate in ESSMER;
17. take responsibility for their own learning, personal and professional development, and role in society, evaluating critical feedback and self-analysis.

1.4 Career Options and Support

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

Graduates of the Earth Sciences and Sustainable Management of Environmental Resources program at Constructor 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 green technologies in research at universities and various State-, NGO- or privately funded research facilities. Possible careers are also possible in environmental consulting and management as well as in start-ups or small and medium-sized companies in the steadily growing environmental and renewable energy sector. Furthermore, high-school and college teaching, work in science journalism and publishing or in the geo- and eco-tourism industry are possible. Since positions in industry and academia often require a M.Sc. degree, the modules and courses in the Earth Sciences and Sustainable Management of Environmental Resources program also aim to prepare students for further studies at graduate schools.

The Earth Sciences and Sustainable Management of Environmental Resources program profits from the excellent placement record held by previous earth sciences programs at Constructor University 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 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 Constructor University is an international residential campus university, all B.Sc. students live in shared housing facilities on Constructor University Campus. The experience of living, learning, and working together with students from more than 100 different countries ensures that all ESSMER graduates are well-prepared for working together in highly diverse multicultural teams and environments.

The Career Service Center (CSC) helps students in their career development. It provides students with high-quality training and coaching in CV creation, cover letter formulation, interview preparation, effective presenting, business etiquette, and employer research as well as in many other aspects, thus helping students identify and follow up on rewarding careers after graduating from Constructor University. Furthermore, the Alumni Office helps students establish a long-lasting and global network which is useful when exploring job options in academia, industry, and elsewhere.

1.5 Admission Requirements

Admission to Constructor University is selective and based on a candidate's school and/or university achievements, recommendations, self-presentation, and performance on standardized tests. Students admitted to Constructor 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 (optional)

- Official or certified copies of high school/university transcripts
- Educational History Form
- Standardized test results (SAT/ACT) if applicable
- Motivation statement
- ZeeMee electronic resume (optional)
- Language proficiency test results (TOEFL Score: 90, IELTS: Level 6.5 or equivalent)

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

For more detailed information about the admission visit: https://constructor.university/admission-aid/application-information-undergraduate

1.6 More information and contacts

For more information on the study program please contact the Study Program Coordinator:

Prof. Dr. Andrea Koschinsky

Professor of Geosciences
Email: akoschinsky@constructor.university

or

Prof. Dr. Vikram Unnithan

Professor of Geosciences
Email: vunnithan@constructor.university

or visit our program website
https://constructor.university/programs/undergraduate-education/earth-sciences-and-sustainable-management-of-environmental-resources

For more information on Student Services please visit:

https://constructor.university/student-life/student-services

2 The Curricular Structure

2.1 General

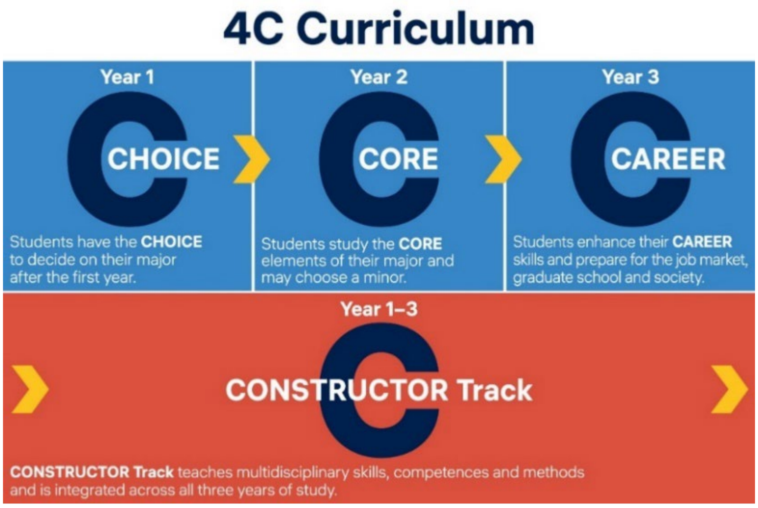
The curricular structure provides multiple elements for enhancing employability, interdisciplinarity, and internationality. The unique CONSTRUCTOR Track, offered across all undergraduate study programs, provides comprehensive tailor-made modules designed to achieve and foster career competency. Additionally, 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 opportunities 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 Constructor 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 Constructor University can be found on the website (https://constructor.university/student-life/student-services/university-policies)

2.2 The Constructor University 4C Model

Constructor 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 undergraduate programs involve 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 4C Model. It groups the disciplinary content of the study program in three overarching themes, CHOICE-CORE-CAREER according to the year of study, while the university-wide CONSTRUCTOR Track is dedicated to multidisciplinary content dedicated to methods as well as intellectual skills and is integrated across all three years of study. The default module size is 5 CP, with smaller 2.5 CP modules being possible as justified exceptions, e.g., if the learning goals are more suitable for 2.5 CP and the overall student workload is balanced.



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 15-45 CP will belong to their intended major. A unique feature of our curriculum structure allows students to select their major freely upon entering Constructor University. The team of Academic Advising Services offers curriculum counseling to all Bachelor students independently of their major, while Academic Advisors, in their capacity as contact persons from the faculty, support students individually in deciding on their major study program.

To pursue Earth Sciences and Sustainable Management of Environmental Resources as a major, the following CHOICE modules (30 CP) need to be taken as mandatory (m) modules:

- CHOICE Module: Fundamentals of Earth Sciences (m, 7.5 CP)
- CHOICE Module: Environmental Systems and Global Change (m, 7.5 CP)
- CHOICE Module: Microeconomics (m, 7.5 CP)
- CHOICE Module: Macroeconomics (m, 7.5 CP)

These CHOICE modules introduce the students in the first semester to the fundamentals of Earth Sciences and Sustainable Management of Environmental Resources (e.g., the structure of the Earth, its major compartments, plate tectonics, and geological timescales, and in the second semester provide more specific knowledge of geological phenomena, climate change and the human impact on the natural environment. At the same time a broad introduction in Economics is given in the first year. More advanced economics skills builds on this in the following years.

The remaining CHOICE modules (15 CP) can be selected in the first year of study according to interest and/or with the aim of allowing a change of major until the beginning of the second year, when the major choice becomes fixed.

Students can still change to another major at the beginning of their second year of studies, provided they have taken the corresponding mandatory CHOICE modules in their first year of studies. All students must participate in an entry advising session with their Academic Advisors to learn about their major change options and consult their Academic Advisor prior to changing their major.

Earth Sciences and Sustainable Management of Environmental Resources 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.

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

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

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 Sciences and Sustainable Management of Environmental Resources as a major, all the following mandatory CORE modules need to be taken:

- CORE Module: Geochemistry of Environmental Systems (m, 7.5 CP)
- CORE Module: Physics of Planet Earth (m, 7.5 CP)
- CORE Module: Natural Resources and Hazards (m, 7.5 CP)
- CORE Module: Advanced Field Laboratories (m, 7.5 CP)
- CORE Module: Concepts in Public Economics and Sustainable Management of Natural Risks (m, 7.5 CP)
- CORE Module: Environmental and Resource Economics (m, 7.5 CP)

The CORE Modules are arranged as three sets of units, with each comprising one fall (F) and one spring (S) module. The student chooses the Fall (F) and Spring (S) semester modules 'Concepts in Public Economics and Sustainable Management of Natural Risks' and 'Environmental and Resource Economics' to focus on economics, finance and sustainable management. Additionally, Geochemistry of Environmental Systems and Natural Resources and Hazards to focus on Geochemistry and Resources and their impact on the environment, and module pair Physics of Planet Earth and Advanced Field Laboratories to focus on geophysics and extended field laboratories (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.

Earth Sciences and Sustainable Management of Environmental Resources students are required to take 45 CP credits of CORE modules to graduate in ESSMER. This does **not permit** the incorporation of a minor study track. However, Bachelor students majoring in other programs can pursue a minor in Earth Sciences (see below).

2.2.3 Year 3 – CAREER

During their third year, students prepare and make decisions for their career after graduation. To explore available choices fitting individual interests, and to gain professional experience, students take a mandatory summer internship (see 2.2.3.1). The third year of studies allows ESSMER students to further sharpen their profile with a selection of discipline-specific, research-oriented specialization modules that can be combined to enhance their individual competences in the natural sciences, strategy development for novel research approaches or managerial capabilities. Furthermore, the third year also focuses on the responsibility of students beyond their discipline (see CONSTRUCTOR Track).

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

2.2.3.1 Internship / Start-up and Career Skills Module

As a core element of Constructor 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 an external professional research environment, apply their knowledge and understanding in the context of an external institution, reflect on the relevance of their major to employment and society, reflect on their own personal role, and further develop their professional orientation. The internship can establish valuable contacts for the students' bachelor's thesis project, for the selection of a master program or graduate school, or for 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 their business plans.

For further information, please contact the Career Service Center (CSC) (https://constructor.university/student-life/career-services).

For organizational aspects consult with your Academic Advisor and the ESSMER SPC for reasonable choices to conduct a prosperous internship.

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 Sciences and Sustainable Management of Environmental Resources as a major, at least 15 CP from the following mandatory elective (me) Specialization Modules need to be taken:

- ESSMER Specialization: Digital Geosciences (me, 5 CP)
- ESSMER Specialization: Sustainability and Policy Evaluation (me, 5 CP)
- ESSMER Specialization: Advanced Environmental Science (me, 5 CP)
- ESSMER Specialization: Current Topics in ESSMER (me, 5 CP)

In addition to the advancement of disciplinary skills within ESSMER, 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 fifth 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 Constructor University's study abroad procedures. Several exchange programs allow students to directly enroll at prestigious partner institutions worldwide. Constructor 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://constructor.university/student-life/study-abroad/international-office)

ESSMER students that wish to pursue a study abroad in their fifth 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 New Skills modules (see CONSTRUCTOR Track). In their sixth 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 New Skills modules to reach the required 15 CP in this area.

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 Constructor University 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 understanding 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 Constructor University 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 CONSTRUCTOR Track

The CONSTRUCTOR Track is another important feature of Constructor University's educational model. The Constructor Track runs orthogonal to the disciplinary CHOICE, CORE, and CAREER modules across all study years and is an integral part of all undergraduate study programs. It provides an intellectual tool kit for lifelong learning and encourages the use of diverse methodologies to approach cross-disciplinary problems. The CONSTRUCTOR track contains Methods, New Skills and German Language and Humanities modules.

2.3.1 Methods and Skills Modules

Methods 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 area in their curriculum. The modules that are specifically assigned to each study program to 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 area. The size of all Methods modules is 5 CP.

To pursue ESSMER as a major, the following Methods and Skills modules (20 CP) need to be taken as mandatory modules:

- Methods Module: Mathematical Concepts (m, 5 CP)
- Methods Module: Statistics with R (m, 5 CP)
- Methods Module: Chemistry for Natural Scientists (m, 5 CP)
- Methods Module: Econometrics (m, 5 CP)

2.3.2 New Skills Modules

This part of the curriculum constitutes an intellectual and conceptual tool kit that cultivates the capacity for a particular set of intellectual dispositions including curiosity, imagination, critical thought, and transferability. It nurtures a range of individual and societal capacities, such as self-reflection, argumentation and communication. Finally, it introduces students to the normative aspects of inquiry and research, including the norms governing sourcing, sharing, withholding materials and research results as well as others governing the responsibilities of expertise as well as the professional point of view.

All students are required to take the following modules in their second year:

- New Skills Module: Logic (m, 2.5 CP)
- New Skills Module: Causation and Correlation (m, 2.5 CP)

These modules will be offered with two different perspectives of which the students can choose. The module perspectives are independent modules which examine the topic from different point of views. Please see the module description for more details.

In the third year, students take three 5 CP modules that build upon previous modules in the track and are partially constituted by modules that are more closely linked to each student's disciplinary field of study. The following module is mandatory for all students:

- New Skills Module: Argumentation, Data Visualization and Communication (m, 5 CP)

This module will also be offered with two different perspectives of which the students can choose.

In their fifth semester, students may choose between:

- New Skills Module: Linear Model/Matrices (me, 5 CP) and
- New Skills Module: Complex Problem Solving (me, 5 CP).

The sixth semester also contains the choice between two modules, namely:

- New Skills Module: Agency, Leadership and Accountability (me, 5 CP) and
- New Skills Module: Community Impact Project (me, 5 CP).

Students who study abroad during the fifth semester and are not substituting the mandatory Argumentation, Data Visualization and Communication module, are required to take this module during their sixth semester. Students who remain on campus are free to take the Argumentation, Data Visualization and Communication module in person in either the fifth or sixth semester as they prefer.

2.3.3 German Language and Humanities Modules

German language abilities foster students' intercultural awareness and enhance their employability in their host country. They are also beneficial for securing mandatory internships (between the 2nd and 3rd year) in German companies and academic institutions. Constructor University supports its students in acquiring basic as well as advanced German skills in the first year of the CONSTRUCTOR Track. Non-native speakers of German are encouraged to take two German modules (me, 2.5 CP each), but are not obliged to do so. Native speakers and other students not taking advantage of this offering take alternative modules in Humanities in each of the first two semesters:

- Humanities Module: Introduction to Philosophical Ethics (me, 2.5 CP)
- Humanities Module: Introduction to the Philosophy of Science (me, 2.5 CP)
- Humanities Module: Introduction to Visual Culture (me, 2.5 CP)

2.4 Earth Sciences as a Minor

The Earth Sciences and Sustainable Management of Environmental Resources program allows Bachelor students from other disciplines to pursue a Minor in Earth Sciences. A Minor in Earth 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.

2.5 Qualification Aims

The purpose of a Minor in Earth 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 Sciences enables them to understand, discuss, participate in and promote science-based approaches which address these issues.

2.5.1 Intended Learning Outcomes

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

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

2.6 Module Requirements

A Minor in Earth Sciences requires 30 CP. It includes the following mandatory CHOICE and CORE modules:

- CHOICE Module: Fundamentals of Earth Sciences (m, 7.5 CP)
- CHOICE Module: Environmental Systems and Global Change (m, 7.5 CP)
- CORE Module: Geochemistry of Environmental Systems (m, 7.5 CP)
- CORE Module: Natural Resources and Hazards (m, 7.5 CP)

2.7 Degree

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

3 Earth Sciences and Sustainable Management of Environmental Resources Undergraduate Program Regulations

3.1 Scope of these Regulations

The regulations in this handbook are valid for all students who entered the Earth Sciences and Sustainable Management of Environmental Resources undergraduate program at Constructor University in Fall 2025 In case of conflict between the regulations in this handbook and the general policies for Bachelor Studies, the latter apply (see https://constructor.university/student-life/student-services/university-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).

Updates to Study Program Handbooks are based on the policies approved by the Academic Senate on substantial and nonsubstantial changes to study programs. Students are integrated in the decision-making process through their respective committee representatives. All students affected by the changes will be properly informed.

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

3.2 Degree

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

3.3 Graduation Requirements

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.

3.4 Schematic Study Plan

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

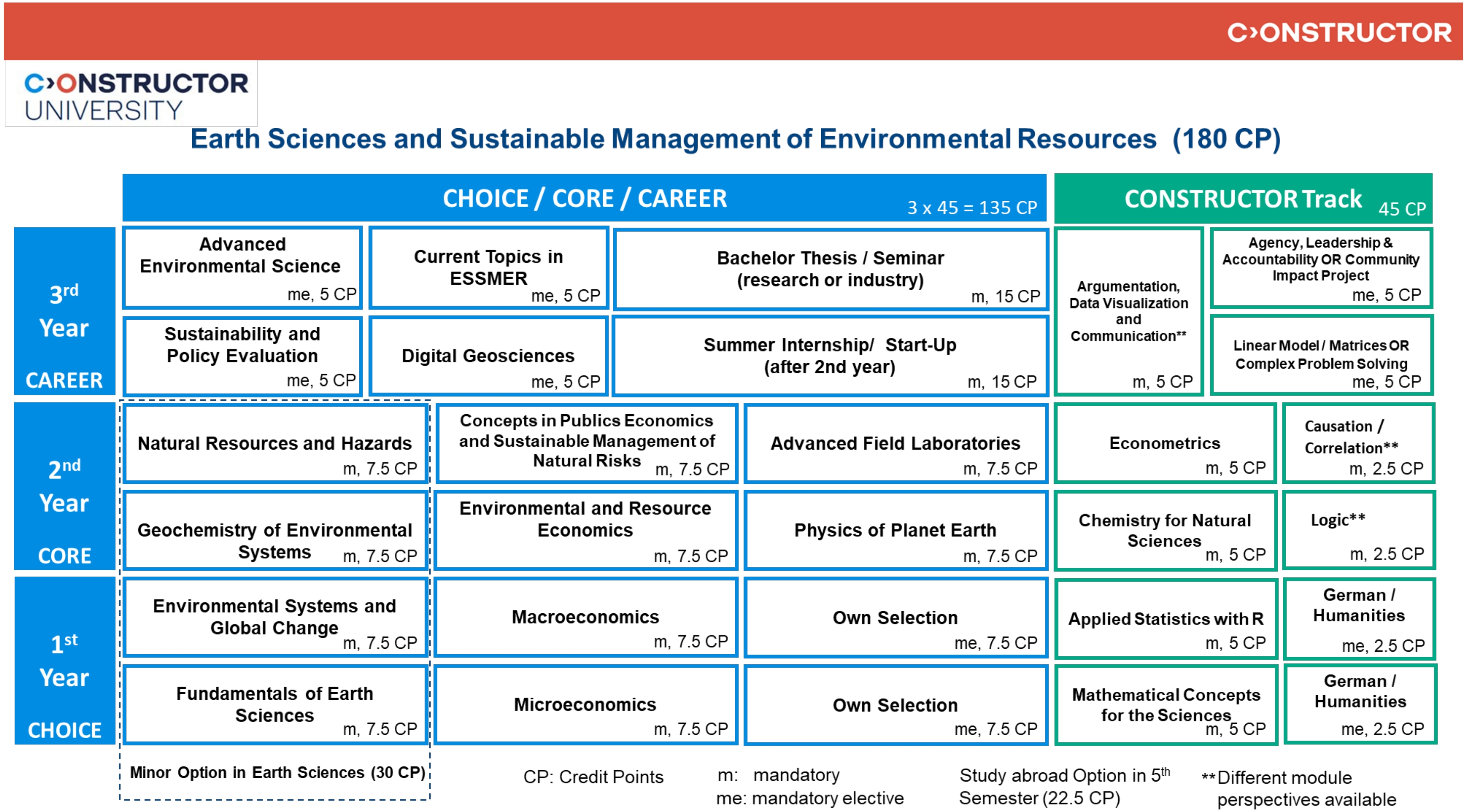


Figure 2: Schematic Study Plan for ESSMER

3.5 Study and Examination Plan

Earth Sciences and Sustainable Management of Environmental Resources (ESSMER)

Matriculation Fall 2025

	Program-Specific Modules	Type	Assessment	Period	Status[1]	Sem.	ECTS
Year 1 - CHOICE							**45**
Take the mandatory CHOICE unit ***(s)*** *listed below, this is a requirement for the ESSMER program.*							
	Unit: Earth Sciences I - Default minor						**15**
CH-132	**Module: Fundamentals of Earth Sciences**				**m**	**1**	**7.5**
CH-132- A	Fundamentals of Earth Sciences	Lecture	Written Examination	Examination period			5
CH-132- B	Fundamentals of Earth Sciences Lab	Lab					2.5
CH-133	**Module: Environmental Systems and Global Change**				**m**	**2**	**7.5**
CH-133- A	Environmental Systems and Global Change	Seminar	Written Examination	Examination period			5
CH-133- B	Environmental Systems Lab	Lab					2.5
	Unit: Sustainable Management of Environmental Resources 1						**15**
CH-310	**Module: Microeconomics**				**m**	**1**	**7.5**
CH-310-A	Microeconomics Theory and Policy	Lecture	Written Examination	Examination period			5
CH-310-B	Microeconomics - Tutorial	Tutorial					2.5
CH-311	**Module: Macroeconomics**				**m**	**2**	**7.5**
CH-311-A	Macroeconomics Theory and Policy	Lecture	Written Examination	Examination period			5
CH-311-B	Macroeconomics - Tutorial	Tutorial					2.5
	Unit: CHOICE (own selection)					**1/2**	**15**
Students take two further CHOICE modules from those offered for all other study programs.[2]							
Year 2 - CORE							**45**
Take all three units listed below							
	Unit: Earth Sciences II - Default minor						**15**
CO-466	**Module: Geochemistry of Environmental Systems**				**m**	**3**	**7.5**
CO-466-A	Geochemistry of Environmental Systems	Lecture/ tutorials	Written Examination	Examination period			
CO-467	**Module: Natural Resources and Hazards**				**m**	**4**	**7.5**
CO-467-A	Natural Resources and Hazards	Lecture/ tutorials	Written Examination	Examination period			
	Unit: Sustainable Management of Environmental Resources II						**15**
CO-621	**Module: Environmental and Resource Economics**				**m**	**3**	**7.5**
CO-621-A	Environmental and Resource Economics	Seminar	Written Examination	Examination period			
CO-621-B	Environmental and Resource Economics - Tutorial	Tutorial					
CO-473	**Module: Concepts in Public Economics and Sustainable Management of Natural Risks**				**m**	**4**	**7.5**
CO-473-A	Concepts in Public Economics	Lecture/ Tutorial	Portfolio Assessment	During the semester			
CO-473-B	Sustainable Management of Natural Risks	Lecture/ Tutorial	Term Paper	During the semester			
	Unit: Earth Sciences III						**15**
CO-471	**Module: Physics of Planet Earth**				**m**	**3**	**7.5**
CO-471-A	Physical Concepts for Earth Sciences	Lecture	Written Examination	Examination period			2.5
CO-471-B	Introduction to Geophysics	Lecture					2.5
CO-471-C	Atmosphere and Climate Physics	Lecture					2.5
CO-472	**Module: Advanced Field Laboratories**				**m**	**4**	**7.5**
CO-472-A	Applying Geoscientific Methods in the Field I	Field Camp / Lectures	Laboratory Report	during the sememster			2.5
CO-472-B	Applying Geoscientific Methods in the Field II	Field Camp / Lectures	Laboratory Report	during the sememster			5

	CONSTRUCTOR Track Modules	Type	Assessment	Period	Status[1]	Sem.	ECTS
Year 1							**15**
	Unit: Skills / Methods						**10**
CTMS-MAT-07	**Module: Mathematical Concepts for the Sciences**				**m**	**1**	**5**
CTMS-07	Mathematical Concepts for the Sciences	Lecture	Written Examination	Examination period			
CTMS-MET-03	**Module: Applied Statistics with R**				**m**	**2**	**5**
CTMS-03	Applied Statistics with R	Lecture/Lab	Written Examination	Examination period			
	Unit: Language						**5**
German is default language and open to Non-German speakers (on campus and online).[4]							
CTLA-	**Module: Language 1**				**me**	**1**	**2.5**
CTLA-	Language 1	Seminar	Various	Various			
CTLA-	**Module: Language 2**				**me**	**2**	**2.5**
CTLA-	Language 2	Seminar	Various	Various			
CTHU-HUM-001	**Humanities Module: Introduction into Philosophical Ethics**				**me**	**2**	**2.5**
CTHU-001	Introduction into Philosophical Ethics	Lecture	Written examination	Examination period			
CTHU-HUM-002	**Humanities Module: Introduction to the Philosophy of Science**				**me**	**1**	**2.5**
CTHU-002	Introduction to the Philosophy of Science	Lecture	Written Examination	Examination period			
CTHU-HUM-003	**Introduction to Visual Culture**				**me**	**2**	**2.5**
CTHU-003	Introduction to Visual Culture	Lecture	Written Examination	Examination period			
Year 2							**15**
	Unit: Skills / Methods						**10**
CTMS-SCI-15	**Module: Chemistry for Natural Sciences**				**m**	**3**	**5**
CTMS-15-A	Chemistry for Natural Sciences	Lecture	Written Examination	Examination period			2.5
CTMS-15-B	Chemistry for Natural Sciences Lab	Lab					2.5
CTMS-MET-05	**Module: Econometrics**				**m**	**4**	**5**
CTMS-05	Econometrics	Seminar	Written Examination	Examination period			5
	Unit: New Skills						**5**
Choose one of the two modules							
CTNS-NSK- 01	**Module: Logic (perspective I)**				**me**	**3**	**2.5**
CTNS-01	Logic (perspective I)	Lecture (online)	Written Examination	Examination period			
CTNS-NSK-02	**Module: Logic (perspective II)**				**me**		**2.5**
CTNS-02	Logic (perspective II)	Lecture (online)	Written Examination	Examination period			
Choose one of the two modules							
CTNS-04	Causation and Correlation (perspective II)	Lecture (online)	Written Examination	Examination period			

Year 3 - CAREER							**45**
CA-INT-900	**Module: Summer Internship**				**m**	**4/5**	**15**
CA-INT-900-0	Summer Internship		Project Report				
CA-EES-800	**Module: Seminar / Thesis ESSMER**				**m**	**6**	**15**
CA-EES-800-T	Thesis ESSMER	Thesis	Thesis				12
CA-EES-800-S	Thesis Seminar ESSMER	Seminar	Presentation				3
	Unit: Specialization				**m**		**15**
CA-S-ESSMER-801	**Module: Digital Geosciences**				**me**	**5**	**5**
CA-ESSMER-801	Digital Geosciences	Lecture	Term paper	during the semester			
CA-S-ESSMER-802	**Module: Sustainability and Policy Evaluation**				**me**	**5**	**5**
CA-ESSMER-802	Sustainability and Policy Evaluation	Lecture	Written Examination	Examination period			
CA-S-ESSMER-803	**Module: Advanced Environmental Science**				**me**	**6**	**5**
CA-ESSMER-803-A	Advanced Environmental Science	Lecture	Written Examination	Examination period			2.5
CA-ESSMER-803-B	Advanced Environmental Science Lab	Lab	Laboratory Report	during the semester			2.5
CA-S-EES-804	**Module: Current Topics in ESSMER**				**me**	**6**	**5**
CA-EES-804	Current Topics in ESSMER	Seminar	Term Paper	during the semester			5
	Total 15 ECTS of specialization modules				m	5/6	15

							15
	Unit: New Skills						**10**
Choose one of the two modules							
CTNS-NSK-05	**Module: Linear Model and Matrices**				**me**	**5**	**5**
CTNS-05	Linear Model and Matrices	Seminar	Written Examination	Examination period			
CTNS-NSK-06	**Module: Complex Problem Solving**				**me**	**5**	**5**
CTNS-06	Complex Problem Solving	Lecture (online)	Written Examination	Examination period			
Choose one of the two modules							
CTNS-NSK-07	**Module: Argumentation, Data Visualization and Communication**				**me**	**5/6**	**5**
CTNS-07	Argumentation, Data Visualization and Communication (perspective I)	Lecture (online)	Written Examination	Examination period		**5**	
CTNS-NSK-08	**Module: Argumentation, Data Visualization and Communication**				**me**	**5/6**	**5**
CTNS-08	Argumentation, Data Visualization and Communication (perspective II)	Lecture (online)	Written Examination	Examination period		**6**	
Choose one of the two modules							
CTNS-NSK-09	**Module: Agency, Leadership & Accountability**				**me**	**6**	**5**
CTNS-09	Agency, Leadership, and Accountability	Lecture (online)	Written Examination	Examination period			
CTNS-CIP-10	**Module: Community Impact Project**				**me**	**5/6**	**5**
CTNS-10	Community Impact Project	Project	Project report	Examination period			
Total ECTS							**180**

¹ Status (m = mandatory, e = elective, me = mandatory elective)

² For a full listing of all CHOICE / CORE / CAREER / Constructor Track units / modules please consult the CampusNet online catalogue and /or the study program handbooks.

[3] German native speakers will have alternatives to the language courses (in the field of Humanities).

[4] Humanities I and II are optional to all students, except for German native speakers.

[5]Choose one of the perspectives

Figure 3: Study and Examination Plan ESSMER

4 ESSMER Modules

4.1 Mathematical Concepts for the Sciences

Module Name	**Mathematical Concepts for the Sciences**
Module Code	2025-CTMS-MAT-07
Module ECTS	5
Study Semester	Mandatory status for: - 2025-BCCB-BSc 1 - 2025-CBT-BSc 1 - 2025-MCCB-BSc 1 - 2025-ESSMER-BSc 1 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Keivan Mallahi Karai Prof. Dr. Joachim Vogt

Forms of Learning and Teaching	
Independent Study	90
Lecture	35
Workload Hours	125 hours

Module Components	**Number**	**Type**	**CP**
Mathematical Concepts for the Sciences	CTMS-07	Lecture	5

Module Description

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.

Recommended Knowledge

Review basic mathematical concepts and tools.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods and New Skills area that is part of the

Constructor Track (Methods and New Skills modules; Language and Humanities modules).

- Mandatory for a major in BCCB, CBT, EES, and MCCB

- Elective for all other study programs.

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify important types of quantitative problems in the natural sciences
2	Select	Select and use key solution strategies, methods, and tools
3	Explain	Explain and apply linear algebra concepts and techniques
4	Analyze	Analyze models and observations of natural systems using derivatives and integrals
5	Classify	Classify differential equations, find equilibria, and apply standard solution methods
6	Process	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://wwwmathucdavisedu/~linear/
- KF Riley MP Hobson and SJ Bence (2002) Mathematical methods for physics and engineering Cambridge: Cambridge University Press
- M Corral Vector Calculus (2008) Retrieved from: http://wwwmecmathnet/calc3bookpdf

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Mathematical Concepts for the Sciences	Written Examination	120 minutes	100	45%	1-6

Module Achievements: None

4.2 Introduction to Visual Culture

Module Name	**Introduction to Visual Culture**
Module Code	2025-CTHU-HUM-003
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Dr. Irina Chiaburu

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	**Number**	**Type**	**CP**
Introduction to Visual Culture	CTHU-003	Lecture (Online)	2.5

Module Description

Of the five senses, the sense of sight has for a long time occupied the central position in human cultures. As John Berger has suggested this could be because we can see and recognize the world around us before we learn how to speak. Images have been with us since the earliest days of the human history. In fact, the earliest records of human history are images found on cave walls across the world. We use images to capture abstract ideas, to catalogue and organize the world, to represent the world, to capture specific moments, to trace time and change, to tell stories, to express feelings, to better understand, to provide evidence and more. At the same time, images exert their power on us, seducing us into believing in their 'innocence', that is into forgetting that as representations they are also interpretations, i.e., a particular version of the world.

The purpose of this course is to explore multiple ways in which images and the visual in general mediate and structure human experiences and practices from more specialized discourses, e.g., scientific discourses, to more informal and personal day-to-day practices, such as self-fashioning in cyberspace. We will look at how social and historical contexts affect how we see, as well as what is visible and what is not. We will explore the centrality of the visual to the intellectual activity, from early genres of scientific drawing to visualizations of big data. We will examine whether one can speak of visual culture of protest, look at the relationship between looking and subjectivity and, most importantly, ponder the relationship between the visual and the real.

Intended Learning Outcomes

No	**Competence**	**ILO**

1	Understand	Understand a range of key concepts pertaining to visual culture, art theory and cultural analysis.
2	Understand	Understand the role visuality plays in development and maintenance of political, social, and intellectual discourses.
3	Think	Think critically about images and their contexts.
4	Reflect	Reflect critically on the connection between seeing and knowing.

Indicative Literature

- Berger, J., Blomberg, S., Fox, C., Dibb, M., & Hollis, R. (1973). Ways of seeing.
- Foucault, M. (2002). The order of things: an archaeology of the human sciences (Ser. Routledge classics). Routledge.
- Hunt, L. (2004). Politics, culture, and class in the French revolution: twentieth anniversary edition, with a new preface (Ser. Studies on the history of society and culture, 1). University of California Press.
- Miller, V. (2020). Understanding digital culture (Second). SAGE.
- Thomas, N. (1994). Colonialism's culture: anthropology, travel and government. Polity Press.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Introduction to Visual Culture	Written Examination	60 minutes	100	45%	1-4

Module Achievements: None

4.3 Introduction to the Philosophy of Science

Module Name	Introduction to the Philosophy of Science
Module Code	2025-CTHU-HUM-002
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Dr. Eoin Ryan

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	Number	Type	CP
Introduction to the Philosophy of Science	CTHU-002	Lecture (Online)	2.5

Module Description

This humanities module will introduce students to some of the central ideas in philosophy of science. Topics will include distinguishing science from pseudo-science, types of inference and the problem of induction, the pros and cons of realism and anti-realism, the role of explanation, the nature of scientific change, the difference between natural and social sciences, scientism and the values of science, as well as some examples from philosophy of the special sciences (e.g., physics, biology).

The course aims to give students an understanding of how science produces knowledge, and some of the various contexts and issues which mean this process is never entirely transparent, neutral, or unproblematic. Students will gain a critical understanding of science as a human practice and technology; this will enable them both to better understand the importance and success of science, but also how to properly critique science when appropriate.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand key ideas from the philosophy of science.
2	Discuss	Discuss different types of inference and rational processes.
3	Describe	Describe differences between how the natural sciences, social sciences and humanities discover knowledge.
4	Identify	Identify ways in which science can be more and less value-laden.
5	Illustrate	Illustrate some important conceptual leaps in the history of science.

Indicative Literature

- Peter Godfrey-Smith Theory and Reality (2021)
- James Ladyman, Understanding Philosophy of Science (2002).
- Paul Song, Philosophy of Science: Perspectives from Scientists (2022).

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Introduction to the Philosophy of Science	Written Examination	60 minutes	100	45%	1-5

Module Achievements: None

4.4 Introduction to Philosophical Ethics

Module Name	Introduction to Philosophical Ethics
Module Code	2025-CTHU-HUM-001
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Dr. Eoin Ryan

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	Number	Type	CP
Introduction to Philosophical Ethics	CTHU-001	Lecture (Online)	2.5

Module Description

The nature of morality - how to lead a life that is good for yourself, and how to be good towards others - has been a central debate in philosophy since the time of Socrates, and it is a topic that continues to be vigorously discussed. This course will introduce students to some of the key aspects of philosophical ethics, including leading normative theories of ethics (e.g. consequentialism or utilitarianism, deontology, virtue ethics, natural law ethics, egoism) as well as some important questions from metaethics (are useful and generalizable ethical claims even possible; what do ethical speech and ethical judgements actually do or explain) and moral psychology (how do abstract ethical principles do when realized by human psychologies). The course will describe ideas that are key factors in ethics (free will, happiness, responsibility, good, evil, religion, rights) and indicate various routes to progress in understanding ethics, as well as some of their difficulties.

Intended Learning Outcomes

No	Competence	ILO
1	Describe	Describe normative ethical theories such as consequentialism, deontology and virtue ethics.
2	Discuss	Discuss some metaethical concerns.
3	Analyze	Analyze ethical language.
4	Highlight	Highlight complexities and contradictions in typical ethical commitments.
5	Indicate	Indicate common parameters for ethical discussions at individual and social levels.

6	Analyze	Analyze notions such as objectivity, subjectivity, universality, pluralism, value.

Indicative Literature

- Simon Blackburn Being Good (2009).
- Russ Shafer-Landay A Concise Introduction to Ethics (2019).
- Mark van Roojen Metaethicas: A Contemporary Introduction (2015).

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Introduction to Philosophical Ethics	Written Examination	60 minutes	100	45%	1-6

Module Achievements: None

4.5 Fundamentals of Earth Sciences

Module Name	Fundamentals of Earth Sciences
Module Code	2025-CH-132
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 1 - 2025-minor-ES 1 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Vikram Unnithan Prof. Dr. Michael Bau

Forms of Learning and Teaching	
Lecture	35
Laboratory	17.5
Independent Study	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Fundamentals of Earth Sciences	CH-132-A	Lecture	5
Fundamentals of Earth Sciences – Lab	CH-132-B	Laboratory	2.5

Module Description

This module introduces earth sciences focussing on physical and historical geology. The module provides a basic understanding of how our planet works and has worked in the past. Students learn about the fundamental concepts of plate tectonics, the internal structure and evolution of the earth, identification of minerals and rocks and their role in the rock cycle. Elements from historical geology provide important concepts such as geological time and an understanding that geological, biological, and environmental processes are interrelated and interconnected but may have different timescales. Students are encouraged to think about the interconnectedness of the Earth as a system and its importance especially in the light of dwindling energy and mineral resources, climate change and growing population. Hands-on practical lab work forms an essential part of this module, whereby students will be introduced to geological methods and techniques such as working with rock samples, geological maps, and Earth data to explore concepts described during the lectures.

Recommended Knowledge

Reading Material - Earth Science Literacy Principles http://www.earthscienceliteracy.org/esliteracy6may10_.pdf

Usability and Relationship to other Modules

CHOICE module, mandatory for ESSMER majors, usable by all

Intended Learning Outcomes

No	Competence	ILO
1	Describe	Describe the general structure of the Earth, and the fundamental concepts of plate tectonics and geological structures
2	Recognize	Recognize, identify and categorize the major rock-forming minerals, indicating the causative geological processes
3	Identify	Identify how Earth materials are transformed by rock cycle processes
4	Appreciate	Appreciate the development of the geological time scale, the role of stratigraphy and absolute and relative time in the recognition of key events in the geological evolution of Earth, and their current relevance
5	Discuss	Discuss "the present is the key to the past" natural processes in the past and present and their implications for the future

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 (2019) Salt Lake City: Salt Lake Community College

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Fundamentals of Earth Sciences	Written Examination	180 minutes	100	45%	All
Fundamentals of Earth Sciences – Lab					

Module Achievements: a minimum of 80% attendance in the Lab component is a prerequisite ("Studienbegleitleistung") for being admitted to the exam.

4.6 Microeconomics

Module Name	Microeconomics
Module Code	2025-CH-310
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-GEM-BA 1 - 2025-IBA-BA 1 - 2025-ESSMER-BSc 1 - 2025-Minor-Gem-BA 1 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-GEM-BA (Global Economics and Management)
Module Coordinator(s)	Prof. Dr. Fabian Dehos

Forms of Learning and Teaching	
Lecture	35
Seminar	17.5
Independent Study	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Microeconomics Theory and Policy	CH-310-A	Lecture	5
Microeconomics - Tutorial	CH-310-B	Tutorial	2.5

Module Description

The study of economics is concerned with the allocation of scarce resources and the associated implications for efficiency, equity, and human welfare. This module introduces the field of microeconomics, focusing on the role of markets in facilitating exchanges between different sectors of the economy such as workers, consumers, firms, and government institutions. Topics addressed include consumer theory, the cost structures and behavior of firms in various industries, competition, monopoly, and government regulation. The module applies theoretical concepts to contemporary policy questions, such as when government intervention is justified to correct market imperfections.

This module aims at transmitting fundamental knowledge of economics at the level of economic agents. A command of microeconomics constitutes the basis for undergraduate studies in the fields of economics and management and helps make sense of economic behaviors in many situations, including professional settings. With its focus on questions of welfare and the policy implications of microeconomic theories, this module also enables students to understand public affairs from an economic perspective at the micro level and promotes their capacity to differentiate among and explain the concepts taught in class. Textbook-based lectures ensure the transmission of the necessary knowledge. The accompanying, interactive tutorials further promote the students' capacity to describe and give examples of the concepts taught in class.

Recommended Knowledge

- Logical reasoning

- High school mathematics

- To prepare for this module, students are recommended to read the article "Research on teaching economics to undergraduates," published in the Journal of Economic Literature in 2015. The article will allow students to get a first-hand look at the challenges of teaching economics from the viewpoint of those who teach it.

Usability and Relationship to other Modules

This module transmits fundamental knowledge of microeconomics that is necessary to the second-year modules "Public Economics and Policy", "Environmental and Resource Economics", "Comparing Economic Systems" and "International Economics". This module further benefits from the contents taught in its accompanying "Macroeconomics" as the combination of the two offers a comprehensive view of economic questions from the interaction of economic agents to the aggregated level.

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain how economic concepts such as opportunity costs and the gains from trade can be applied to a range of themes of relevance to human welfare.
2	Understand	Understand the basics of consumer and producer behavior, and how interactions between consumers and producers give rise to market outcomes that have implications for welfare.
3	Use	Use graphical depictions to derive insights into how markets function.
4	Identify	Identify the key features that distinguish perfectly competitive markets from non-competitive markets as well as the sources of market failure.
5	Recognize	Recognize that economics is a social science that seeks to answer both positive and normative questions.
6	Distinguish	Distinguish between equity and efficiency when evaluating the outcomes of economic policies.
7	Use	Use economic concepts to critically assess the case for government policies that affect the functioning of markets.

Indicative Literature

- Hayek, F. A. (1945). The use of knowledge in society. American Economic Review, 35(4): 519-530.
- King, M. L., Jr. (1963). Letter from a Birmingham jail.
- Thaler, R. H. (2016). Behavioral economics: Past, present, and future. American Economic Review, 106(7): 1577-1600.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Microeconomics Theory and Policy	Written Examination	120 minutes	100	45%	1-7
Microeconomics - Tutorial					

Module Achievements: None

4.7 Applied Statistics with R

Module Name	Applied Statistics with R
Module Code	2025-CTMS-MET-03
Module ECTS	5
Study Semester	Mandatory status for: - 2025-GEM-BA 2 - 2025-MDDA-BSc 2 - 2025-IBA-Online-BA 2 - 2025-ESSMER-BSc 2 - 2025-ISCP-BA 2 - 2025-IEM-BSc 2 Mandatory Elective status for: - 2025-IBA-BA 2 - 2025-IRPH-BA 2
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Adalbert F.X. Wilhelm

Forms of Learning and Teaching	
Assessment Preparation	10
Lecture	17.5
Independent Study	80
Laboratory	17.5
Workload Hours	125 hours

Module Components	Number	Type	CP
Applied Statistics with R	CTMS-03	Lecture and Laboratory	5

Module Description

We live in a world full of data and more and more decisions are taken based on a comprehensive analysis of data. A central method of data analysis is the use of models describing the relationship between a set of predictor variables and a response. This module provides a thorough introduction to quantitative data analysis covering graphical representations, numerical summary statistics, correlation, and regression models. The module also introduces the fundamental concepts of statistical inference. Students learn about the different data types, how to best visualize them and how to draw conclusions from the graphical representations. Students will learn in this module the ideas and techniques of regression models within the generalized linear model framework involving multiple predictors and co-variates. Students will learn how to become an intelligent user of statistical techniques from a prosumers perspective to assess the quality of presented statistical results and to produce high-quality analyses by themselves. By using illustrative examples from economics, engineering, and the natural and social sciences students will gain the relevant background knowledge for their specific major as well as an interdisciplinary glimpse of other research fields. The general objective of the module is to enable students to become skilled statistical modelers who are well versed in the various assumptions, limitations, and controversies of statistical models and their application. Regular exercises and practical sessions will corroborate the students' proficiency with the statistical software R.

Recommended Knowledge

Get acquainted to statistical thinking by watching online videos for introductory probability and statistics as well as paying attention whenever arguments are backed up by empirical data

Usability and Relationship to other Modules

- Quantitative analytical skills are used and needed in many modules of all study programs

- Pre-requisite for Econometrics

- This module introduces students to R in preparation for the 2nd year mandatory method module on econometrics and 3rd year module on advanced econometrics

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply basic techniques in statistical modeling and quantitative research methods.
2	Describe	Describe fundamental statistical concepts, procedures, their assumptions and statistical fallacies.
3	Explain	Explain the potential of using quantitative methods in all fields of applications.
4	Express	Express informed skepticism of the limitations of statistical reasoning.
5	Interpret	Interpret statistical modeling results in scientific publications.
6	Perform	Perform basic and intermediate-level statistical analyses of data, using R.

Indicative Literature

- Michael J. Crawley (2013). The R Book, Second Edition. Hoboken: John Wiley & Sons.
- Peter Daalgard (2008). Introductory Statistics with R. Berlin: Springer.
- John Maindonald, W. John Braun (2010). Data Analysis and Graphics Using R – an Example-Based Approach, Third Edition, Cambridge Series. In Statistical and Probabilistic Mathematics. Cambridge: Cambridge University Press.
- Christopher Gandrud (2015). Reproducible Research with R and RStudio, Second Edition. The R Series, Chapman & Hall/CRC Press.
- Randall E. Schumacker (2014). Learning Statistics Using R. Thousand Oaks: Sage.
- Charles Wheelan (2013). Naked Statistics: Stripping the Dread from The Data. New York: W.W. Norton & Company.

Entry Requirements

Prerequisites	None
Co-requisites	None

Additional Remarks	None

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Applied Statistics with R	Written Examination	120 minutes	100	45%	All

Module Achievements: None

4.8 Environmental Systems and Global Change

Module Name	Environmental Systems and Global Change
Module Code	2025-CH-133
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 2 - 2025-minor-ES 2 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Andrea Koschinsky

Forms of Learning and Teaching	
Lecture	55
Laboratory	25
Independent Study	107.5
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Environmental Systems and Global Change	CH-133-A	Seminar	5
Environmental Systems Lab	CH-133-B	Laboratory	2.5

Module Description

The module is an introduction to how planet Earth works with a focus on the natural processes that affect and shape the surface of the Earth, and the environmental issues pertinent to society. 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. The module aims 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 module will consider both terrestrial systems such as freshwater and soil systems, as well as marine systems, always in the context of their special environmental parameters and related environmental vulnerability or resilience.

Usability and Relationship to other Modules

Recommended for all ESSMER CHOICE and CORE modules.

Intended Learning Outcomes

No	Competence	ILO
1	Discuss	Discuss natural processes that shape the Earth and the implications these processes have for the evolution of our planet and the environment
2	Connect	Connect environmental conditions to the development of specific adapted terrestrial and marine ecosystems
3	Appreciate	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
4	Assess	Assess the extraction and use of various natural resources, land-use and climate change, and the impact these changes have on society
5	Critically	Critically assess the natural and human-driven systems and processes that provide resources, produce energy and affect the climate and our Earth surface environment
6	Apply	Apply sedimentological, chemical and biological data as proxies to reconstruct ancient environments and climate
7	Suggest	Suggest mitigation strategies to remediate water, soil and air pollution, negative changes in the marine system, and global warming
8	Demonstrate	Demonstrate awareness of the difficulties involved in the detection of any unusual environmental change signal above the background noise of natural variability

Indicative Literature

- United Nations Environmental Programme (2015). One Planet Many People. Retrieved from: https://na.unep.net/atlas/onePlanetManyPeople/book.php
- William F. Ruddiman: Earth's Climate – Past and Future. New York, W.H. Freeman and Company

Entry Requirements

Prerequisites	Fundamentals of Earth Sciences
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Environmental Systems and Global Change	Written Examination	120 minutes	100	45%	All

Environmental Systems Lab					

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

4.9 Macroeconomics

Module Name	Macroeconomics
Module Code	2025-CH-311
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-IBA-BA 2 - 2025-GEM-BA 2 - 2025-ESSMER-BSc 2 - 2025-Minor-Gem-BA 2 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-GEM-BA (Global Economics and Management)
Module Coordinator(s)	Prof. Dr. Colin Vance

Forms of Learning and Teaching	
Lecture	35
Tutorial	17.5
Independent Study	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Macroeconomics Theory and Policy	CH-311-A	Lecture	5
Macroeconomics - Tutorial	CH-311-B	Tutorial	2.5

Module Description

The study of economics is concerned with the allocation of scarce resources and the associated implications for efficiency, equity, and human welfare. The subdiscipline of macroeconomics investigates the workings of the overall economy, focusing on how shifts in aggregate demand and supply affect variables such as employment, gross domestic product, inflation, and the balance of trade. This module applies theoretical concepts from macroeconomics to contemporary policy questions, such as when, why and how governments intervene in the economy. The module will distinguish fiscal and monetary policies, and what these government interventions mean for various markets and economic actors. The lectures cover the material students need to know to take and pass the module examination. In the tutorials, the students further integrate the material taught in the lectures via discussions of related concepts, policy problems, scientific studies, and exercises.

A command of macroeconomics constitutes the basis for undergraduate studies in the fields of economics and management, further preparing students for graduate study in these fields. Beyond these academic qualifications, students will be equipped with analytical tools that and help make sense of the economic conditions that affect both their private and professional lives. With its coverage of market regulation and the policy implications of macroeconomic theories, this module also enables students to understand public affairs from the perspective of whole economies. Textbook-based lectures ensure the transmission of the necessary knowledge. The accompanying, interactive tutorials further promote the students' capacity to differentiate and explain the concepts taught in class.

Recommended Knowledge

- Logical reasoning

- High school mathematics

Usability and Relationship to other Modules

This module transmits fundamental knowledge of macroeconomics that is necessary to the second-year modules "Public Economics and Policy", "Environmental and Resource Economics", "Comparing Economic Systems" and "International Economics". This module further benefits from the contents taught in its accompanying module "Microeconomics" as the combination of the two offers a comprehensive view of economic questions from the interaction of economic agents to the aggregated level.

Intended Learning Outcomes

No	Competence	ILO
1	Express	Express and discuss ways to analyze the performance of national economies through key indicators such as GDP growth, unemployment, inflation, government deficit and trade imbalances.
2	Explain	Explain and differentiate the goals and effectiveness of government interventions to combat economic crises in the form of monetary and fiscal policies.
3	Describe	Describe how supply side measures such as improvements in infrastructure, education, and research can improve long-term growth and the international competitiveness of national economies.
4	Assess	Assess the distributional consequences of economic development and economic policy decisions.
5	Explain	Explain the policy implications of macroeconomic theories.

Indicative Literature

- Goodwin, N., Harris, J., Rajkarnikar, P. J., Roach, B. Torras, M. (2019). Macroeconomics in context. London: Routledge.
- Snowdown, B., Vane, H. R. (2005). Modern macroeconomics. Its origins, development and current state. Cheltenham: Edward Elgar.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Macroeconomics Theory and Policy	Written Examination	120 minutes	100	45%	1-5
Macroeconomics - Tutorial					1-5

Module Achievements: None

4.10 Logic (perspective II)

Module Name	Logic (perspective II)
Module Code	2025-CTNS-NSK-02
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Jules Coleman

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	Number	Type	CP
Logic (perspective II)	CTNS-02	Lecture (Online)	2.5

Module Description

The focus of this module is on formal systems of logic, since they are at the heart of both scientific argumentation and computer developed algorithms. There are in fact many kinds of logic and all figure to varying degrees in scientific inquiry. There are inductive types of logic, which purport to formalize the relationship between premises that if true offer evidence on behalf of a conclusion and the conclusion and are represented as claims about the extent to which the conclusion is confirmed by the premises. There are deductive types of logic, which introduce a different relationship between premise and conclusion. These variations of logic consist in rules that if followed entail that if the premises are true then the conclusion too must be true.

This module introduces logics that go beyond traditional deductive propositional logic and predicate logic and as such it is aimed at students who are already familiar with basics of traditional formal logic. The aim of the module is to provide an overview of alternative logics and to develop a sensitivity that there are many different logics that can provide effective tools for solving problems in specific application domains.

The module first reviews the principles of a traditional logic and then introduces many-valued logics that distinguish more than two truth values, for example true, false, and unknown. Fuzzy logic extends traditional logic by replacing truth values with real numbers in the range 0 to 1 that are expressing how strong the believe into a proposition is. Modal logics introduce modal operators expressing whether a proposition is necessary or possible. Temporal logics deal with propositions that are qualified by time. One can view temporal logics as a form of modal logics where propositions are qualified by time constraints. Interval temporal logic provides a way to reason about time intervals in which propositions are true.

The module will also investigate the application of logic frameworks to specific classes of problems. For example, a special subset of predicate logic, based on so-called Horn clauses, forms the basis of logic programming languages such as Prolog. Description logics, which are usually decidable logics, are used to model relationships and they have applications in the semantic web, which enables search engines to reason about resources present on the Internet.

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply the various principles of logic.
2	Explain	Explain practical relevance of non-standard logic.
3	Describe	Describe how many-valued logic extends basic predicate logic.
4	Apply	Apply basic rules of fuzzy logic to calculate partial truth values.
5	Sketch	Sketch basic rules of temporal logic.
6	Implement	Implement predicates in a logic programming language.
7	Prove	Prove some simple non-standard logic theorems.

Indicative Literature

- Bergmann, Merry. “An Introduction to Many-Valued and Fuzzy Logic: Semantics, Algebras, and Derivation Systems”, Cambridge University Press, April 2008.
- Sterling, Leon S., Ehud Y. Shapiro, Ehud Y. "The Art of Prolog", 2nd edition, MIT Press, March 1994.
- Fisher, Michael. "An Introduction to Practical Formal Methods Using Temporal Logic", Wiley, Juli 2011.
- Baader, Franz. "The Description Logic Handbook: Theory Implementation and Applications", Cambridge University Press, 2nd edition, May 2010.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Logic (perspective II)	Written Examination	60 minutes	100	45%	All

Module Achievements: None

4.11 Physics of Planet Earth

Module Name	Physics of Planet Earth
Module Code	2025-CO-471
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 3 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Joachim Vogt

Forms of Learning and Teaching	
Lecture	52.5
Independent Study	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Physical Concepts for Earth Sciences	CO-471-A	Lecture	2.5
Introduction to Geophysics	CO-471-B	Lecture	2.5
Atmosphere and Climate Physics	CO-471-C	Lecture	2.5

Module Description

The module introduces the physics of fundamental Earth structures and processes. The course Physical Concepts for Earth Sciences reviews and summarizes relevant descriptions and methods from different physical disciplines, most notably classical mechanics, fluid dynamics, thermodynamics, electromagnetism, and radiation physics. The course Introduction to Geophysics is concerned with the physics of Earth as a planet, including physical principles governing the structure of the interior and the atmosphere, Earth’s gravity, and the geomagnetic field. The course Atmosphere and Climate Physics discusses atmosphere formation and stability, the vertical structure of the atmosphere, heat transfer processes, global circulation and winds, and the physics of the climate system, with an introduction to climate modeling.

Recommended Knowledge

Introductory courses on Earth Sciences, Mathematical Concepts, basic physics

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain key physical processes that are relevant for Earth Sciences

2	Apply	Apply selected physical concepts and methods to problems in Earth Sciences
3	Identify	Identify basic physical principles governing important planetary processes
4	Understand	Understand global geophysical fields and their variability
5	Describe	Describe the structure and the global dynamics of the atmosphere
6	Characterize	Characterize the climate system and the physics of climate change

Indicative Literature

- E. J. Tarbuck et al.: Earth Science, Pearson Education
- H. Goose et al.: Introduction to Climate Dynamics and Climate Modeling, online textbook available at http://www.climate.be/textbook
- M. Salby: Fundamentals of Atmospheric Physics, Elsevier

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Physical Concepts for Earth Sciences	Written Examination	180 minutes	100	45%	All
Introduction to Geophysics					
Atmosphere and Climate Physics					

Module Achievements: None

4.12 Logic (perspective I)

Module Name	Logic (perspective I)
Module Code	2025-CTNS-NSK-01
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Jules Coleman

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	Number	Type	CP
Logic (perspective I)	CTNS-01	Lecture (Online)	2.5

Module Description

Suppose a friend asks you to help solve a complicated problem? Where do you begin? Arguably, the first and most difficult task you face is to figure out what the heart of the problem actually is. In doing that you will look for structural similarities between the problem posed and other problems that arise in different fields that others may have addressed successfully. Those similarities may point you to a pathway for resolving the problem you have been asked to solve. But it is not enough to look for structural similarities. Sometimes relying on similarities may even be misleading. Once you've settled tentatively on what you take to be the heart of the matter, you will naturally look for materials, whether evidence or arguments, that you believe is relevant to its potential solution. But the evidence you investigate of course depends on your formulation of the problem, and your formulation of the problem likely depends on the tools you have available - including potential sources of evidence and argumentation. You cannot ignore this interactivity, but you can't allow yourself to be hamstrung entirely by it. But there is more. The problem itself may be too big to be manageable all at once, so you will have to explore whether it can be broken into manageable parts and if the information you have bears on all or only some of those parts. And later you will face the problem of whether the solutions to the particular sub problems can be put together coherently to solve the entire problem taken as a whole.

What you are doing is what we call engaging in computational thinking. There are several elements of computational thinking illustrated above. These include: Decomposition (breaking the larger problem down into smaller ones); Pattern recognition (identifying structural similarities); Abstraction (ignoring irrelevant particulars of the problem): and Creating Algorithms), problem-solving formulas.

But even more basic to what you are doing is the process of drawing inferences from the material you have. After all, how else are you going to create a problem-solving formula, if you draw incorrect inferences about what information has shown and what, if anything follows logically from it. What you must do is apply the rules of logic to the information to draw inferences that are warranted.

We distinguish between informal and formal systems of logic, both of which are designed to indicate fallacies as well as warranted inferences. If I argue for a conclusion by appealing to my physical ability to coerce you, I prove nothing about the truth of what I claim. If anything, by doing so I display my lack of confidence in my argument. Or if the best I can do is berate you for your skepticism, I have done little more than offer an ad hominem instead of an argument. Our focus will be on formal systems of logic, since they are at the heart of both scientific argumentation and computer developed algorithms. There are in fact many different kinds of logic and all figure to varying degrees in scientific inquiry. There are inductive types of logic, which purport to formalize the relationship between premises that if true offer evidence on behalf of a conclusion and the conclusion and are represented as claims about the extent to which the conclusion is confirmed by the premises. There are deductive types of logic, which introduce a different relationship between premise and conclusion. These variations of logic consist in rules that if followed entail that if the premises are true then the conclusion too must be true.

There are also modal types of logic which are applied specifically to the concepts of necessity and possibility, and thus to the relationship among sentences that include either or both those terms. And there is also what are called deontic logic, a modification of logic that purport to show that there are rules of inference that allow us to infer what we ought to do from facts about the circumstances in which we find ourselves. In the natural and social sciences most of the emphasis has been placed on inductive logic, whereas in math it is placed on deductive logic, and in modern physics there is an increasing interest in the concepts of possibility and necessity and thus in modal logic. The humanities, especially normative discussions in philosophy and literature are the province of deontic logic.

This module will also take students through the central aspects of computational thinking, as it is related to logic; it will introduce the central concepts in each, their relationship to one another and begin to provide the conceptual apparatus and practical skills for scientific inquiry and research.

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply the various principles of logic and expand them to computational thinking.
2	Understand	Understand the way in which logical processes in humans and in computers are similar and different at the same time.
3	Apply	Apply the basic rules of first-order deductive logic and employ them rules in the context of creating a scientific or social scientific study and argument.
4	Employ	Employ those rules in the context of creating a scientific or social scientific study and argument.

Indicative Literature

- Frege, Gottlob (1879), Begriffsschrift, eine der arithmetischen nachgebildete Formelsprache des reinen Denkens [Translation: A Formal Language for Pure Thought Modeled on that of Arithmetic],Halle an der Salle: Verlag von Louis Nebert.
- Gödel, Kurt (1986), Russels mathematische Logik. In: Alfred North Whitehead, Bertrand Russell: Principia Mathematica. Vorwort, S. V–XXXIV. Suhrkamp.
- Leeds, Stephen. "George Boolos and Richard Jeffrey. Computability and logic. Cambridge University Press, New York and London1974, x+ 262 pp." The Journal of Symbolic Logic 42.4 (1977): 585-586.
- Kubica, Jeremy. Computational fairy tales. Jeremy Kubica, 2012.
- McCarthy, Timothy. "Richard Jeffrey. Formal logic: Its scope and limits. of XXXVIII 646. McGraw-Hill Book Company, New York etc. 1981, xvi+ 198 pp." The Journal of Symbolic Logic 49.4 (1984): 1408-1409.

<u>Entry Requirements</u>

Prerequisites	None
Co-requisites	None
Additional Remarks	None

<u>Assessment and Completion</u>

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Logic (perspective I)	Written Examination	60 minutes	100	45%	All

Module Achievements: None

4.13 Geochemistry of Environmental Systems

Module Name	Geochemistry of Environmental Systems
Module Code	2025-CO-466
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 3 - 2025-minor-ES 3 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Michael Bau Prof. Dr. Andrea Koschinsky

Forms of Learning and Teaching	
Lecture	37.5
Tutorial	15
Homework	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Geochemistry of Environmental Systems	CO-466-A	Lecture and Seminar	7.5

Module Description

This module introduces the geochemistry of natural systems ranging from igneous and sedimentary rocks, aqueous systems (e.g., freshwater, groundwater, seawater and other natural waters) and soils with respect to major and trace elements, and organic compounds. Stable and radiogenic isotope geochemistry will be addressed and how the distribution and behaviour of elements and their isotopes are controlled by chemical processes in relation to environmental conditions. The theoretical framework will be provided by lectures that are complemented by tutorials and homework assignments in which students will apply trace element and isotope geochemical tools in a quantitative way to solve basic geochemical problems related to, for example, element behavior during water-rock interaction during weathering and changing climatic conditions. The module also provides the knowledge to assess the distribution and potential bioavailability of chemical compounds in the environment and hence their role as nutrients and/or contaminants. In addition to the study of natural systems, the anthropogenic change of natural elemental cycles as well as the introduction of industrial compounds into the environment and their fate will be addressed. Students learn to understand the implications of these anthropogenic interventions with organisms including humans and evaluate environmental mitigation and remediation techniques.

Recommended Knowledge

Please review the content of the ESSMER CHOICE modules:

- Fundamentals of Earth Sciences

- Environmental Systems and Global Change

Usability and Relationship to other Modules

This module builds on the ESSMER CHOICE modules "Fundamentals of Earth Sciences" and "Environmental Systems and Global Change"

Intended Learning Outcomes

No	Competence	ILO
1	Classify	Classify elements according to their physico-chemical characteristics and behavior in natural systems
2	Characterize	Characterize the fundamental parameters and processes that control the behavior of elements in aqueous natural systems
3	Predict	Predict and quantify the behavior of major and trace elements and organics in natural aqueous systems
4	Characterize	Characterize and apply the radiogenic isotope systems commonly used in geochronology and as source proxies
5	Characterize	Characterize and apply the stable isotope systems commonly used in biogeochemistry
6	Assess	Assess the potential environmental impact of different elements based on their specific geochemical behavior
7	Assess	Assess the risk and possible mitigation and remediation strategies of contamination with anthropogenic chemical compounds

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 14: Organic Geochemistry; 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
- Schwedt, G. (2001). The Essential Guide to Environmental Chemistry. Wiley

Entry Requirements

Prerequisites	Fundamentals of Earth Sciences Environmental Systems and Global Change
Co-requisites	Chemistry for Natural Sciences
Additional Remarks	

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Geochemistry of Environmental Systems	Written Examination	180 minutes	100	45%	All

Module Achievements: None

4.14 Chemistry for Natural Sciences

Module Name	Chemistry for Natural Sciences
Module Code	2025-CTMS-SCI-15
Module ECTS	5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 3 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Andrea Koschinsky

Forms of Learning and Teaching	
Lecture	17.5
Laboratory	17.5
Independent Study	90
Workload Hours	125 hours

Module Components	Number	Type	CP
Chemistry for Natural Sciences	CTMS-15-A	Lecture	2.5
Chemistry for Natural Sciences Lab	CTMS-15-B	Laboratory	2.5

Module Description

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 provide 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 demonstrate 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.

Recommended Knowledge

Methods track

Intended Learning Outcomes

No	Competence	ILO

1	Describe	Describe the basis of atomic theory and explain the structure of an atom, ions and electronic configuration
2	Describe	Describe periodic trends for groups and periods
3	Calculate	Calculate molecules, molar mass, moles and molarity
4	Identify	Identify the types of chemical reactions in natural systems
5	Relate	Relate bonding and intermolecular forces to the structure of solids and molecules
6	Apply	Apply the principles of pH, acids and bases as well as the action of buffers
7	Balance	Balance chemical reactions
8	Explain	Explain and calculate equilibrium constants for different types of reactions
9	Name	Name simple organic compounds and identify common functional groups
10	Describe	Describe the chemical reactions and physical properties of hydrocarbons
11	Apply	Apply their knowledge of common organic functional groups to predict simple reaction products
12	Participate	Participate effectively in group work and problem solving through participation in lab practical sessions
13	Work	Work safely in the laboratory under supervision
14	Carry	Carry out simple sample preparation techniques including grinding, weighing, drying, filtration, and performing dilutions
15	Determine	Determine pH, redox potential and conductivity in water samples
16	Analyze	Analyze key components such as nutrients in natural water samples using photometry and other simple analytical tools
17	Identify	Identify the aims of a laboratory experiment, record procedures and results accurately, interpret them, and draw conclusions
18	Critically	Critically assess accuracy and errors in lab techniques

Indicative Literature

- Schwedt, G., & Haderlie, B. (1997). The essential guide to analytical chemistry. New York: Wiley
- Timberlake, K. C. (2016). Basic chemistry. Global Edition, 5th edition: Pearson Education

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs

Chemistry for Natural Sciences	Written Examination	120 minutes	50	45%	All
Chemistry for Natural Sciences Lab			50		

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

4.15 Natural Resources and Hazards

Module Name	Natural Resources and Hazards
Module Code	2025-CO-467
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 4 - 2025-minor-ES 4 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Vikram Unnithan Prof. Dr. Michael Bau

Forms of Learning and Teaching	
Lecture	37.5
Tutorial	15
Homework	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Natural Resources and Hazards	CO-467-A	Lecture and Seminar	7.5

Module Description

This module provides an introduction to the field of natural resources (i.e. environmental and mineral resources, the latter with special emphasis on resources of critical high-technology metals for enabling technologies, such as rare earth elements, gallium, or lithium), to the processes that affect the environmental impact of resource exploitation and on the recognition and appreciation of environmental resources such as soil and freshwater as essential and hence precious natural resources. The risks and hazards related to the exploitation of both environmental and mineral resources will be addressed and will be discussed in relation to other natural risks such as earthquakes, volcanic eruptions, droughts and

floods.

Recommended Knowledge

Please review the content of the ESSMER CHOICE and CORE modules:

- Fundamentals of Earth Sciences

- Environmental Systems and Global Change

- Geochemistry of Environmental Systems

Usability and Relationship to other Modules

This module builds the ESSMER CHOICE modules “Fundamentals of Earth Sciences” and “Environmental Systems and Global Change” and on the CORE module “Geochemistry of Environmental Systems”

Intended Learning Outcomes

No	Competence	ILO
1	Recognize	Recognize and characterize the major different types of environmental and mineral resources
2	Relate	Relate specific geological processes and environmental conditions to the formation and preservation of environmental and mineral resources
3	Appraise	Appraise and apply the concept of "criticality" in the context of environmental and mineral resource
4	Understand	Understand and critically assess the potential role of risks and hazards to sustainable use of environmental and mineral resources

Indicative Literature

- H Robb, L. (2005). Introduction to Ore-Forming Processes. Hoboken: Blackwell
- and others (to be defined)

Entry Requirements

Prerequisites	Fundamentals of Earth Sciences Environmental Systems and Global Change Chemistry for Natural Sciences Geochemistry of Environmental Systems
Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Natural Resources and Hazards	Written Examination	180 minutes	100	45%	All

Module Achievements: None

4.16 Advanced Field Laboratories

Module Name	Advanced Field Laboratories
Module Code	2025-CO-472
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 4 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Vikram Unnithan Prof. Dr. Michael Bau

Forms of Learning and Teaching	
Lecture	4.5
Laboratory	
Workload Hours	4.5 hours

Module Components	Number	Type	CP
Applying Geoscientific Methods in the Field I: Eifel, GER	CO-472-A	Excursion	2.5
Applying Geoscientific Methods in the Field II: Dingle, IRL	CO-472-B	Excursion	5

Module Description

This module consists of two components, both of which focus on the application of methods and techniques used in resource and environmental geology, geochemistry, geophysics and oceanography. While the first module component (I) introduces the basic geoscientific methods and techniques used in the real-life environment, the extended field laboratory (II) builds upon and expands and complements component I. Students will be made familiar with geological features at various scales and with techniques applied in geological, geochemical, geophysical and oceanographic field work. The module focuses on geological sequences that illustrate the chemical evolution of and the interconnections within the Earth's lithosphere, hydrosphere and atmosphere. A mapping project complements the FieldCamp.

Recommended Knowledge

Please review the content of the ESSMER CHOICE and CORE modules:

- Fundamentals of Earth Sciences

- Environmental Systems and Global Change

- Geochemistry of Environmental Systems

Usability and Relationship to other Modules

This module builds the ESSMER CHOICE modules “Fundamentals of Earth Sciences” and “Environmental Systems and Global Change” and on the CORE modules “Geochemistry of Environmental Systems” and “Natural Resources and risks”

Intended Learning Outcomes

No	Competence	ILO
1	Review	Review, research and discuss relevant literature on the field topic
2	Apply	Apply concepts, methods and analyses to real world problems including anthropogenic impact
3	Perform	Perform and actively contribute to geological and oceanographic field studies
4	Prepare	Prepare a scientific report using relevant terminology and illustrations
5	Demonstrate	Demonstrate the ability to work individually but also as part of a group in a field situation

Indicative Literature

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

Entry Requirements

Prerequisites	Fundamentals of Earth Sciences Environmental Systems and Global Change Chemistry for Natural Sciences Geochemistry of Environmental Systems
Co-requisites	Natural Resources and Hazards
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration/ Length	Weight (%)	Minimum	ILOs
Applying Geoscientific Methods in the Field I: Eifel, GER	Laboratory Report	minimum 5 pages	33	45%	All
Applying Geoscientific Methods in the Field II: Dingle, IRL	Laboratory Report	minimum 15 pages	67	45%	All

Module Achievements: None

4.17 Causation and Correlation (perspective I)

Module Name	Causation and Correlation (perspective I)
Module Code	2025-CTNS-NSK-03
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Jules Coleman

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	Number	Type	CP
Causation and Correlation	CTNS-03	Lecture (Online)	2.5

Module Description

In many ways, life is a journey. And also, as in other journeys, our success or failure depends not only on our personal traits and character, our physical and mental health, but also on the accuracy of our map. We need to know what the world we are navigating is actually like, the how, why and the what of what makes it work the way it does. The natural sciences provide the most important tool we have developed to learn how the world works and why it works the way it does. The social sciences provide the most advanced tools we have to learn how we and other human beings, similar in most ways, different in many others, act and react and what makes them do what they do. In order for our maps to be useful, they must be accurate and correctly reflect the way the natural and social worlds work and why they work as they do.

The natural sciences and social sciences are blessed with enormous amounts of data. In this way, history and the present are gifts to us. To understand how and why the world works the way it does requires that we are able to offer an explanation of it. The data supports a number of possible explanations of it. How are we to choose among potential explanations? Explanations, if sound, will enable us to make reliable predictions about what the future will be like, and also to identify many possibilities that may unfold in the future. But there are differences not just in the degree of confidence we have in our predictions, but in whether some of them are necessary future states or whether all of them are merely possibilities? Thus, there are three related activities at the core of scientific inquiry: understanding where we are now and how we got here (historical); knowing what to expect going forward (prediction); and exploring how we can change the paths we are on (creativity).

At the heart of these activities are certain fundamental concepts, all of which are related to the scientific quest to uncover immutable and unchanging laws of nature. Laws of nature are thought to reflect a causal nexus between a previous event and a future one. There are also true statements that reflect universal or nearly universal connections between events past and present that are not laws of nature because the relationship they express is that of a correlation between events. A working thermostat accurately allows us to determine or even to predict the temperature in the room in which it is located, but it does not explain why the room has the temperature it has. What then is the core difference between causal relationships and correlations? At the same time, we all recognize that given where we are now there are many possible futures for each of us, and even had our lives gone just the slightest bit differently than they have, our present state could well have been very different than it is. The relationship between possible pathways between events that have not materialized but could have is expressed through the idea of counterfactual.

Creating accurate roadmaps, forming expectations we can rely on, making the world a more verdant and attractive place requires us to understand the concepts of causation, correlation, counterfactual explanation, prediction, necessity, possibility, law of nature and universal generalization. This course is designed precisely to provide the conceptual tools and intellectual skills to implement those concepts in our future readings and research and ultimately in our experimental investigations, and to employ those tools in various disciplines.

Intended Learning Outcomes

No	Competence	ILO
1	Formulate	Formulate testable hypotheses that are designed to reveal causal connections and those designed to reveal interesting, important and useful correlations.
2	Distinguish	Distinguish scientifically interesting correlations from unimportant ones.
3	Apply	Apply critical thinking skills to evaluate information.
4	Understand	Understand when and why inquiry into unrealized possibility is important and relevant.

Indicative Literature

- Thomas S. Kuhn: The Structure of Scientific Revolutions. Nelson, fourth edition, 2012.
- Goodman, Nelson. Fact, fiction, and forecast. Harvard University Press, 1983.
- Quine Willard, Van Orman, and Joseph Silbert Ullian. The web of belief. Vol 2. New York: Random house, 1978.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs

Causation and Correlation	Written Examination	60 minutes	100	45%	1-4

Module Achievements: None

4.18 Causation and Correlation (perspective II)

Module Name	Causation and Correlation (perspective II)
Module Code	2025-CTNS-NSK-04
Module ECTS	2.5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Dr. Eoin Ryan Dr. Irina Chiaburu Prof. Dr. Keivan Mallahi Karai

Forms of Learning and Teaching	
Independent Study	45
Online Lecture	17.5
Workload Hours	62.5 hours

Module Components	Number	Type	CP
Causation and Correlation (perspective II)	CTNS-04	Lecture (Online)	2.5

Module Description

Causality or causation is a surprisingly difficult concept to understand. David Hume famously noted that causality is a concept that our science and philosophy cannot do without, but it is equally a concept that our science and philosophy cannot describe. Since Hume, the problem of cause has not gone away, and sometimes seems to get even worse (e.g., quantum mechanics confusing previous notions of causality). Yet, ways of doing science that lessen our need to explicitly use causality have become very effective (e.g., huge developments in statistics). Nevertheless, it still seems that the concept of causality is at the core of explaining how the world works, across fields as diverse as physics, medicine, logistics, the law, sociology, and history - and ordinary daily life - through all of which, explanations and predictions in terms of cause and effect remain intuitively central.

Causality remains a thorny problem but, in recent decades, significant progress has occurred, particularly in work by or inspired by Judea Pearl. This work incorporates many 20th century developments, including statistical methods - but with a reemphasis on finding the why, or the cause, behind statistical correlations -, progress in understanding the logic, semantics and metaphysics of conditionals and counterfactuals, developments based on insights from the likes of philosopher Hans Reichenbach or biological statistician Sewall Wright into causal precedence and path analysis, and much more. The result is a new toolkit to identify causes and build causal explanations. Yet even as we get better at identifying causes, this raises new (or old) questions about causality, including metaphysical questions about the nature of causes (and effects, events, objects, etc), but also questions about what we really use causality for (understanding the world as it is or just to glean predictive control of specific outcomes), about how causality is used differently in different fields and activities (is cause in physics the same as that in history?), and about how other crucial concepts relate to our concept of cause (space and time seem to be related to causality, but so do concepts of legal and moral responsibility).

This course will introduce students to the mathematical formalism derived from Pearlâ€™s work, based on directed acyclic graphs and probability theory. Building upon previous work by Reichenbach and Wright, Pearl defines a "a calculus of interventions" of "do-calculus" for talking about interventions and their relation to causation and counterfactuals. This model has been applied in various areas ranging from econometrics to statistics, where acquiring knowledge about causality is of great importance.

At the same time, the course will not forget some of the metaphysical and epistemological issues around cause, so that students can better critically evaluate putative causal explanations in their full context. Abstractly, such issues involve some of the same philosophical questions Hume already asked, but more practically, it is important to see how metaphysical and epistemological debates surrounding the notion of cause affect scientific practice, and equally if not more importantly, how scientific practice pushes the limits of theory. This course will look at various ways in which empirical data can be transformed into explanations and theories, including the variance approach to causality (characteristic of the positivistic quantitative paradigm), and the process theory of causality (associated with qualitative methodology). Examples and case studies will be relevant for students of the social sciences but also students of the natural/physical world as well.

Recommended Knowledge

Basic probability theory

Intended Learning Outcomes

No	Competence	ILO
1	Have	Have a clear understanding of the history of causal thinking.
2	Form	Form a critical understanding of the key debates and controversies surrounding the idea of causality.
3	Recognize	Recognize and apply probabilistic causal models.
4	Explain	Explain how understanding of causality differs among different disciplines.
5	Demonstrate	Demonstrate how theoretical thinking about causality has shaped scientific practices.

Indicative Literature

- Paul, L. A. and Ned Hall. Causation: A User’s Guide. Oxford University Press 2013.
- Pearl, Judea. Causality: Models, Reasoning and Inference. Cambridge University Press 2009.
- Pearl, Judea, Glymour Madelyn and Jewell, Nicolas. Causal Inference in Statistics: A Primer. Wiley 2016.
- llari, Phyllis McKay and Federica Russo. Causality: Philosophical Theory Meets Scientific Practice. Oxford University Press 2014.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Causation and Correlation (perspective II)	Written Examination	60 minutes	100	45%	1-5

Module Achievements: None

4.19 Econometrics

Module Name	Econometrics
Module Code	2025-CTMS-MET-05
Module ECTS	5
Study Semester	Mandatory status for: - 2025-MDDA-BSc 3 - 2025-GEM-BA 4 - 2025-IBA-Online-BA 4 - 2025-ESSMER-BSc 4 Mandatory Elective status for: - 2025-IBA-BA 4 - 2025-IEM-BSc 4
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Fabian Dehos

Forms of Learning and Teaching	
Independent Study	90
Seminar	35
Workload Hours	125 hours

Module Components	Number	Type	CP
Econometrics	CTMS-05	Seminar	5

Module Description

This module focuses on the application of econometric methods to the analysis of secondary data. Specifically, the goal is to expose students to some of the issues and challenges typically confronted by econometricians when analyzing empirical data in the realms of social science research, business and finance. Emphasis will be placed on the intuition underlying various commonly applied econometric techniques and on the steps needed to implement them. The module expands on the knowledge acquired in statistics and intensifies discussions of multiple regression analysis. The general objective is to become familiar with contemporary methods that are used in econometric and business analyses and to become a critical reader of case studies. In this regard, a clear distinction will be drawn along two dimensions: between questions of statistical significance versus those of economic or social significance; and between correlation and causation. The module takes a practical approach that covers how to estimate econometric models using R software. Sessions will often include computer applications to foster understanding of the discussed topics.

Recommended Knowledge

- An accessible overview of regression analysis can be found in Sykes, A.O. (1993). An Introduction to Regression Analysis. Coase-Sandor Institute for Law & Economics, Univ. of Chicago Working Paper No. 20. https://chicagounbound.uchicago.edu/law_and_economics/51/. Students are also encouraged to read: Ziliak, Stephen T. (2008). Retrospectives: Guinnessometrics: The Economic Foundation of "Student's". Journal of Economic Perspectives 22(4): 199-216.

- Knowledge of the ordinary least-squares regression model.

- Ability to estimate regression models using R software.

- Skills in conducting statistical inference tests.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods area that is part of the Constructor Track (Methods and New Skills modules; Language and Humanities modules).

- This module builds on models and topics from the first-year modules "Microeconomics" and "Macroeconomics" and from the second-year modules "Environmental and Resource Economics" and "Development Economics"

- This module introduces students to R in preparation for the 2nd year mandatory method module on econometrics and 3rd year GEM module on advanced econometrics; the statistics skills prepare students for all 2nd and 3rd year GEM modules and the thesis

- This module prepares students in IBA for the analysis of data in the 2nd year modules International Strategic Management and Marketing and the 3rd year module Contemporary Topics in Marketing and the thesis

- Mandatory for a major in GEM.

- Mandatory elective for a major in IBA

- Elective for all other study programs.

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain the mechanics and assumptions underpinning the Ordinary Least Squares (OLS) regression model.
2	Estimate	Estimate an OLS model on secondary data using R-software.
3	Interpret	Interpret the coefficient estimates from an OLS model with respect to their sign and magnitude.
4	Conduct	Conduct one- and two-sided tests of the statistical significance of coefficients.

Indicative Literature

- Abadie, A. & Cattaneo, M.D. (2018). Econometric methods for program evaluation. Annual Review of Economics, 10, 465-503.
- Angrist, J.D. & Pischke, J.S. (2014). Mastering'metrics: The path from cause to effect. Princeton University Press.
- Kabacoff, R. (2015). R in action: Data analysis and graphics with R. Chapter 8. Manning Publications Co.
- Wooldridge, J. M. (2015). Introductory econometrics: A modern approach. 6th edition. Cambridge Learning.

- Ziliak, Stephen T. (2008). Guinnessometrics: The economic foundation of "student's". Journal of Economic Perspectives 22(4), 199-216.

Entry Requirements

Prerequisites	Applied Statistics with R
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Econometrics	Written Examination	120 minutes	100	45%	All

Module Achievements: None

4.20 Concepts in Public Economics and Sustainable Management of Natural Risks

Module Name	**Concepts in Public Economics and Sustainable Management of Natural Risks**
Module Code	2025-CO-473
Module ECTS	7.5
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 4 Mandatory Elective status for: None
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Dr. Maheshi Danthurebandara

Forms of Learning and Teaching	
Lecture	35
Seminar	17.5
Independent Study	135
Workload Hours	187.5 hours

Module Components	**Number**	**Type**	**CP**
Concepts in Public Economics	CO-473-A	Lecture/Tutorial	5
Sustainable Management of Natural Risks	CO-473-B	Lecture/Tutorial	2.5

Module Description

The first part of the course will deal with Public Economics concepts. In particular, the course will provide students with basic general theoretical and empirical tools associated with public economics. Students will study the main market failures and contexts of direct government intervention, instruments of government revenues (taxation) and areas of government expenditures (education, healthcare, pension, infrastructures).

The second part of the course will deal with climate change policy under its multiple economic facets. Alternative economic scenarios in which climate change and climate policy play a crucial role are compared with different business as usual scenarios, analyzing the impact of climate change on social and economic variables. Furthermore, based on a game-theoretic framework that carefully describes international climate negotiations, it will then be possible to identify the main properties of an effective international agreement on climate change control.

Finally, this module will give a general overview of the different impacts of climate change by providing students with a set of techniques to deal with natural risk effects (e.g., risk transfer, risk mitigation). Through the application of disaster risk management concepts, students will be able to combine different tools for a comprehensive assessment of the efficacy and effectiveness of alternative management strategies.

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify the main pros and cons of Government intervention in the economy.
2	Understand	Understand the reasons and the role of Government expenditure.
3	Discuss	Discuss the impact of major public interventions.
4	Formulate	Formulate and argue simple hypotheses, also developing a critical approach to the evaluation of alternative scenarios in natural risk management.
5	Assess	Assess the impacts of climate change and apply economic instruments to mitigate it.
6	Identify	Identify and evaluate ex-ante and post-disaster funding interventions.

Indicative Literature

- Jonathan Grubner (2022): Public Finance and Public Policy, 7th Edition.
- Hayek, F. A. (1945). The Use of Knowledge in Society. American Economic Review 35(4), 5019-530.
- Ostrom, V., & Ostrom, E. (1971). Public choice: A Different Approach to the Study of Public Administration. Public Administration Review, 31(2), 203-216.
- Devarajan, S., & Fisher, A. C. (1981). Hotelling's" Economics of Exhaustible Resources": Fifty Years Later. Journal of Economic Literature, 19(1), 65-73.
- Holland, S. P. (2008). Modeling Peak Oil. The Energy Journal, 29(2), 61-80.
- Sinn, H. W. (2015). The Green Paradox: A Supply-side View of the Climate Problem. Review of Environmental Economics and Policy 9(2), 239-245.
- Ostrom, E. E., Dietz, T. E., Dolšak, N. E., Stern, P. C., Stonich, S. E., & Weber, E. U. (2002). The Drama of the Commons. National Academy Press.
- Abbass, K., Qasim, M.Z., Song, H. et al. A review of the global climate change impacts, adaptation, and sustainable mitigation measures. Environ Sci Pollut Res 29, 42539–42559 (2022). https://doi.org/10.1007/s11356-022-19718-6.

Entry Requirements

Prerequisites	Microeconomics Macroeconomics
Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs

Concepts in Public Economics	Portfolio Assessment		67	45%	1,2,3,4
Sustainable Management of Natural Risks	Term Paper		33	45%	5,6

Module Achievements: None

4.21 Environmental and Resource Economics

Module Name	Environmental and Resource Economics
Module Code	2025-CO-621
Module ECTS	7.5
Study Semester	Mandatory status for: -2025-ESSMER-BSc 3 Mandatory Elective status for: - 2025-GEM-BA 3 - 2025-Minor-Gem-BA 3
Duration	1 Semester
Program Affiliation	2025-GEM-BA (Global Economics and Management)
Module Coordinator(s)	Prof. Dr. Colin Vance

Forms of Learning and Teaching	
Seminar	35
Tutorial	17.5
Independent study	135
Workload Hours	187.5 hours

Module Components	Number	Type	CP
Environmental and Resource Economics	CO-621-A	Seminar	5
Environmental and Resource Economics - Tutorial	CO-621-B	Tutorial	2.5

Module Description

This module covers the application of theoretical and empirical economics to the analysis of environmental and resource management issues. Specific topics include global climate change, energy use, transportation, and the extraction of exhaustible and non-exhaustible resources. Cross-cutting these topics is an emphasis on how economic analysis can contribute to contemporary policy debates, such as the strengths and weaknesses of regulatory- and market-based policy instruments for reducing CO_2 emissions. We also examine the implications for industry of national and international efforts to protect the environment. In the tutorials, students have the opportunity to review the material taught in the seminar and further train their understanding of these concepts and theories in group discussions of concepts and case study problems.

This module aims at transmitting fundamental knowledge of environmental dynamics from an economics perspective. Understanding the underlying mechanisms and economic dimensions of environmental issues constitutes an important basis for undergraduate studies in the fields of economics and the management of sustainability and helps students make sense of economic behaviors in many situations, including professional settings. With its interest in questions of resource exhaustibility and in the impact of economic behavior on the environment, this module helps students to understand public affairs from an environmental perspective and promotes their capacity to anticipate the consequences of economic and managerial decisions, including their own.

Recommended Knowledge

- Logical and causality-based reasoning

- Basic knowledge in micro- and macroeconomics

- To prepare for this module, students are recommended to read the article "How do economists really think about the environment?" published in Nature in 1998.

Usability and Relationship to other Modules

- One of two default 2nd-year Core modules for a minor in GEM (a minor in GEM is feasible only with the modules "Development Economics and Environment and Resources" (default), or with "International Economics and Comparing Economic Systems."

- This module builds on the knowledge acquired in the first-year modules "Microeconomics" and "Macroeconomics" and expands students' understandings of these two disciplines by focusing on the linkages between economy and the environment both an economic agent and a policy perspective. This module benefits from the contents taught in its accompanying module "Development Economics" as the combination of the two modules further places of environmental sustainability issues into the perspective of economic growth and inequality in international trade, and vice versa. This module provides knowledge that is required for the third-year modules "Managing Public and Nonprofit Organizations", "Advanced Econometrics" and "Information Economics".

Intended Learning Outcomes

No	Competence	ILO
1	Name	Name and discuss key theoretical frameworks for understanding environmental economics.
2	Differentiate	Differentiate and discriminate among empirical evidence on economy-environment linkages.
3	Apply	Apply theoretical and empirical knowledge to judge the merits of environmental policies, in particularly, the pros and cons of market-based versus regulatory approaches.
4	Calculate	Calculate the net present value of alternative measures to protect the environment.

Indicative Literature

- Tietenberg, T., Lewis, L., (2019). Environmental economics: The essentials. Routledge.
- Fullerton, D., Stavins. R. N. (1998). How do economists really think about the environment? Nature, 395: 433-434.

Entry Requirements

Prerequisites	Microeconomics Macroeconomics

Co-requisites	None
Additional Remarks	

__Assessment and Completion__

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Environmental and Resource Economics	Written Examination	120 minutes	100	45%	1-4
Environmental and Resource Economics - Tutorial					

Module Achievements: None

4.22 Linear Model and Matrices

Module Name	Linear Model and Matrices
Module Code	2025-CTNS-NSK-05
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Marc-Thorsten Hütt

Forms of Learning and Teaching	
Independent Study	90
Online Lecture	35
Workload Hours	125 hours

Module Components	Number	Type	CP
Linear model and matrices	CTNS-05	Seminar (Online)	5

Module Description

There are no universal 'right skills'. But the notion of linear models and the avenue to matrices and their properties can be useful in diverse disciplines to implement a quantitative, computational approach. Some of the most popular data and systems analysis strategies are built upon this framework. Examples include principal component analysis (PCA), the optimization techniques used in Operations Research (OR), the assessment of stable and unstable states in nonlinear dynamical systems, as well as aspects of machine learning.

Here we introduce the toolbox of linear models and matrix-based methods embedded in a wide range of transdisciplinary applications (part 1). We describe its foundation in linear algebra (part 2) and the range of tools and methods derived from this conceptual framework (part 3). At the end of the course, we outline applications to graph theory and machine learning (part 4). Matrices can be useful representations of networks and of system of linear equations. They are also the core object of linear stability analysis, an approach used in nonlinear dynamics. Throughout the course, examples from neuroscience, social sciences, medicine, biology, physics, chemistry, and other fields are used to illustrate these methods.

A strong emphasis of the course is on the sensible usage of linear approaches in a nonlinear world. We will critically reflect the advantages as well as the disadvantages and limitations of this method. Guiding questions are: How appropriate is a linear approximation of a nonlinear system? What do you really learn from PCA? How reliable are the optimal states obtained via linear programming (LP) techniques?

This debate is embedded in a broader context: How does the choice of a mathematical technique confine your view on the system at hand? How, on the other hand, does it increase your capabilities of analyzing the system (due to software available for this technique, the ability to compare with findings from other fields built upon the same technique and the volume of knowledge about this technique)?

In the end, students will have a clearer understanding of linear models and matrix approaches in their own discipline, but they will also see the full transdisciplinarity of this topic. They will make better decisions in their choice of data analysis methods and become mindful of the challenges when going from linear to nonlinear thinking.

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply the concept of linear modeling in their own discipline.
2	Distinguish	Distinguish between linear and nonlinear interpretation strategies and understand the range of applicability of linear models.
3	Make	Make use of data analysis / data interpretation strategies from other disciplines, which are derived from linear algebra.
4	Be	Be aware of the ties that linear models have to machine learning and network theory,
5	Note	Note that these four ILOs can be loosely associated with the four parts of the course indicated above.

Indicative Literature

- Part 1: material from Linear Algebra for Everyone, Gilbert Strang, Wellesley-Cambridge Press, 2020.
- Part 2: material from Introduction to Linear Algebra (5th Edition), Gilbert Strang, Cambridge University Press, 2021.
- Part 3: Mainzer, Klaus. "Introduction: from linear to nonlinear thinking." Thinking in Complexity: The Computational Dynamics of Matter, Mind and Mankind (2007): 1-16.; material from Mathematics of Big Data: Spreadsheets, Databases, Matrices, and Graphs, Jeremy Kepner, Hayden Jananthan, The MIT Press, 2018.; material from Introduction to Linear Algebra (5th Edition), Gilbert Strang, Cambridge University Press, 2021.
- Part 4: material from Linear Algebra and Learning from Data, Gilbert Strang, Wellesley-Cambridge Press, 2019.

Entry Requirements

Prerequisites	Logic (perspective I) Causation and Correlation (perspective I) Causation and Correlation (perspective II) Logic (perspective II)
Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Linear model and matrices	Written Examination	120 minutes	100	45%	1-4

Module Achievements: None

4.23 Complex Problem Solving

Module Name	Complex Problem Solving
Module Code	2025-CTNS-NSK-06
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Marco Verweij

Forms of Learning and Teaching	
Independent Study	90
Online Lecture	35
Workload Hours	125 hours

Module Components	Number	Type	CP
Complex Problem Solving	CTNS-06	Lecture (Online)	5

Module Description

Complex problems are, by definition, non-linear and/or emergent. Some fifty years ago, scholars such as Herbert Simon began to argue that societies around the world had developed an impressive array of tools with which to solve simple and even complicated problems, but still needed to develop methods with which to address the rapidly increasing number of complex issues. Since then, a variety of such methods has emerged. These include 'serious games' developed in computer science, 'multisector systems analysis' applied in civil and environmental engineering, 'robust decision-making' proposed by the RAND Corporation, 'design thinking' developed in engineering and business studies, 'structured problem-solving' used by McKinsey & Co., 'real-time technology assessment' advocated in science and technology studies, and 'deliberative decision-making' emanating from political science.

In this course, students first learn to distinguish between simple, complicated and complex problems. They also become familiar with the ways in which a particular issue can sometimes shift from one category into another. In addition, the participants learn to apply several tools for resolving complex problems. Finally, the students are introduced to the various ways in which natural and social scientists can help stakeholders resolve complex problems. Throughout the course examples and applications will be used. When possible, guest lectures will be offered by experts on a particular tool for tackling complex issues. For the written, take-home exam, students will have to select a specific complex problem, analyse it and come up with a recommendation - in addition to answering several questions about the material learned.

Recommended Knowledge

- Being able to read primary academic literature

- Willingness to engage in teamwork

- Camillus, J. (2008). Strategy as a wicked problem. Harvard Business Review 86: 99-106;

- Rogers, P. J. (2008). Using programme theory to evaluate complicated and complex aspects of interventions. Evaluation, 14, 29–48.

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify a complex problem.
2	Develop	Develop an acceptable recommendation for resolving complex problems.
3	Understand	Understand the roles that natural and social scientists can play in helping stakeholders resolve complex problems.

Indicative Literature

- Camillus, J. (2008). Strategy as a wicked problem. Harvard Business Review 86: 99-106; Rogers, P. J. (2008). Using programme theory to evaluate complicated and complex aspects of interventions. Evaluation, 14, 29–48.
- Chia, A. (2019). Distilling the essence of the McKinsey way: The problem-solving cycle. Management Teaching Review 4(4): 350-377.
- Den Haan, J., van der Voort, M.C., Baart, F., Berends, K.D., van den Berg, M.C., Straatsma, M.W., Geenen, A.J.P., & Hulscher, S.J.M.H. (2020). The virtual river game: Gaming using models to collaboratively explore river management complexity, Environmental Modelling & Software 134, 104855.
- Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S., & Walker, B. (2002). Resilience and sustainable development: Building adaptive capacity in a world of transformations. AMBIO: A Journal of the Human Environment 31(5): 437-440.
- Ostrom, E. (2010). Beyond markets and states: Polycentric governance of complex economic systems. American Economic Review 100(3): 641-72.
- Pielke, R. Jr. (2007). The honest broker: Making sense of science in policy and politics. Cambridge: Cambridge University Press.
- Project Management Institute (2021). A guide to the project management body of knowledge (PMBOK® guide).
- Schon, D. A., & Rein, M. (1994). Frame reflection: Toward the resolution of intractable policy controversies. New York: Basic Books.
- Simon, H. A. (1973). The structure of ill structured problems. Artificial Intelligence 4(3-4): 181-201.
- Verweij, M. & Thompson, M. (Eds.) (2006). Clumsy solutions for a complex world. London: Palgrave Macmillan.

Entry Requirements

Prerequisites	Logic (perspective I) Causation and Correlation (perspective I) Causation and Correlation (perspective II) Logic (perspective II)

Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Complex Problem Solving	Written Examination	120 minutes	100	45%	1-3

Module Achievements: None

4.24 Argumentation, Data Visualization and Communication (perspective I)

Module Name	Argumentation, Data Visualization and Communication (perspective I)
Module Code	2025-CTNS-NSK-07
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Arvid Kappas Prof. Dr. Jules Coleman

Forms of Learning and Teaching	
Independent Study	90
Online Lecture	35
Workload Hours	125 hours

Module Components	Number	Type	CP
Argumentation, Data Visualization and Communication (perspective I)	CTNS-07	Lecture (Online)	5

Module Description

One must be careful not to confuse argumentation with being argumentative. The latter is an unattractive personal attribute, whereas the former is a requirement of publicly holding a belief, asserting the truth of a proposition, the plausibility of a hypothesis, or a judgment of the value of a person or an asset. It is an essential component of public discourse. Public discourse is governed by norms and one of those norms is that those who assert the truth of a proposition or the validity of an argument or the responsibility of another for wrongdoing open themselves up to good faith requests to defend their claims. In its most general meaning, argumentation is the requirement that one offer evidence in support of the claims they make, as well as in defense of the judgments and assessments they reach. There are different modalities of argumentation associated with different contexts and disciplines. Legal arguments have a structure of their own as do assessments of medical conditions and moral character. In each case, there are differences in the kind of evidence that is thought relevant and, more importantly, in the standards of assessment for whether a case has been successfully made. Different modalities of argumentation require can call for different modes of reasoning. We not only offer reasons in defense of or in support of beliefs we have, judgments we make and hypotheses we offer, but we reason from evidence we collect to conclusions that are warranted by them.

Reasoning can be informal and sometimes even appear unstructured. When we recognize some reasoning as unstructured yet appropriate what we usually have in mind is that it is not linear. Most reasoning we are familiar with is linear in character. From A we infer B, and from A and B we infer C, which all together support our commitment to D. The same form of reasoning applies whether the evidence for A, B or C is direct or circumstantial. What changes in these cases is perhaps the weight we give to the evidence and thus the confidence we have in drawing inferences from it.

Especially in cases where reasoning can be supported by quantitative data, wherever quantitative data can be obtained either directly or by linear or nonlinear models, the visualization of the corresponding data can become key in both, reasoning and argumentation. A graphical representation can reduce the complexity of argumentation and is considered a must in effective scientific communication. Consequently, the course will also focus on smart and compelling ways for data visualization - in ways that go beyond what is typically taught in statistics or mathematics lectures. These tools are constantly developing, as a reflection of new software and changes in state of the presentation art. Which graph or bar chart to use best for which data, the use of colors to underline messages and arguments, but also the pitfalls when presenting data in a poor or even misleading manner. This will also help in readily identifying intentional mis-representation of data by others, the simplest to recognize being truncating the ordinate of a graph in order to exaggerate trends. This frequently leads to false arguments, which can then be readily countered.

There are other modalities of reasoning that are not linear however. Instead they are coherentist. We argue for the plausibility of a claim sometimes by showing that it fits in with a set of other claims for which we have independent support. The fit is itself the reason that is supposed to provide confidence or grounds for believing the contested claim.

Other times, the nature of reasoning involves establishing not just the fit but the mutual support individual items in the evidentiary set provide for one another. This is the familiar idea of a web of interconnected, mutually supportive beliefs. In some cases, the support is in all instances strong; in others it is uniformly weak, but the set is very large; in other cases, the support provided each bit of evidence for the other is mixed: sometimes strong, sometimes weak, and so on.

There are three fundamental ideas that we want to extract from this segment of the course. These are (1) that argumentation is itself a requirement of being a researcher who claims to have made findings of one sort or another; (2) that there are different forms of appropriate argumentation for different domains and circumstances; and (3) that there are different forms of reasoning on behalf of various claims or from various bits of evidence to conclusions: whether those conclusions are value judgments, political beliefs, or scientific conclusions. Our goal is to familiarize you with all three of these deep ideas and to help you gain facility with each.

Intended Learning Outcomes

No	Competence	ILO
1	Distinguish	Distinguish among different modalities of argument, e.g. legal arguments, vs. scientific ones.
2	Construct	Construct arguments using tools of data visualization.
3	Communicate	Communicate conclusions and arguments concisely, clearly and convincingly.

Indicative Literature

- Tufte, E.R. (1985). The visual display of quantitative information. The Journal for Healthcare Quality (JHQ), 7(3), 15.

- Cairo, A (2012). The Functional Art: An introduction to information graphics and visualization. New Ridders.
- Knaflic, C.N. (2015). Storytelling with data: A data visualization guide for business professionals. John Wiley & Sons.

Entry Requirements

Prerequisites	Logic (perspective I) Causation and Correlation (perspective I) Causation and Correlation (perspective II) Logic (perspective II)
Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Argumentation, Data Visualization and Communication (perspective I)	Written Examination	120 minutes	100	45%	1-3

Module Achievements: None

4.25 Sustainability and Policy Evaluation

Module Name	Sustainability and Policy Evaluation
Module Code	2025-CA-S-ESSMER-802
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - 2025-ESSMER-BSc 5 - 2025-ESSMER-BSc 6
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Vikram Unnithan Prof. Dr. Andrea Koschinsky

Forms of Learning and Teaching	
Lecture	35
Independent Study	90
Workload Hours	125 hours

Module Components	Number	Type	CP
Sustainability and Policy Evaluation	CA-ESSMER-802	Lecture	5

Module Description

The course is designed to give students a comprehensive introduction to theories, approaches, and methods for public policy analysis. The course examines how politics and institutions shape public policy, the processes of public policy change, and the challenges of public sector management.

Furthermore, students are provided with a set of quantitative tools used for data analysis and applied empirical research, focusing on the estimation of causal relationships between policy interventions and the observed outcome.

In particular, the course will introduce the following econometric techniques, particularly suitable for policy evaluation:

- Natural experiments;

- Randomized controlled trials;

- Observational Data and Instrumental Variable;

- Regression discontinuity designs;

- Exploiting variation over time: Panel, difference-in-differences, and synthetic control methods.

Recommended Knowledge

Basic knowledge of quantitative methods for social sciences. Furthermore, the course assumes students to have already had some familiarity with the basic concepts and terminology of public policy and administration.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand fundamental theories, approaches and methods for public policy analysis
2	Evaluate	Evaluate how and why public policies emerge, and the processes involved in policy making
3	Understand	Understand how policy impact is evaluated at local and international levels
4	Analyse	Analyse the effectiveness of policy reforms that aim to improve government efficiency and representation, accelerate transitions to sustainability, and govern rapidly emerging technologies using real-world examples
5	Recognize	Recognize interesting research questions associated with the impact of policy intervention
6	Reproduce	Reproduce empirical analyses choosing the most appropriate quantitative econometric technique, motivating the choice

Indicative Literature

- Weimer, David L., and Aidan R. Vining. 2017. Policy Analysis: Concepts and Practice. 6th edition. Routledge
- Kingdon, John. 2010. Agendas, Alternatives, and Public Policy. 2nd edition. Pearson
- Cairney, Paul. 2011. Understanding Public Policy: Theories and Issues. MacMillan
- J. ANGRIST, J.S. PISCHKE, Mastering Metrics, Princeton University Press, 2014
- J.H. STOCK, M.W. WATSON, Introduction to Econometrics, Pearson, 2015

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Sustainability and Policy Evaluation	Written Examination	120 minutes	100	45%	All

Module Achievements: None

4.26 Digital Geosciences

Module Name	Digital Geosciences
Module Code	2025-CA-S-ESSMER-801
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - 2025-ESSMER-BSc 5
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Joachim Vogt

Forms of Learning and Teaching	
Lecture	35
Independent Study	90
Workload Hours	125 hours

Module Components	Number	Type	CP
Digital Geosciences	CA-ESSMER-801	Lecture	5

Module Description

This module is concerned with digital aspects of Earth Sciences such as processing and analysis of geophysical data, remote sensing applications, and computational modeling of environmental systems. Starting with a general introduction to datasets, models, and tools in Earth Sciences (ES), students learn to find, access, and display ES data and models of different types and formats, and to perform basic processing and visualization operations. In the remote sensing part of the module, students are introduced to space-borne observations of the surface, the oceans, and the atmosphere. The module is concluded with a discussion of computational modeling approaches in the Earth Sciences.

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify and select digital tools, data repositories, and computational models to answer topical questions in the Earth sciences (ES)
2	Perform	Perform basic processing and analysis of ES datasets and models
3	Distinguish	Distinguish and explain different measurement principles in remote-sensing and in-situ instrumentation
4	Access	Access, process, and display satellite observations of the Earth's surface, oceans, and atmosphere

5	Analyze	Analyze and interpret satellite observations of the Earth's surface, oceans, and atmosphere
6	Differentiate	Differentiate and explain computational modeling approaches in ES

Indicative Literature

- J. B. Campbell: Introduction to Remote Sensing, 5New York: The Guilford Press
- Jake VanderPlas: Python Data Science Handbook. Newton: O'Reilly
- K. Tempfli, N. Kerle, G. C. Huurneman, L. L. F. Janssen (eds.): Principles of Remote Sensing (free PDF), International Institute for Geo-Information Science & EO (ITC), Enschede, 2009

Entry Requirements

Prerequisites	Physics of Planet Earth
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Digital Geosciences	Term Paper	15 pages	100	45%	All

Module Achievements: None

4.27 Current Topics in ESSMER

Module Name	**Current Topics in ESSMER**
Module Code	2025-CA-S-EES-804
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - 2025-ESSMER-BSc 5
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Vikram Unnithan

Forms of Learning and Teaching	
Lecture	35
Independent Study	90
Workload Hours	125 hours

Module Components	**Number**	**Type**	**CP**
Current Topics in ESSMER	CA-EES-804	Seminar	5

Module Description

In this module, topics currently (controversially) discussed in ESSMER 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 ESSMER 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.

Recommended Knowledge

Review all previous ESSMER modules.

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.

Intended Learning Outcomes

No	**Competence**	**ILO**
1	Critically	Critically assess scientific literature on a wide range of topical research in ESSMER

2	Familiarize	Familiarize themselves with current much-debated topics in selected ESSMER disciplines and subject areas
3	Summarize	Summarize and describe topical research questions in selected ESSMER disciplines and subject areas
4	Synthesize	Synthesize a body of knowledge on a given ESSMER subject
5	Participate	Participate in scientific discussions on topical and possibly controversial ESSMER subjects

Indicative Literature

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

Entry Requirements

Prerequisites	Fundamentals of Earth Sciences Environmental Systems and Global Change
Co-requisites	None
Additional Remarks	Two additional ESSMER CORE modules required

Assessment and Completion

Components	**Examination Type**	**Duration /Length**	**Weight (%)**	**Minimum**	**ILOs**
Current Topics in ESSMER	Term Paper	20 pages	100	45%	All

Module Achievements: None

4.28 Agency, Leadership, and Accountability

Module Name	Agency, Leadership, and Accountability
Module Code	2025-CTNS-NSK-09
Module ECTS	5
Study Semester	Mandatory status for: - 2025-S-ACS-BSc 5 Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Jules Coleman

Forms of Learning and Teaching	
Independent Study	90
Online Lecture	35
Workload Hours	125 hours

Module Components	Number	Type	CP
Agency, Leadership, and Accountability	CTNS-09	Lecture (Online)	5

Module Description

Each of us is judged by the actions we undertake and held to account for the consequences of them. Sometimes we may be lucky and our bad acts don't have harmful effects on others. Other times we may be unlucky and reasonable decisions can lead to unexpected or unforeseen adverse consequences for others. We are therefore held accountable both for choices and for outcomes. In either case, accountability expresses the judgment that we bear responsibility for what we do and what happens as a result. But our responsibility and our accountability in these cases is closely connected to the idea that we have agency.

Agency presumes that we are the source of the choices we make and the actions that result from those choices. For some, this may entail the idea that we have free will. But there is scientific world view that holds that all actions are determined by the causes that explain them, which is the idea that if we knew the causes of your decisions in advance, we would know the decision you would make even before you made it. If that is so, how can your choice be free? And if it is not free, how can you be responsible for it? And if you cannot be responsible, how can we justifiably hold you to account for it?

These questions express the centuries old questions about the relationship between free will and a determinist world view: for some, the conflict between a scientific world view and a moral world view.

But we do not always act as individuals. In society we organize ourselves into groups: e.g. tightly organized social groups, loosely organized market economies, political societies, companies, and more. These groups have structure. Some individuals are given the responsibility of leading the group and of exercising authority. But one can exercise authority over others in a group merely by giving orders and threatening punishment for non-compliance.

Exercising authority is not the same thing as being a leader? For one can lead by example or by encouraging others to exercise personal judgment and authority. What then is the essence of leadership?

The module has several educational goals. The first is for students to understand the difference between actions that we undertake for which we can reasonably held accountable and things that we do but which we are not responsible for. For example, a twitch is an example of the latter, but so too may be a car accident we cause as a result of a heart attack we had no way of anticipating or controlling. This suggests the importance of control to responsibility. At the heart of personal agency is the idea of control. The second goal is for students to understand what having control means. Some think that the scientific view is that the world is deterministic, and if it is then we cannot have any personal control over what happens, including what we do. Others think that the quantum scientific view entails a degree of indeterminacy and that free will and control are possible, but only in the sense of being unpredictable or random. But then random outcomes are not ones we control either. So, we will devote most attention to trying to understand the relationships between control, causation and predictability.

But we do not only exercise agency in isolation. Sometimes we act as part of groups and organizations. The law often recognizes ways in which groups and organizations can have rights, but is there a way in which we can understand how groups have responsibility for outcomes that they should be accountable for. We need to figure out then whether there is a notion of group agency that does not simply boil down to the sum of individual actions. We will explore the ways in which individual actions lead to collective agency.

Finally we will explore the ways in which occupying a leadership role can make one accountable for the actions of others over which one has authority.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand and reflect how the social and moral world views that rely on agency and responsibility are compatible, if they are, with current scientific world views.
2	Understand	Understand how science is an economic sector, populated by large powerful organizations that set norms, fund research agendas.
3	Identify	Identify the difference between being a leader of others or of a group - whether a research group or a lab or a company - and being in charge of the group.
4	Learn	Learn to be a leader of others and groups. Understand that when one graduates one will enter not just a field of work but a heavily structured set of institutions and that one's agency and responsibility for what happens, what work gets done, its quality and value, will be affected accordingly.

Indicative Literature

- Hull, David L. "Science as a Process." Science as a Process. University of Chicago Press, 2010.
- Feinberg, Joel. "Doing & deserving; essays in the theory of responsibility." (1970).

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Agency, Leadership, and Accountability	Written Examination	120 minutes	100	45%	1-4

Module Achievements: None

4.29 Advanced Environmental Science

Module Name	Advanced Environmental Science
Module Code	2025-CA-S-ESSMER-803
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - 2025-ESSMER-BSc 6
Duration	1 Semester
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	Prof. Dr. Vikram Unnithan Prof. Dr. Michael Bau

Forms of Learning and Teaching	
Lecture	17.5
Laboratory	40
Independent Study	67.5
Workload Hours	125 hours

Module Components	Number	Type	CP
Advanced Environmental Science	CA-ESSMER-803- A	Lecture	2.5
Advanced Environmental Science Lab	CA-ESSMER-803- B	Laboratory	2.5

Module Description

This module engages students to further their understanding of Environmental Sciences by exploring the largest and least explored habitat on our planet: the ocean. They are introduced to marine geophysical exploration methods, major oceanographic processes, and the effects of global climate change on conditions that sustain marine life, ecosystems, and humans. Students are challenged to think about the interconnectedness of Earth's systems and how altering the atmosphere, biosphere, and geosphere impacts oceans (hydrosphere). The goal is for students to appreciate the complexity of ocean processes and the need for systems thinking to comprehend such complex interactions both in space and time. Some key concepts from systems thinking such as positive and negative feedback loops, emergence, and resilience with also be discussed in the context of oceans. An emphasis on practical field and lab work, dealing with real-world data is an important theme for this module and functions as a capstone unit allowing students to employ interdisciplinary knowledge to discuss management decisions or evaluate strategies for environmental protection or climate change mitigation. Overall, this module will make students aware of our dependence on and responsibility for the preservation and protection of the largest habitat on Earth - the oceans

Usability and Relationship to other Modules

ESSMER Majors

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand and apply fundamental practical skills and concepts in biological, geological, geochemical, and environmental fields of ocean research
2	Apply	Apply basic marine data acquisition, analysis and interpretation techniques
3	Apply	Apply chemical and physical concepts and methods to real-world problems in marine environmental sciences

Indicative Literature

- Marine and Coastal Resource Management: Principles and Practice by David R. Green, Jeffrey L. Payne (2017); Essentials of Oceanography by Trujillo, Thurman (2019)

Entry Requirements

Prerequisites	Fundamentals of Earth Sciences Advanced Field Laboratories
Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Advanced Environmental Science	Written Examination	60 minutes	50	45%	All
Advanced Environmental Science Lab	Laboratory Report		50	45%	All

Module Achievements: None

4.30 Internship / Startup and Career Skills

Module Name	Internship / Startup and Career Skills
Module Code	2025-CA-INT-900
Module ECTS	15
Study Semester	Mandatory status for: - Mandatory for all undergraduate study programs except IEM Mandatory Elective status for: - None
Duration	1 Semester
Program Affiliation	Career ()
Module Coordinator(s)	Dr. Tanja Woebs Clémentine Senicourt

Forms of Learning and Teaching	
Internship	308
Internship Event	2
Independent Study	32
Interactive Learning	33
Workload Hours	375 hours

Module Components	Number	Type	CP
Internship	CA-INT-900-0	Internship	15

Module Description

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 SCS, 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 Student Career Support.

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 Service Center (e.g. the annual Constructor 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.

Recommended Knowledge

- Information provided on CSC

- Major specific knowledge and skills

- 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://constructor.university/student-life/career-services

- Participating in the internship events of earlier classes

Usability and Relationship to other Modules

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.

Intended Learning Outcomes

No	Competence	ILO
1	Describe	Describe the scope and the functions of the employment market and personal career development.
2	Apply	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.
3	Independently	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.).
4	Apply	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.
5	Justify	Justify professional decisions based on theoretical knowledge and academic methods.
6	Reflect	Reflect on their professional conduct in the context of the expectations of and consequences for employers and their society.
7	Reflect	Reflect on and set their own targets for the further development of their knowledge, skills, interests, and values.
8	Establish	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.
9	Discuss	Discuss observations and reflections in a professional network.

Indicative Literature

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Entry Requirements

Prerequisites	Internship / Startup and Career Skills
Co-requisites	None
Additional Remarks	At least 15 CP from CORE modules in the major

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Internship	Project Report	3500 words	100	45%	1-9

Module Achievements: None

4.31 Argumentation, Data Visualization and Communication (perspective II)

Module Name	**Argumentation, Data Visualization and Communication (perspective II)**
Module Code	2025-CTNS-NSK-08
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective for all UG students
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	Prof. Dr. Arvid Kappas Prof. Dr. Jules Coleman

Forms of Learning and Teaching	
Independent Study	80
Online Lecture	35
Tutorial	10
Workload Hours	125 hours

Module Components	**Number**	**Type**	**CP**
Argumentation, Data Visualization and Communication (perspective II)	CTNS-08	Lecture (Online)	5

Module Description

Humans are a social species and interaction is crucial throughout the entire life span. While much of human communication involves language, there is a complex multichannel system of nonverbal communication that enriches linguistic content, provides context, and is also involved in structuring dynamic interaction. Interactants achieve goals by encoding information that is interpreted in the light of current context in transactions with others. This complexity implies also that there are frequent misunderstandings as a sender's intention is not fulfilled. Students in this course will learn to understand the structure of communication processes in a variety of formal and informal contexts. They will learn what constitutes challenges to achieving successful communication and to how to communicate effectively, taking the context and specific requirements for a target audience into consideration. These aspects will be discussed also in the scientific context, as well as business, and special cases, such as legal context â€“ particularly with view to argumentation theory.

Communication is a truly transdisciplinary concept that involves knowledge from diverse fields such as biology, psychology, neuroscience, linguistics, sociology, philosophy, communication and information science. Students will learn what these different disciplines contribute to an understanding of communication and how theories from these fields can be applied in the real world. In the context of scientific communication, there will also be a focus on visual communication of data in different disciplines. Good practice examples will be contrasted with typical errors to facilitate successful communication also with view to the Bachelorâ€™s thesis.

Recommended Knowledge

- Ability and openness to engage in interactions

- Media literacy, critical thinking and a proficient handling of data sources

- Own research in academic literature

Intended Learning Outcomes

No	Competence	ILO
1	Analyze	Analyze communication processes in formal and informal contexts.
2	Identify	Identify challenges and failures in communication.
3	Design	Design communications to achieve specified goals to specific target groups.
4	Understand	Understand the principles of argumentation theory.
5	Use	Use data visualization in scientific communications.

Indicative Literature

- Joseph A. DeVito: The Interpersonal Communication Book (Global edition, 16th edition), 2022.
- Steven L. Franconeri, Lace M. Padilla, Priti Shah, Jeffrey M. Zacks, and Jessica Hullman: The Science of Visual Data Communication: What Works Psychological Science in the Public Interest, 22(3), 110–161, 2022.
- Douglas Walton: Argumentation Theory – A Very Short Introduction. In: Simari, G., Rahwan, I. (eds) Argumentation in Artificial Intelligence. Springer, Boston, MA, 2009.

Entry Requirements

Prerequisites	Logic (perspective I) Logic (perspective II) Causation and Correlation (perspective I) Causation and Correlation (perspective II)
Co-requisites	None
Additional Remarks	

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Argumentation, Data Visualization and Communication (perspective II)	Presentation	Digital submission (Asynchronous)	100	45%	1-5

Module Achievements: Asynchronous presentation on a topic relating to the major of the student, including a reflection including concept outlining the rationale for how arguments are selected and presented based on a particular target group for a particular purpose. The presentation shall be multimedial and include the presentation of data. The module achievement ensures sufficient knowledge about key concepts of effective communication including a reflection on the presentation itself.

4.32 Community Impact Project

Module Name	Community Impact Project
Module Code	2025-CTNS-CIP-10
Module ECTS	5
Study Semester	Mandatory status for: None Mandatory Elective status for: - Mandatory elective
Duration	1 Semester
Program Affiliation	2025-CT ()
Module Coordinator(s)	CIP Faculty Coordinator

Forms of Learning and Teaching	
Introductory, Accompanying, and Final Events	10
Self-Organized Teamwork	115
Workload Hours	125 hours

Module Components	Number	Type	CP
Community Impact Project	CTNS-10	Project	5

Module Description

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.

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).

Recommended Knowledge

- Basic knowledge of the main concepts and methodological instruments of the respective disciplines.

- Develop or join a community impact project before the 5th or 6th 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.

Intended Learning Outcomes

No	Competence	ILO
1	The	The Community Impact Project is designed to convey the required personal and social competencies for enabling students to finish their studies at Constructor University as socially conscious and responsible graduates (part of the Constructor University's 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.
2	Understand	Understand the real-life issues of communities, organizations, and industries and relate them to concepts in their own discipline.
3	Enhance	Enhance problem-solving skills and develop critical faculty, create solutions to problems, and communicate these solutions appropriately to their audience.
4	Apply	Apply media and communication skills in diverse and non-peer social contexts.
5	Develop	Develop an awareness of the societal relevance of their own scientific actions and a sense of social responsibility for their social surroundings.
6	Reflect	Reflect on their own behavior critically in relation to social expectations and consequences.
7	Work	Work in a team and deal with diversity, develop cooperation and conflict skills, and strengthen their empathy and tolerance for ambiguity.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	At least 15 CP from CORE modules in the major.

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Community Impact Project	Project Assessment		100	Graded as pass/fail	All

Module Achievements: None

4.33 Bachelor Thesis and Seminar

Module Name	**Bachelor Thesis and Seminar**
Module Code	2025-CA-EES-800
Module ECTS	15
Study Semester	Mandatory status for: - 2025-ESSMER-BSc 6 Mandatory Elective status for: None
Duration	14-week lecture period
Program Affiliation	2025-ESSMER-BSc (Earth Sciences and Sustainable Management of Environmental Resources)
Module Coordinator(s)	SPC

Forms of Learning and Teaching	
Independent Study/Laboratory Work	350
Seminar	25
Workload Hours	375 hours

Module Components	**Number**	**Type**	**CP**
Bachelor Thesis ESSMER	CA-EES-800-T	Thesis	12
Thesis Seminar ESSMER	CA-EES-800-S	Seminar	3

Module Description

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 Constructor 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.

Recommended Knowledge

- 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.

- 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.

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.

Intended Learning Outcomes

No	Competence	ILO
1	Independently	Independently plan and organize advanced learning processes
2	Design	Design and implement appropriate research methods taking full account of the range of alternative techniques and approaches
3	Collect	Collect, assess and interpret relevant information
4	Draw	Draw scientifically founded conclusions that consider social, scientific and ethical insights
5	Apply	Apply their knowledge and understanding to a context of their choice
6	Develop	Develop, formulate and advance solutions to problems and arguments in their subject area, and defend these through argument
7	Discuss	Discuss information, ideas, problems and solutions with specialists and non-specialists

Indicative Literature

None

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	Students must have taken and successfully passed a total of at least 30 CP from advanced modules, and of those, at least 20 CP from advanced modules in the major.

Assessment and Completion

Components	Examination Type	Duration /Length	Weight (%)	Minimum	ILOs
Bachelor Thesis ESSMER	Thesis	approx. 6.000 – 8.000 words (15 – 25 pages), excluding front and back matter.	80	45%	All, mainly 1-6
Thesis Seminar ESSMER	Presentation	approx. 15 to 30 minutes	20	45%	All, mainly 6 & 7

Module Achievements: 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.

4.34 Language and Humanities Modules

4.34.1 Languages

The descriptions of the language modules are provided in a separate document, the "Language Module Handbook" that can be accessed from the Constructor University's Language & Community Center internet sites (https://constructor.university/student-life/language-community-center/learning-languages).

5 Appendix

5.1 Intended Learning Outcomes Assessment-Matrix

ESSMER					Fundamentals in Earth Sciences	Environmental Systems and Global Change	Microeconomics	Macroeconomics	Geochemistry of Environmental Systems	Natural Resources and Hazards	Concepts in Public Economics and Sustainable Management of Natural Risks	Physics of Planet Earth	Advanced Field Laboratories	Digital Geoscience	Sustainability and Policy Evaluation	Advanced Environmental Science	Current Topics in ESSMER	Bachelor Thesis	CT Methods/Skills	CT New Skills	CT Language/Humanities
Semester					1	2	1	2	3	4	3	3	4	5	5	6	6	6	1-4	3-6	1-2
mandatory/mandatory elective					m	m	m	m	m	m	m	m	m	me	me	me	me	m	m	m	me
Credits					7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	5	5	5	5	12	20	20	5
	Competencies*																				
Program Learning Outcomes	A	E	P	S																	
explain key concepts and processes in geology, oceanography, environmental sciences, geochemistry, Earth data science and digital geosciences	x	x			x	x			x	x		x	x	x		x	x				
describe and discuss (near-)surface systems, identify and examine their components and interactions	x	x			x	x			x	x		x	x	x		x	x				
apply fundamental chemical and physical concepts and methods to real-world problems	x	x		x	x	x			x	x		x	x	x		x	x				
apply fundamental theories, approaches and methods for public policy analysis	x	x					x	x			x				x						
apply fundamental field skills, technologies, and concepts in ESSMER;		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				
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	x				
select and apply key data processing and analysis techniques in applied and environmental geosciences;	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					
analyze scientific and technical questions, put them into relationship to what is known in the literature, and suggest avenues to solve the questions at hand;	x	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				
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				
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				
apply research methods appropriate in ESSMER;	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	
distinguish among the economic interests and activities of different stakeholders	x	x	x	x			x	x			x				x						
evaluate economic, political, and societal problems with regard to climate change using economics and management theories and scientific reasoning	x	x		x			x	x			x				x						
Assessment Type																					
Written examination					x	x	x	x	x	x	x	x			x	x			x	x	x
Term paper											x			x			x				
Essay																					x
Project report																					
Poster presentation																					
Laboratory report													x			x					
Program Code																					
Oral examination																					x
Presentation																		x		x	x
Practical Assessments																					
Project Assessments																				x	
Portfolio Assessments																					
Bachelor Thesis																		x			
Module achievements					x	x													x	x	x

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