Module description
Master Environmental Sustainability

Examination regulations on SoSe 2022

Head of programme: Prof. Dr.-Ing. Frieder Kunz
Created on 26.09.2025
Valid on SoSe 2022

Table of Contents

Compulsory subjects

Name of the module	Master Thesis
Name of the module (engl.)	Master's Thesis
Abbreviation of the module	MARB
Number	8990
Type of module	Compulsory module
Specialization	
Formal requirements	see examination regulations „Prüfungsordnung Masterstudiengang“ and „Allgemeine Prüfungsordnung“
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	

Workload	900 h	**Credits**	30
Contact Time		**Weighting**	30
Self studying	900 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter/Summer semester	**Duration**	6 months
Start regular semester			
Maximum number of participants		**Language**	englisch, deutsch

Courses

Teaching and Didactics:
The student has to demonstrate the ability of autonomous scientific work. Therefore, only little control and support will be given by regular meetings and discussions of work progress.

Learning objectives and skills

This Module students enables students to
- solve a scientific question or task autonomously,
- structure and plan a scientific project,
- apply the knowledge and skills acquired at university to solve a problem
- analyze, present and discuss results accordingly,
- develop and assess new approaches for the specific tasks,
- write a scientific thesis according to the guidelines of good scientific practice.

Content

- Topic will be defined by student and professor.
- Methods will be chosen by student with support of professor.
- Time, resource and cost planning
- Executing the plan
- Evaluating the results
- Writing the thesis in time

Work to be completed for the awarding of credit points	
Timely completion of thesis. Approval of thesis and presentation by supervisor	
Weighting (for partial performances)	

Literature

Other information or comments
Person in charge / Lecturers: Professor at Bingen University of Applied Science. Name has to be defined before the thesis starts. Language: English. German or other languages after approval by the examination board.

Name of the module	Scientific Project Work
Name of the module (engl.)	Scientific Project Work
Abbreviation of the module	PROJ
Number	100
Type of module	Compulsory module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Prof. Dr.-Ing. Frieder Kunz, Dr. Bettina Kempf

Workload	contact time: 4 SWS self-study: 300 h incl. thesis and presenta-tions	**Credits**	12
Contact Time	4 SWS	**Weighting**	12
Self studying	300 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter/Summer semester	**Duration**	2 semester
Start regular semester			
Maximum number of participants		**Language**	englisch, deutsch

Courses
Workshop, Lecture, Seminar, Teamwork, Thesis

Learning objectives and skills
This Module enables students • to work autonomously on a project of applied sciences • to pick topics and form a well-defined project solvable in 300 h. • to structure and plan a small scientific project • to choose the appropriate methods • to use scientific methods on investigating literature describing the state of science • to handle literature and sources suitably • to analyze and evaluate findings • to document and write down the project results

Content
Kick off workshop Concept Elaboration/Hypothesis Generation Scientific Methods: • constructing a scientific framework • setting up hypotheses • working on hypotheses • designing experiments Fundamentals in Project management Defining projects and goals Panning project structure, time and resources Working stages from the subject selection to the definition of objectives and implementation **Preliminary presentation** Students present • Literature survey • Project plan according to time, resources, costs • Material and Methods • Design of Experiments • Preliminary results **Final presentation** Students present in a restricted time frame • Hypothesis • Methods, experiments, supervisions • Analysis and conclusions

Work to be completed for the awarding of credit points	
PL: Attendance, Approved Scientific report and final presentation	
Weighting (for partial performances)	

Literature

Other information or comments
The Module has 4 compulsory sessions: • Kick-off workshop • Audience at final presentation of predecessing group • preliminary presentation • final presentation Language: English, German or other languages after approval by the examination board Exam: Scientific report and final presentation

Compulsory elective subject

Name of the module	Academic English
Name of the module (engl.)	Academic English
Abbreviation of the module	ACE
Number	2000
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	More than sound B2 writing and speaking performance in English, C1 in comprehension of both written and oral English
Module use (in other study programmes)	Environmental Sustainability (M.Sc.)
Responsible person	Birgit Hoess
Lecturer	Birgit Hoess

Workload	contact time: 6 SWS self-study: 90 h	**Credits**	6
Contact Time	6 SWS	**Weighting**	6
Self studying	90 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

Lecture/Tutorial

Learning objectives and skills

Students
- acquire in-depth knowledge about academic conventions regarding scholarly strategies in the process of academic research and writing.
- structure written and oral contributions appropriately before and during performance
- write and speak English in a competent manner
- enhance fluency in written and spoken contributions

Content

- Research, references, and citation
- Advanced paraphrasing
- Strategies for explicit structure of papers and presentations
- Personalised advanced English training
- Language as a mental and interactive tool

Work to be completed for the awarding of credit points

PL: written examination (90 min)
SL: attendance and weekly tasks

Weighting (for partial performances)	

Literature

Appropriate state-of-the-art samples and sources

Other information or comments

Name of the module	Air Resources
Name of the module (engl.)	Air Resources
Abbreviation of the module	AIRE
Number	2010
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Dr. rer. nat. Sven Meyer
Lecturer	Prof. Dr.-Ing. Dr. rer. nat. Sven Meyer

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

Lecture

Learning objectives and skills

Upon completion of the module, students will
- be able to link the relationships in the legal regulations on immission protection
- be able to identify sources of pollutants and plan their avoidance as well as derive their significance for the climate impact.
- be able to derive the need for action for emission reduction measures.
- be able to implement basic components of emission reduction techniques in the sense of a “toolbox”.

Content

- Emission and immission of pollutants (legal basis, emission propagation, propagation modeling, immission parameters, air pollution control plans)
- Basics of atmospheric chemistry
- Sources and origins of pollutants
- Introduction to the emission reduction technologies

Work to be completed for the awarding of credit points	
PL: written examination (90 min)	
Weighting (for partial performances)	

Literature

Will be provided during the course

Other information or comments

Name of the module	Atmospheric Chemistry
Name of the module (engl.)	Atmospheric Chemistry
Abbreviation of the module	ATCE
Number	2340
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	Climate Mitigation and Climate Adaption (B.Sc.) Agriculture and Environment (M.Sc.) Environmental Protection (B.Sc.) Environmental Protection (M.Sc.)
Responsible person	Prof. Dr. Katharina Lenhart
Lecturer	Prof. Dr. Katharina Lenhart

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	0
Self studying	60 h	**Importance of the grade for the final grade**	
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture and seminar

Learning objectives and skills

Content

Work to be completed for the awarding of credit points	
SL: passed short tests (at least 50 %), attendance (at least 80 %)	
Weighting (for partial performances)	

Literature
• Lecture slides • Material from corresponding OLAT course

Other information or comments
Participation in the excursion to the Max Planck Institute for Chemistry in Mainz is compulsory.

Name of the module	Climate Risk Assessment
Name of the module (engl.)	Climate Risk Assessment
Abbreviation of the module	CRA
Number	2260
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Successful completion of the module Environmental Impacts of Climate Change (ENIC)
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Dr. Borbála Katalin Pájer-Gálos

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture and Seminar

Learning objectives and skills

After completing the module, students will be able to:
- evaluate sensitivity, exposure and vulnerability,
- identify the climate risk factors for investments,
- suggest adaptation options under climate change conditions.

To achieve this, the students will be qualified:
- to understand the differences between climate variability and climate change,
- to select the appropriate databases,
- to interpret the observed and expected tendency of climate extremes and impacts,
- to select the appropriate risk assessment method,
- to understand and interpret uncertainty.

Content

- Climate variability and climate change. Extreme events, observed and expected impacts.
- Sensitive and vulnerable regions and ecosystems, affected physical assets and infrastructure.
- Integration of climate change into Environmental impact assessments. Resilience, resistance, recovery, adaptation capacity.
- Risk assessment. Essential databases.
- Sensitivity analysis, evaluation of exposure to climate hazards, vulnerability assessment. Case studies.
- Risk identification, risk matrix. Case studies.
- Scoping of adaptation options, making investments climate resilient.
- Decision making under uncertainty.
- Monitoring networks, warning systems, decision support systems & related recent international research projects.

Work to be completed for the awarding of credit points	
PL: written examination (90 min)	
Weighting (for partial performances)	

Literature

- Lecture slides
- Non-paper Guidelines for Project Managers: Making vulnerable investments climate resilient. European Commission, Directorate-General for Climate Action http://ec.europa.eu/clima/policies/adaptation/what/docs/non_paper_guidelines_project_managers_en.pdf
- EU Commission Staff Working Paper - Risk Assessment and Mapping Guidelines for Disaster Management https://climate-adapt.eea.europa.eu/metadata/guidances/eu-commission-staff-working-paper-risk-assessment-and-mapping-guidelines-for-disaster-management
- IPCC 2021. Climate Change 2021: The Physical Science Basis, the Working Group I contribution to the Sixth Assessment Report https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/
- IPCC 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) http://www.ipcc.ch/report/srex/

Other information or comments

Name of the module	Conflicts and Synergies in Climate and Environmental Protection
Name of the module (engl.)	Conflicts and Synergies in Climate and Environmental Protection
Abbreviation of the module	COSY
Number	2130
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Environmental Law, Economics, Climatology and Climate change, Air pollution control and Greenhouse gas inventory, Climate change mitigation and adaptation, English for Engineers 1
Module use (in other study programmes)	
Responsible person	Prof. Dr. Oleg Panferov
Lecturer	Prof. Dr. Oleg Panferov

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture

Learning objectives and skills

After completing the module, students will be able to:

- select, develop and plan the climate change mitigation and adaptation as well as environmental protection measures in a most optimal way so that the conflicts are as far as possible minimized and the synergies are created and efficiently used.

To achieve this, the students will be qualified:

- to estimate and evaluate the local or regional climate and land use change processes;
- to analyse the future climate projections;
- to recognize and evaluate the possible practical mitigation and climate change adaptation options, to identify and to link the affected fields of action, sectors and actors;
- to analyse the interactions and feedbacks between measures, to analyse the current scientific state-of-the-art on environmental consequences of possible climate change mitigation and adaptation measures;
- to derive measures to protect biodiversity and to assess the climate impact of environmental protection and nature conservation measures.

The students will be trained in the perception of their social skills and for social engagement.

Content
• Observed and projected climate change in Germany, local and regional peculiarities • Region-specific vulnerabilities, need for adaptation and climate change mitigation potential, • Climate change mitigation goals and German adaptation strategy, • Analysis of the climate change adaptation measures and to reduce greenhouse gas emissions at different levels for different sectors (energy, industry, agriculture and forestry, waste), • Effects, interactions and unexpected co-benefits and adverse side effects of climate mitigation and adaptation measures as well as of environmental protection measures, e.g. interactions / conflicts of bioenergy and biodiversity, between climate, biodiversity, agriculture, water, health, transport, infrastructure, etc., • Identification and linking of the actors: politics, administration, business and the public, • Weighting of the goals, identification of trade-offs and selection of the optimal measures.

Work to be completed for the awarding of credit points	
PL: 50 % oral presentation (5-10 min), 50 % written examination (60 min)	
Weighting (for partial performances)	

Literature
• Lecture slides • UBA, 2017, Synergies and Conflicts between Climate Protection and Adaptation Measures in Countries of Different Development Levels. https://www.umweltbundesamt.de/en/publikationen/synergies-conflicts-between-climate-protection

Other information or comments

Name of the module	Ecological Intensification of Agri-cultural Systems
Name of the module (engl.)	Ecological Intensification of Agricultural Systems
Abbreviation of the module	EIAS
Number	2270
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Elmar Schulte genannt Geldermann
Lecturer	Prof. Dr. Elmar Schulte genannt Geldermann

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture/Tutorial

Learning objectives and skills

After successful completion of this course, students are expected to be able to:
- describe and evaluate different tools solutions and farming system approaches in respect to their sustainability and resilience
- describe and apply general procedures of agro-ecological system analysis,
- apply tools and solution for the design and redesign of sustainable agricultural systems
- evaluate agricultural concepts and system approaches for potential trade-offs and synergies
- apply frameworks and models that measure the domains of ecological intensification

Content

The course will focus on concepts that integrate ecological with agricultural principles to optimize resource conservation, productivity, societal benefit, and profitability.
Major topics included are:
- Major concepts and practices based on ecological intensification of farming and food systems (e.g. agroecology, agroforestry, organic farming, conservation agriculture, climate smart agriculture)
- Categories of ecosystem services and their integration into agriculture
- Types, causes and effects of soil degradation, loss of biodiversity, agricultural pollution.
- Tools and solutions for increased soil fertility and soil health management; improved water and general resource use efficiencies; sustainable improvement of crop and livestock productivity; farm diversification.
- Constraints and opportunities for social and economic development of local, regional and global agricultural systems.
- Methods of environmental and social impact assessment.

Work to be completed for the awarding of credit points	
PL: Case study assessment reports, including poster presentation (70%), peer review assessment (30%)	
Weighting (for partial performances)	

Literature
Study guide and list of relevant literature provided by the course lecturer(s)

Other information or comments

Name of the module	Emission and Immission Lab. Air & Noise
Name of the module (engl.)	Emission and Immission Lab. Air & Noise
Abbreviation of the module	ELAB
Number	2030
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Air Resources (AIRE) and Environment Noise Control (ENC) should be combined with this laboratory
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz, Prof. Dr.-Ing. Dr. rer. nat. Sven Meyer
Lecturer	Prof. Dr.-Ing. Frieder Kunz, Prof. Dr.-Ing. Dr. rer. nat. Sven Meyer

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	6	**Language**	englisch

Courses
Laboratory

Learning objectives and skills
Upon completion of the module, students will • understand noise measurements • understand noise prediction in free space • understand air pollution measurements • understand air pollution prediction

Content
• sound pressure measurement • sound power measurement • binaural measurement of noise • environmental noise prediction according to Cnossos • measurement of basic figures for emissions • measurement of odors • stack calculation

Work to be completed for the awarding of credit points	
PL: Completed reports on measurements and calculations **SL:** attendance	
Weighting (for partial performances)	

Literature
Will be provided during the course

Other information or comments

Name of the module	Energetic Use of Renewable Materials
Name of the module (engl.)	Energetic Use of Renewable Materials
Abbreviation of the module	EUOR
Number	2070
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Oliver Marcus Türk
Lecturer	Prof. Dr. Oliver Marcus Türk

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	25	**Language**	englisch

Courses

Lecture

Learning objectives and skills

The students know the most important renewable energy carriers and their usage. They are able to discuss properties and challenges/problems along the chain of usage where agricultural questions as well as land surface availability, processing, allocation, technical usage as energy carrier up to the political and legislative boundaries are of importance. The students know about the borderline between material and energetic use including concepts of cascade usage and the area of conflict between food production and the energetic use of renewables.

Content

- Introduction: Climatic change, usage of fossile resources, sustainability
- Solid renewable energy carriers: wood and straw, composition of energy carriers, availabilities, boiler types, efficiencies, ash (composition, treatment), emissions/pollutants
- Liquid renewable energy carriers: plant oil, biodiesel, bioethanol, energy balance, life cycle assessment, political and legal questions and boundaries, land surface availability, prospects, fundamental reasonableness in distinction to electric mobility
- Gaseous renewable energy carriers: biogas, plant design, concepts and optimization, substrates, processes, fundamental reasonableness with regard to food usage for energy production
- Deepened consideration of land surface availabilities, life cycle assessment, consideration of distinction to other renewable energies: where is biomass useful and reasonable?
- Biobased hydrogen in distinction to renewable hydrogen from fluctuating renewable energies
- Outlook, future developments

Work to be completed for the awarding of credit points	
PL: homework/seminar paper	
Weighting (for partial performances)	

Literature
Lecture notes, literature list will be given in the lecture

Other information or comments
Selection of EUOR excludes occupancy of ENNR and vice versa

Name of the module	Environmental Controlling
Name of the module (engl.)	Environmental Controlling
Abbreviation of the module	ENCO
Number	2050
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	Environmental Sustainability (M.Sc.) Climate Mitigation and Climate Adaption (B.Sc.) Agriculture and Environment (M.Sc.) Environmental Protection (B.Sc.) Environmental Protection (M.Sc.)
Responsible person	Prof. Rainer Hartmann
Lecturer	Prof. Rainer Hartmann

Workload	contact time: 4 SWS self-study: 120 h (incl. assessment)	**Credits**	6
Contact Time	4 SWS	**Weighting**	6
Self studying	120 h (incl. assessment)	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

Lectures, Practicals, Fieldwork, Group Work, Seminars

Learning objectives and skills

On successful completion of this module students will be able to:
- Identify, name, handle and evaluate the key instruments of Environmental Assessment, Environmental Management and Environmental Controlling,
- Define and describe the prerequisites for efficient Environmental Controlling and Environmental and other Quality Management disciplines,
- Recognize and explain the important role of Environmental Controlling for
    - the communication with stakeholders
    - the management and shareholders
- Integrate new developments in Environmental Management and Controlling in the context of previously used instruments
- Realize and explain the important role of environmental disasters for the development of environmental awareness and environmental legislation throughout Europe and
- Demonstrate a thorough understanding how the legislative process in Europe works.

Content

Students will be introduced to the relevant instruments for the use in a corporate environment of:
- Env. Quality Management systems following EMAS and ISO 14001
- ISO 50001 Energy Management
- Environmental Auditing
- Environmental and carbon footprints
- Corporate Social Responsibility (CSR) following ISO 26000
- Sustainability Reporting

Work to be completed for the awarding of credit points	
PL: homework and presentation **SL:** regular active participation in seminars, attendance (at least 80 %)	
Weighting (for partial performances)	

Literature
An up-to-date literature list will be provided during the seminars.

Other information or comments
Coursework/ Presentation may be submitted in English or German: The module ENCO can only be credited if the student had not enrolled on the module ENCO or a similar module as part of a previous university degree.

Name of the module	Environmental Impact of Plastics
Name of the module (engl.)	Environmental Impact of Plastics
Abbreviation of the module	EIOP
Number	2140
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Oliver Marcus Türk
Lecturer	Prof. Dr. Oliver Marcus Türk

Workload	contact time: 4 SWS self-study: 120 h	**Credits**	6
Contact Time	4 SWS	**Weighting**	6
Self studying	120 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	25	**Language**	englisch

Courses
Lecture

Learning objectives and skills

Upon completion of the module the students will:
- know the most important facts about the sustainability concept with regard to material use
- know the most important mass and special plastics, the raw material basis, production and applications
- know the environmental problems that are caused by the materials, their raw material and intermediates with regard to the production, use, and end of life
- know the most important environmental laws that are relevant in the context of plastics production, usage, and end of life with regard to the most important regions
- know approaches and initiatives for a “better plastics world”
- are able to discuss the environmental impact of plastics and are informed about the pros and cons of plastic materials in their respective typical applications

Content

- Introduction: Material flows, fossile resources, climatic change, sustainability concepts
- Mass- and special plastics, materials, processes, applications, markets
- Raw materials, formulation, critical ingredients
- Recycling
- Legislation regarding plastics in the most important countries
- Initiatives against plastics or for a better plastics world and usage
- Outlook: The „better plastics world“ of the future

Work to be completed for the awarding of credit points	
PL: homework/seminar paper	
Weighting (for partial performances)	

Literature
• Lecture notes, literature list will be given in the lecture • Türk, O.; Stoffliche Nutzung nachwachsender Rohstoffe, Springer Vieweg, Wiesbaden, 2014 • Türk, O.: Plastics Sustainability Handbook, DeGruyter, Berlin, 2025

Other information or comments
Selection of EIOP excludes occupancy of KUUW and vice versa

Name of the module	Environmental Impacts of Climate Change
Name of the module (engl.)	Environmental Impacts of Climate Change
Abbreviation of the module	ENIC
Number	2380
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Elke Hietel, Prof. Dr. Oleg Panferov
Lecturer	Prof. Dr. Elke Hietel, Prof. Dr. Oleg Panferov

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

Lecture (60 %), seminar (40 %)

Learning objectives and skills

Upon completion of the module, students will:
- have gathered a basic understanding of the weather, climate and climate change
- understand the interaction between climate and land use/cover
- have learned about the impacts of climate and climate change on biodiversity
- have an enhanced comprehension of climate change mitigation and adaption and a more detailed knowledge of sustainable management instruments

Content

- Climate characteristics and climate zones, natural and anthropogenic reasons for climate changes, SRES Scenarios and Climate scenarios, effects of individual climate characteristics and their combinations on terrestrial ecosystems (with focus on forest and agricultural ecosystems). abiotic risks in forest and agricultural ecosystems. Possible feedbacks of land use changes on regional climate
- Impacts on Biodiversity: fossil and pollen records of past climate change, impacts of recent climate change on biodiversity: phenology, community composition, terrestrial and aquatic ecosystem processes, species extinction and immigration, adaptation principles, conservation management and case studies

Work to be completed for the awarding of credit points	
PL: oral presentation (10 min) **SL:** written abstract of presentation (1-2 pages)	
Weighting (for partial performances)	

Literature

- Lecture notes on Climate Reconstructions and Climate Change Impacts on Key Elements of Biodiversity
- Lecture slides on Climate and Climate Change, Impacts on Ecosystems
- Climate Change 2021 - The Physical Science Basis, Contribution of Working Group I to the Sixths Assessment Report of the IPCC, www.ipcc.ch
- Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixths Assessment Report of the Intergovernmental Panel on Climate Change, www.ipcc.ch
- Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixths Assessment Report of the Intergovernmental Panel on Climate Change, www.ipcc.ch
- IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Inter-governmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Bron-dizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany.
- Filho, W.L. & Barbir, J. (2018): Handbook of Climate Change and Biodiversity. Springer.
- Lovejoy T.E., Hannah L.J. (eds.) (2005): Climate Change and Biodiversity. Yale University Press, New Haven & London.

Other information or comments

Lecturers: Prof. Dr. Elke Hietel (Impacts on Biodiversity), Prof. Dr. Oleg Panferov (Climate and Climate Change, Impacts on Ecosystems)

Name of the module	Environmental Noise Control
Name of the module (engl.)	Environmental Noise Control
Abbreviation of the module	ENC
Number	2060
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Module ELAB contains laboratories on Noise and Air Pollution and should be taken in parallel.
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Prof. Dr.-Ing. Frieder Kunz

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lectures

Learning objectives and skills
Upon completion of the module, students • will know basics of acoustics • can read noise maps • knows about noise abatement and noise action planning • is able to apply the END 2002/49/EU on a community level

Content
Basics on airborne acoustics • Sound pressure, Sound intensity, Sound power • Levels in dB, dB(A), dB(C) • Noise measurement techniques • Noise calculation in free space with Cnossos European Noise Directive (END) 2002/49/EU • Noise mapping • participation • actions plans Noise abatement measures

Work to be completed for the awarding of credit points	
PL: written examination (90 min)	
Weighting (for partial performances)	

Literature
Will be provided during the course

Other information or comments

Name of the module	Fuel Cells
Name of the module (engl.)	Fuel Cells
Abbreviation of the module	FUCE
Number	2090
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	introductory course in thermodynamics and/or physical chemistry
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Michael Mangold
Lecturer	Prof. Dr.-Ing. Michael Mangold

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture

Learning objectives and skills

At the end of the module, the students will be able to
- choose suitable types of fuel cells depending on the area of application;
- understand fuel cell systems including balance-of-plant components; dimension fuel cell systems;
- formulate dynamic first principle models of fuel cell systems;
- assess pros and cons of different methods for hydrogen generation and hydrogen storage with respect to costs, application area, and environmental impact.

Content

- Physical and chemical fundamentals of fuel cells: equilibrium voltage, energetic and exergetic efficiency; Tafel equation; Butler-Volmer-kinetics
- Types of fuel cells: PEMFC, DMFC, PAFC, MCFC, SOFC
- Dynamic modeling of fuel cells: mass balance, charge balance, energy balance
- Balance-of-plant (BOP) components
- Systems of fuel cells and batteries; simple battery models
- Methods of hydrogen generation and hydrogen storage

Work to be completed for the awarding of credit points	
PL: written examination (60 min)	
Weighting (for partial performances)	

Literature

- EG and G Technical services Inc, Fuel Cell Handbook, U.S. Department of Energy, 2016.
- Hoogers, G. (ed.), Fuel Cell Technology Handbook, CRC Press, 2002.
- Larminie, J. and Dicks, A., Fuel Cell Systems Explained, Wiley, 2003.
- Pukrushpan, J. et al., Control of Fuel Cell Power Systems, Springer, 2004.

Other information or comments

Name of the module	Geographic Information Systems
Name of the module (engl.)	Geographic Information Systems
Abbreviation of the module	GIS
Number	2280
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Dipl.-Ing. Sigrid Daub-Spielmann

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

Lecture, Lab

Learning objectives and skills

The main objective of the course is to understand the GIS terms, data sources and the data processing algorithms. The first part of the course focuses on the basic GIS terms, the system components and geomodelling concept. In addition to the first part the understanding, the role and usage of the datum and projection systems are important. The second course part deals with the vector data model: the collection of vector data, storing vector and attribute data in files and databases, the creation and editing of vector data, the vector-based data query and analysis, and finally the thematic display of the vector data. A separate lecture explains the concept and the importance of topology, the relationship among spatial elements. The third chapter of the course concentrate on the raster model: the raster georeference, the raster data sources and storage, the several layers of raster analysis and the display of raster data. The objective of the last chapter is the understanding of surface modelling: the grid based surface creation, the surface analysis and visualization. The labs follow the lectures, the students get to know and use the basic geoinformation software products and solve nature and environment protection related geospatial problems

Content

- GIS terms, components, and methods
- Geomodelling, datum and projection systems
- Vector based modelling
- Vector data analysis
- Raster based modelling
- Raster data analysis
- Grid based surface modelling
- GIS applications in Environmental Protection
- Case studies, practice

Work to be completed for the awarding of credit points	
PL: course paper (case study report)	
Weighting (for partial performances)	According to credit points

Literature
Lecture slides

Other information or comments

Name of the module	Georisks
Name of the module (engl.)	Georisks
Abbreviation of the module	GEO
Number	2350
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Dr. Anna Reusch-Oehler

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	50	**Language**	englisch

Courses

Lecture

Learning objectives and skills

This module enables students to:
- Acquire in-depth knowledge about a wide variety of geohazards.
- Differentiate between natural risks and geohazards, exposure and vulnerability.
- Learn about different aspects of Natural Disaster Risk Reduction.
- Understand economic loss estimates from natural disaster events.
- Undertake scientific literature review about natural hazards and present results.

Content

- Geophysical/geological natural hazards (e.g. earthquakes, gravitational mass transport deposits (e.g. landslides), volcanic activity)
- Hydrological hazards (e.g. floods, tsunami, avalanches)
- Climatological/meteorological hazards (e.g. storms, extreme temperatures, droughts, wildfires)
- Definitions “Natural risks”, “Natural Disasters”, “Geohazards”, “Exposure” and “Vulnerability”
- Natural Disaster Risk Reduction and economic losses from natural disaster events

Work to be completed for the awarding of credit points	
PL: oral presentation (15 min)	
Weighting (for partial performances)	

Literature

- Lecture Slides
- State-of-the-art literature will be provided during the course

Other information or comments

Name of the module	Global Environment and Sustainability Management
Name of the module (engl.)	Global Environment and Sustainability Management
Abbreviation of the module	GESM
Number	2320
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	Energy, Facilities and Environment Management (M.Sc.)
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Ingo Weiss

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture

Learning objectives and skills

On successful completion of this module students will be able to:
- link the relationships in the legal regulations and apply the most important principles and standards for Environmental, Social and Governance (ESG) and Sustainability
- interpretate and apply the United Nation Sustainable Development Goals (SDG)
- understand environment and sustainability management for global operating companies
- analyze essential environmental and sustainability aspects
- apply a double materiality analyzes
- professionalize stakeholder engagement
- understand how to develop a global environment and sustainability strategy
- develop key performance indicators (KPI) to measure environment and sustainability performance
- understand sustainability governance structure in global operating companies
- understand the value of environment and sustainability reporting

Content
Students will be introduced to: • target-oriented global environment and sustainability management with practical examples from global operating companies • global environment and sustainability regulations, standards, concepts, and industrial trends • development of global environment and sustainability strategies • global environment and sustainability benchmarking • double materiality analyses • tools for stakeholder analyses and engagement • tools for change management • reporting and communication requirements

Work to be completed for the awarding of credit points	
PL: written examination (90 min)	
Weighting (for partial performances)	

Literature
• Lecture script • UN Sustainable Development Goals (SDG) (www.un.org/sustainabledevelopment) • UN Global Compact (https://unglobalcompact.org) • Greenhouse Gas Protocol (https://ghgprotocol.org) • Science Based Targets initiative (https://sciencebasedtargets.org) • Global Reporting Initiative (GRI) (https://www.globalreporting.org/) • EU Green Deal • Corporate Sustainable Reporting Directive • European Sustainability Reporting Standards (ESRS) • ISO 14001 Environmental management systems • ISO 26000 Social responsibility • ISO 31000 Risk management • AA1000 AccountAbility Standards (https://www.accountability.org/standards) • SA 8000 Social Accountability (https://sa-intl.org/resources/sa8000-standard)

Other information or comments

Name of the module	International Sales with Case Studies
Name of the module (engl.)	International Sales with Case Studies
Abbreviation of the module	INSA
Number	2110
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Stefan Gabriel
Lecturer	Prof. Dr. Stefan Gabriel

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

Lectures and exercises

Learning objectives and skills

Upon completion of the module, students will
- be able to develop marketing, sales and pricing strategies for products in international markets
- have an enhanced comprehension of options for market development and market activities as well as market analysis, messaging and product portfolio adjustments
- have learned about the relevance of different models of international sales activities, account management, composition of adequate sales channels, and sales supporting activities
- be able to apply the relevant tools which are shown, discussed and illustrated in the lecture by using case studies

Content

- Global Marketing Research
- Strategies for Global Markets
- Sociocultural Environment, Cultural Aspects and Challenges in International Markets
- International Pricing Politics, Terms and Conditions, Product Live Cycle
- Export Modes
- Support of International Sales Activities using CRM
- Management of the International Sales Organization, Global Account Management
- Management of the International Distribution System
- International Sales Controlling, Sales Intelligence

Work to be completed for the awarding of credit points	
PL: Presence in the lectures; written examination (60 min)	
Weighting (for partial performances)	Lectures approx. 2/3, exercises approx. 1/3

Literature

- Lecture presentation slides and handouts;
- Kotler, Philip: ‘Marketing-Management’, Pearson, international edition;
- Hollensen, Svend: ‘Global Marketing – a decision oriented approach’, Prentice Hall

Other information or comments

Name of the module	International Water and Waste Management
Name of the module (engl.)	International Water and Waste Management
Abbreviation of the module	IWWM
Number	2120
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Rainer Hartmann
Lecturer	Prof. Rainer Hartmann, Prof. Dr. Mike Heath

Workload	contact time: 4 SWS self-study: 120 h incl. assessment	**Credits**	6
Contact Time	4 SWS	**Weighting**	6
Self studying	120 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lectures, Practicals, Fieldwork, Group Work, Seminars

Learning objectives and skills

On successful completion of this module students will be able to:
- Identify, name and evaluate the key aspects of water and waste management in an international context
- Undertake and present competent, self-directed research into these topic areas

Waste Management
- Analyse the requirements of a community and set waste management plans up for different communities in dependence of their environment
- Describe all major routes of re-use, recycling and waste treatment with their advantages and disadvantages
- Identify the most sustainable waste management options depending on requirements
- Design and set up a local waste management strategy

Water Management and Waste Water (WW) Treatment
- Identify, analyse and evaluate the predominant water issues in different parts of the world
- Analyse and evaluate water issues in a variety of geographical, cultural and political settings
- Analyse, describe and design appropriate water and waste water treatment technology

Content
Waste Management • Extended waste hierarchy • Waste management strategies depending on regional circumstances • Treatment, technology and destinations of waste and secondary raw materials • Effects and consequences of no, suboptimal or incorrect waste handling, • Waste management case studies from around der world Water Management • International water issues and their derivation • Geographical, climate and political reasons and consequences of/ for water issues • Water and WW technology and their appropriate application in various environments • Water quality analysis and assessment.

Work to be completed for the awarding of credit points	
PL: written examination (90 min), attendance in lectures at least 80 %	
Weighting (for partial performances)	

Literature
An up-to-date literature list will be provided during the seminars. Literature: Englisch and German

Other information or comments

Name of the module	Life Cycle Assessment
Name of the module (engl.)	Life Cycle Assessment
Abbreviation of the module	LCA
Number	2300
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Own computer or notebook with AppsAnywhere installed to work with GaBi Education software.
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Dr. András Polgár

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture and seminar

Learning objectives and skills

After completing the module, students will be able to:
- do general tasks related to environmental life cycle analysis (LCA),
- know and adapt at the level of proficiency between types of environmental life cycle impact assessment,
- be informed at the level of knowledge a software and manual analysis methods.

To achieve this, the students will be qualified:
- to define the adequate system boundaries of an LCA
- to set up a life cycle inventory and an eco balance of a general product, activity, technology or service;
- to assess the environmental impacts of a general product, activity, technology or service with different assessment methodologies;
- to make an interpretation of the results of a life cycle assessment;
- to get familiar with the main life cycle assessment software.

The students will be trained in the perception of their social skills and for social engagement.

Content

- Environmental management. Life cycle approach. Circular economy.
- Life Cycle Assessment (LCA). Standards of LCA.
- Steps of the LCA
- Goal and scope definition, life cycle inventory
- Life cycle impact assessment, life cycle interpretation
- Impact assessment and management. Impact assessment methodologies.
- Case studies.
- Practical experience of executing a life cycle assessment using commercial software.

Work to be completed for the awarding of credit points	
PL: written examination (90 min)	
Weighting (for partial performances)	

Literature

- Lecture slides
- ISO 14040:2006 Environmental management -- Life cycle assessment -- Principles and framework
- ISO 14044:2006 Environmental management -- Life cycle assessment -- Requirements and guidelines
- European Commission - Joint Research Centre - Institute for Environment and Sustainability (2010). International Reference Life Cycle Data System (ILCD) Handbook - General Guide for Life Cycle Assessment - Detailed Guidance. Publications Office of the European Union, Lux-embourg.
- Journals with discussions on LCA methodology and case studies

Other information or comments

Getting your copy of the free GaBi Education software license with your Student ID and with the help of the Lecturer for the University Verification **or** by using AppsAnywhere **as directed by the supervisor.**GaBi Education License Application Form can be downloaded here: https://gabi.sphera.com/software/gabi-universities/gabi-education-free/gabi-education-application/.

Name of the module	Life Cycle Assessment - Case Study
Name of the module (engl.)	Life Cycle Assessment - Case Study
Abbreviation of the module	LCAS
Number	2170
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Module LCA should be taken in advance. The contents of the LCA lecture are assumed to be known.
Module use (in other study programmes)	
Responsible person	Prof. Dr. Thilo Kupfer
Lecturer	Prof. Dr. Thilo Kupfer

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	16	**Language**	englisch

Courses
Lectures, work and discussion on the case study in groups and in the plenum

Learning objectives and skills
Upon completion of the module, students will be able to • Describe an LCA according to ISO 14040 • Transfer the theory to a case study • Describe and justify the own value choices for the subjective parts of an LCA • Criticise an existing LCA on the case study subject

Content
Life Cycle Assessment according to ISO 14040 • Goal & scope • Life cycle inventory • Life cycle impact assessment • Interpretation and use of the results The theory of LCA is first introduced and then used on a case study. The subject of the study will be discussed and fixed in the course. This module is the continuation of the LCA module, therefore, module LCA should be taken in advance (winter term). The contents of the LCA lecture are assumed to be known.

Work to be completed for the awarding of credit points	
PL: written examination (60 min)	
Weighting (for partial performances)	

Literature
• Lecture notes • ISO 14040

Other information or comments
This module is the continuation of the LCA module, therefore, module LCA should be taken in advance (winter term). The contents of the LCA lecture are assumed to be known.

Name of the module	Marine und mediterrane Ökosysteme 2
Name of the module (engl.)	Marine and Mediterranean Ecosystems 2
Abbreviation of the module	MMÖS 2
Number	2360
Type of module	Compulsory elective module
Specialization	
Formal requirements	Marine and Mediterranean Ecosystems (MMÖS) or equivalent expertise in marine science and ecology
Content requirements	Biology, Ecology, Geography, Climate Science An individual financial contribution between 600 and 1000 € per student will need to be charged.
Module use (in other study programmes)	Environmental Sustainability (M.Sc.) Agriculture and Environment (M.Sc.) Environmental Protection (B.Sc.) Environmental Protection (M.Sc.)
Responsible person	Prof. Rainer Hartmann
Lecturer	Prof. Rainer Hartmann

Workload	contact time: 6 SWS self-study: 90 h	**Credits**	6
Contact Time	2 SWS (during field course)	**Weighting**	6
Self studying	approx. 150 h (field course)	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter/Summer semester	**Duration**	1 semester
Start regular semester			
Maximum number of participants		**Language**	

Courses
Field trip, Practicals, Fieldwork, Group Work, Seminars

Learning objectives and skills

On successful completion of this module students will be able to:

- Demonstrate their expertise and knowledge of the geographical and ecological principles of the terrestrial, littoral and marine Ecosystems of the Northern Mediterranean
- Applied Expertise in marine sciences
- Be familiar with the theoretical and practical aspects of Mediterranean and Marine Ecology
- Understand and explain the physical and ecological relationships in the Mediterranean Sea
- Critically assess and evaluate the effects of environmental pressures on these habitats
- Demonstrate their ability to systematically research their topic in theory and practice in a multi-lingual environment with a variety of resources.

Content

- Scientific work in a multilingual environment
- Fundamentals of Oceanology
- The Mediterranean region: History, geology, geography and ecology
- The theory and practice of the systematics and ecology of terrestrial, marine habitats and the Littoral
- The habitats and ecological societies in the Mediterranean
- Practical investigation of distribution of nutrients, trophic chains and webs, plankton and its development stages
- Practical research in the problems of pollution and ecological signals of environmental pollution and pressures.
- Investigation of the advantages and disadvantages of the economic use of space as a resource.

Work to be completed for the awarding of credit points	
PL: oral presentation (50 %) and homework (50 %) **SL:** active participation in excursions, seminars, field work and laboratory practicals	
Weighting (for partial performances)	

Literature

Literature: An up-to-date literature list will be provided during the seminars.

Mediterrane Geschichte, Geographie und Ökosysteme

- Abulafia, D. (2011), The Great Sea: A Human History of the Mediterranean
- Norwich, J.J. (2007), The Middle Sea: A History of the MediterraneanNorwich, J.J. (2012), A History of Venice
- Da Mosto, F. , Francesco's Mediterranean Voyage [DVD], Amazon
- Da Mosto, F. , Francesco's Venice [DVD], Amazon
- Schönfelder, I., Schönfelder, P. (2014), Was blüht am Mittelmeer, Kosmos
- Schönfelder, P. u. I. (2022), Die Kosmos Mittelmeer-Flora, Kosmos
- Polunin, O. (1969), Flowers of Europe: A Field Guide
- Polunin, O., Wright, R.S. (1972), The Concise Flowers of Europe, Oxford University Press

Meereskunde

- Riedel, R. (1983), Fauna und Flora des Mittelmeeres, Parey oder
- Riedel, R. (2011), Nachdruck: Fauna und Flora des Mittelmeeres, Seifert Verlag
- Hofrichter, R. (2002), Das Mittelmeer Bd. 1 u. 2, Spektrum Akademischer Verlag
- Hofrichter, R. (2020) Das Mittelmeer, 2. Aufl., Springer Verlag
- Bergbauer, M., Humberg, B. (1999), Was lebt im Mittelmeer, Kosmos Verlag
- Ott, J. (1996), Meereskunde, UTB Stuttgart
- Neumann, V., Paulus, T. (2005), Mittelmeer Atlas, Mergus Verlag
- Kaiser, M.J. et al. (2011), Marine Ecology: Processes, Systems, and Impacts
- Townsend, D.W. (2012), Oceanography and Marine Biology: An Introduction to Marine Science
- Mladenov, P.V. (2013), Marine Biology: A Very Short Introduction

Other information or comments

- This is an international field course which can only be offered if the political situation allows for the required travel arrangements and if the number of participants render the field course economically viable!
- Successful completion of assessment and regular active participation in seminars, field work and laboratory practicals is essential.
- Coursework and presentation can be submitted in German or English.
- The module MMÖS 2 can only be credited if the student had not enrolled on the module MMÖK2 or a similar module as part of a previous university degree.
- 10 – 14 day field course with instructed field work, seminars, laboratory practicals, wrap-up seminars.

Name of the module	Material Flow Management
Name of the module (engl.)	Material Flow Management
Abbreviation of the module	MFMG
Number	2230
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Oliver Marcus Türk
Lecturer	Prof. Dr. Oliver Marcus Türk

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	25	**Language**	englisch

Courses
Lecture

Learning objectives and skills
Material flow management is the analysis and optimization of material and energy flows under consideration of the sustainability approach, i.e. under combination of ecologic, economic, and social aspects. Thus, material flow management is a very comprehensive and interdisciplinary approach. Upon completion of the module the students will be able to understand the approach comprehensively and apply to material and energy flows under consideration of respective tools. The ability to consider legal aspects, the holistic view of the interplay of ecologic, economic, and social aspects, the structurization of the analysis, and the differentiation of systems and their boundaries will be communicated in the lecture. A number of material examples will be discussed in the lecture.

Content
Basics of material flow management • Spatial hierarchies (operational, local, regional, national, global) • Material and energetic consideration • Material circles („cradle-to-cradle" product design), cascade use • Material analysis, coupling with life cycle assessment, specific software, systems and boundaries • legal aspects • Material examples, boundaries of the approach

Work to be completed for the awarding of credit points	
PL: homework/seminar paper	
Weighting (for partial performances)	

Literature
Lecture notes, literature list will be given in the lecture

Other information or comments
Selection of MFMG excludes occupancy of SSMA and vice versa

Name of the module	Professional English
Name of the module (engl.)	Professional English
Abbreviation of the module	PRE
Number	2180
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	More than sound B2 writing and speaking performance in English, C1 in comprehension of both written and oral English
Module use (in other study programmes)	Environmental Sustainability (M.Sc.)
Responsible person	Birgit Hoess
Lecturer	Birgit Hoess

Workload	contact time: 6 SWS/90 h self-study: 90 h	**Credits**	6
Contact Time	6 SWS	**Weighting**	6
Self studying	90 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture/Tutorial

Learning objectives and skills
Students • communicate more effectively and fluently • participate more confidently in meetings • approach negotiations more diplomatically • respond more spontaneously in different situations • have expanded your range of professional vocabulary • are able to network with greater confidence

Content
Students • communicate more effectively and fluently • participate more confidently in meetings • approach negotiations more diplomatically • respond more spontaneously in different situations • have expanded your range of professional vocabulary • are able to network with greater confidence

Work to be completed for the awarding of credit points	
PL: written examination (90 min) **SL:** attendance and weekly tasks	
Weighting (for partial performances)	

Literature
Appropriate state-of-the-art samples and sources

Other information or comments

Name of the module	Remote Sensing of Environmental Changes
Name of the module (engl.)	Remote Sensing of Environmental Changes
Abbreviation of the module	RESE
Number	2250
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	Informatics, any programming language and/or statistical tools (e.g. R).
Module use (in other study programmes)	Environmental Protection (M.Sc.)
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Dr. Elena Zakharova

Workload	contact time: 4 SWS self-study: 120 h	**Credits**	6
Contact Time	4 SWS	**Weighting**	6
Self studying	120 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture (2 SWS), Labs (2 SWS)

Learning objectives and skills
The course gives an insight into remote sensing and its application for detection and analysis of environmental changes. The course starts from introduction into the physical principles: electromagnetic spectrum, understanding of electromagnetic radiation and its interaction with the earth surface and atmosphere, interpretation of satellite measurements acquired in optical, thermal and microwave bands. Information on characteristics of historical and modern satellite platforms and instrument's used in environmental studies will help to understand advantages and limits of different techniques for solving specific tasks. The second part of the course is dedicated to the investigation and analysis of case studies grouped in two main domains: 1) changes of continental water cycle and its components and 2) changes in the cryosphere. Along the lectures, students learn about modern European satellite programs, products and services; become familiar with the processing of optical and microwave images using free software; learn how to find, extract/interpret an information/data from satellite data products; understand how to detect, attribute and analyse changes in environmental parameters; to explore a multi-satellite approach.

Content
1. Basics of remote sensing • Electromagnetic spectra and remote sensing: theory and applications, use in remote sensing. • Visible / Near infra-red / Thermal infra-red / UV /Radar; • Physics of measure; emission, capacities and limitations of active and passive sensors. • Lab. Introduction to image treatment using free software **2. Environmental changes. Case studies.** 2.1 Continental water cycle and hydrology: • satellite monitoring of soil moisture and draught conditions • water regime of rivers/lakes/wetlands from space (altimetry, radiometry, optics, gravimetry) • water quality. • Lab: Altimetry, radiometry and gravimetry data exploration 2.2. Detection and monitoring of changes in the cryosphere: • operational remote sensing of the arctic sea ice retreat • changing Greenland (from ice sheet melt to water productivity increase) • fate of lake and river ice (state-of-the-art and remote sensing contribution) • space monitoring of permafrost degradation and its environmental and socio-economic effects. • Lab: Multi-satellite approach implementation. 2.3 Investigation of an environmental change in one of the World regions using satellite obser-vations: • Methodological approach and realisation • Lab: Autonomous information search, data download, processing, analysis, preparation of resulting report.

Work to be completed for the awarding of credit points	
PL: written examination (90 min) **SL:** course paper (max. 3 pages)	
Weighting (for partial performances)	

Literature
Lecture slides, scientific papers, satellite product descriptions (ATBD, Handbooks etc)

Other information or comments

Name of the module	Renewable Energies
Name of the module (engl.)	Renewable Energies
Abbreviation of the module	REEN
Number	2200
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	basic knowledge in physics and engineering
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Prof. Dr.-Ing. Frieder Kunz

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	25	**Language**	englisch

Courses

lecture, excursion, seminar

Learning objectives and skills

Upon completion of the module, students will be
- conversant with criteria and issues related to sustainable energy sources.
- able to identify relevant problems, collect and discuss relevant data and published information

Content

Background knowledge, calculation concept and planning basics for a self-sustaining building project including
- Energy Demand and Efficiency
- Electricity, production and transport, grid
- Market mechanisms
- Wind, Water, Solar, Bio Mass, Geothermal Heat
- Storage Technologies

Work to be completed for the awarding of credit points

PL: written examination (90 min)
SL: presentation

Weighting (for partial performances)	

Literature

Will be provided during the course

Other information or comments

Lectures, case studies, seminar (group and individual work with short presentations)

Name of the module	Renewable Materials
Name of the module (engl.)	Renewable Materials
Abbreviation of the module	REMA
Number	2210
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Oliver Marcus Türk
Lecturer	Prof. Dr. Oliver Marcus Türk

Workload	contact time: 4 SWS self-study: 120 h	**Credits**	6
Contact Time	4 SWS	**Weighting**	6
Self studying	120 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	25	**Language**	englisch

Courses

Lecture, (excursion)

Learning objectives and skills

Upon completion of the module, students will
- distinguish renewable raw materials by their chemical nature, basic structures and resulting properties in processing and final use.
- suggest potential application fields for the materials according to their material profile.
- can judge about sustainability/ecological aspects of such materials by compari-son with classical construction materials like metals and particularly petrochemi-cal plastics.
- know about availability, economic aspects of renewable materials and future chances.
- be able to consider critically materials according to their profile and application.
- be able to provide an integrated consideration of material, energetical and cas-cade use of materials in connection with climatic change and limited petrochem-ical resources.
- be able to prepare biobased materials for measurement in the laboratory, can conduct measurements with the materials and relevant analytical instruments.

Content

- Material use of renewable materials / “biobased materials”
- Chemical families of renewable materials, structures, properties, availability
- Processing and fields of application
- Competitive materials, economical aspects of such materials
- Environmental/ecological aspects of such materials
- Material/energetical/cascade use
- Potential future development
- Connection with climatic change and limited resources
- Practical course as additional module

Work to be completed for the awarding of credit points	
PL: homework/seminar paper	
Weighting (for partial performances)	

Literature
• Lecture notes, literature list will be given in the lecture • Türk, O.; Stoffliche Nutzung nachwachsender Rohstoffe, Springer Vieweg, Wiesbaden, 2014 • Türk, O.: Plastics Sustainability Handbook, DeGruyter, Berlin, 2025

Other information or comments
Selection of REMA excludes occupancy of BIMA and vice versa

Name of the module	Renewable Materials - Practical Course
Name of the module (engl.)	Renewable Materials - Practical Course
Abbreviation of the module	REMA P
Number	2290
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	none
Module use (in other study programmes)	
Responsible person	Prof. Dr. Oliver Marcus Türk
Lecturer	Prof. Dr. Oliver Marcus Türk

Workload	contact time: 4 SWS self-study: 120 h	**Credits**	6
Contact Time	4 SWS	**Weighting**	6
Self studying	120 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

4 SWS laboratory

Learning objectives and skills

Upon completion of the module, students will
- Have “hands-on” experience with biobased materials in general and biobased plastics in particular in the laboratory
- Be able to use several important analytical methods relevant for the development of materials
- Complete the theoretical knowledge from the lecture REMA with practical experience in the real handling and analysis of the materials

Content

Laboratory trials using several analytical methods for the analysis of biobased materials / plastics:
- Differential Scanning Calorimetry (DSC)
- Dynamical Mechanical Analysis (DMA)
- Dielectric Analysis (DEA)
- Thermogravimetric Analysis (TGA)
- Rheometry
- Tensiometry

Work to be completed for the awarding of credit points	
PL: homework/seminar paper with the results of the laboratory trials, regular attendance	
Weighting (for partial performances)	

Literature

- Lecture notes, literature list will be given in the lecture
- Türk, O.; Stoffliche Nutzung nachwachsender Rohstoffe, Springer Vieweg, Wiesbaden, 2014
- Türk, O.: Plastics Sustainability Handbook, DeGruyter, Berlin, 2025

Other information or comments
Selection of REMA-P excludes occupancy of BIMA-P and vice versa.

Name of the module	Restoration Ecology
Name of the module (engl.)	Restoration Ecology
Abbreviation of the module	RECO
Number	2190
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	basic knowledge in biology and ecology
Module use (in other study programmes)	
Responsible person	Prof. Dr. rer. nat. Michael Rademacher
Lecturer	Prof. Dr. rer. nat. Michael Rademacher

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	25	**Language**	englisch

Courses
seminar, excursion

Learning objectives and skills
At the end of this module, the students will have basic knowledge of the restoration of ecosystems disturbed by humans. There will be a detailed reading about: • the limiting abiotic and biotic factors of restoration • the restoration of open-cast mining areas • the renaturation of lakes and lake shores

Content
Lecture • Introduction to restoration ecology • Ecological bases and limiting factors of restoration • Basics of the renaturation of still waters • Lake shore renaturation, rehabilitation and renaturation of eutrophic lakes • Renaturation and recultivation of mining sites • Research network - the "Society for Ecological Renaturation (SER)" Excursion • Excursion to the restored limestone quarry Mainz-Weisenau

Work to be completed for the awarding of credit points	
PL: Coursework: 20 min presentation, handout (2 pages), regular attendance **SL:** attendance	
Weighting (for partial performances)	

Literature

- Script
- Clewell, A. & Aronson, J. (2013): Ecological Restoration, Second Edition: Principles, Values, and Structure of an Emerging Profession. - Society for Ecological Restoration (SER)
- Rademacher, M. (2015): Biodiversity Management in quarries and gravel pits. – HeidelbergCement, ISBN 978-3-9815050-8-5
- Gann, G. (2019): International Principles And Standards For The Practice Of Ecological Restoration. - Society for Ecological Restoration (SER).
- Zerbe, S. & G. Wiegleb (2009): Renaturierung von Ökosystemen in Mitteleuropa. – Springer.
- Kollmann et a. (2019): Renaturierungsökologie. – Springer.
- Zerbe, S. (2019): Renaturierung von Ökosystemen im Spannungsfeld von Mensch und Umwelt

Other information or comments

Name of the module	Sustainable Agricultural Economics
Name of the module (engl.)	Sustainable Agricultural Economics
Abbreviation of the module	SAE
Number	2330
Type of module	Compulsory elective module
Specialization	
Formal requirements	Admission to the Master's programme
Content requirements	spreadsheet calculations (e.g. Microsoft Excel), skills in mathematics and statistics, economic comprehension, knowledge of agricultural production systems
Module use (in other study programmes)	
Responsible person	Prof. Dr. Thore Toews
Lecturer	Prof. Dr. Thore Toews

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Winter semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lecture/Tutorial

Learning objectives and skills
On successful completion of this module students will be expected to be able: • to explain the advantages of international trade and the arising problems. • to explain the problems of overexploitation of resources if they are common goods. • to conduct calculations to show that overexploitation of natural resources is less a problem in the case of private property rights. • to explain economically viable ways of integrating the agricultural system into a greenhouse gas mitigation strategy.

Content
International trade, new institutional economics, resource economics, production economics, greenhouse gas mitigation policy

Work to be completed for the awarding of credit points	
PL: written examination (90 min)	
Weighting (for partial performances)	

Literature
Perman, R., Ma, Y., McGilvray, J., Common, M. (2003): Natural Resource and Environmental Economics. 3rd Edition. ISBN: 0273655590

Other information or comments

Name of the module	Sustainable Business Administration and Simulation
Name of the module (engl.)	Sustainable Business Administration and Simulation
Abbreviation of the module	SBAS
Number	2220
Type of module	Compulsory elective module
Specialization	
Formal requirements	Admission to the Master's programme
Content requirements	Basics in economics
Module use (in other study programmes)	
Responsible person	Prof. Dr.-Ing. Christian Reichert, Dr. rer. nat. Martin Pudlik
Lecturer	Prof. Dr.-Ing. Christian Reichert, Dr. rer. nat. Martin Pudlik

Workload	contact time: 3 SWS self-study: 135 h	**Credits**	6
Contact Time	3 SWS	**Weighting**	6
Self studying	135 h	**Importance of the grade for the final grade**	According to credit points
Frequency	Summer semester only	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses
Lectures, Business Simulation, Group work

Learning objectives and skills
Upon completion of the module, students will • provide basics in economics with focus on sustainability as well as on entrepreneurial thinking. • are able to evaluate business data and to adequately adopt, read and interpret finan-cial management reports. • are able to recognize and consider internal and external conditions for business success in a dynamic competitive environment. • acquire presentation skills for results, strategies and analysis. • learn effective decision-making in a team including assessment of the implications of decision.

Content

This course is designed to introduce the students to the principles and functions of business with a focus on topics like ecology and sustainability as important part of the business environment. Within the module business will be studied as an important part of the total social, political and economic environment. The different areas of business will be covered and en-hanced by application of a computer-based business simulation. Participants will represent the owners of up to six companies. They need to make strategic and operative decisions and try to lead their company successfully in a competitive environment. The course will be accompanied by relevant lectures providing basics in:

- Business ownership
- Financial information
- Planning
- Profit and loss account
- Financial accounting
- Financial reporting
- Strategy, Porter's Five Forces Analysis
- Sustainability from an entrepreneur’s point of view

Work to be completed for the awarding of credit points	
PL: Performance and successful participation in the business simulation **SL:** Participation in at least 90 % of the business simulation sessions	
Weighting (for partial performances)	

Literature

- Participant's manual of the business simulation tool TOPSIM Mastering General Management
- Campbell McConnell, Stanley Brue, Sean Flynn McConnell: Economics. McGraw Hill, 21st edition (2017)
- Other relevant material handed by the lecturers

Other information or comments

Participation in business simulation requires equipment capable of online operation like laptop or tablet (alternative: participation via IT room at UAS Bingen)

Organization:

- The module will take place as a 3-day block seminar at the end of the semester.
- Parts of the seminar will be held online via MS Teams.
- A minimum number of eight participants is required.
- Log-in data as well as composition of the teams will be announced one week before the seminar starts.
- The number of participants for every seminar is limited to 25 persons. There is a special registration procedure which has to be followed. Registrations will then be considered in the order of receipt.

Name of the module	World Heritage Summer School
Name of the module (engl.)	World Heritage Summer School
Abbreviation of the module	WHSS
Number	2390
Type of module	Compulsory elective module
Specialization	
Formal requirements	none
Content requirements	basic knowledge and interest in botany, geology, monument protection; physical fitness to stand the excursions and field work
Module use (in other study programmes)	Agriculture and Environment (M.Sc.) Environmental Protection (M.Sc.)
Responsible person	Prof. Dr.-Ing. Frieder Kunz
Lecturer	Dr. Bettina Kempf

Workload	contact time: 2 SWS self-study: 60 h	**Credits**	3
Contact Time	2 SWS	**Weighting**	3
Self studying	60 h	**Importance of the grade for the final grade**	According to credit points
Frequency	irregularly	**Duration**	1 semester
Start regular semester			
Maximum number of participants	20	**Language**	englisch

Courses

excursion, practical work, seminar

Learning objectives and skills

Upon completion of the module, students will
- know the UNESCO World Heritage Program
- know about the special features of the World Heritage Site "Upper Middle Rhine Valley"
- understand the geomorphology and landscape genesis in the Middle Rhine Valley and the connection between biotope maintenance, viticulture, cultural landscape and landscape mosaic
- learn about the characteristics of a typical village in the Upper Middle Rhine Valley
- know about challenges for urban development and Rhine Romanticism between sustainable development, monument protection and World Heritage
- get insights how this World Heritage Site can be maintained
- get insights into the planning of the “Bundesgartenschau 2029”

Content

- Background knowledge about the UNESCO World Heritage Program
- Several excursions: a typical Upper Middle Rhine village, a castle, Koblenz, boat trip on the Rhine
- Seminars about geomorphology and landscape genesis, viticulture, cultural landscape and landscape mosaic
- Active participation in maintenance of several World Heritage Sites (care of monuments and biotopes)
- Learn how to build a drywall

Work to be completed for the awarding of credit points

PL: learning diary in sufficient quality
SL: regular attendance in seminars, active participation in work assignments/excursions

Weighting (for partial performances)	

Literature

Other information or comments
This module is a two-week full-time module. **Students must apply separately with our co-operation partner. Places are limited**. Students will live and work together with other international young people in a local youth hostel. All expenses (including the costs of travel, entrance fees, meals and accommodation in a youth hostel) are covered within a fee of approx. 150 EUR (as of 2025). Travel to and from the event is not covered (but possible without extra costs using the TH Bingen Semesterticket).