



M O D U L E H A N D B O O K

**Description of Modules
Master Course**

ENVIRONMENTAL SUSTAINABILITY

11.04.2025

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1: Compulsory / Pflichtmodule

Scientific Project Work

Scientific Project Work (PROJ)						
CODE MI-ES-PROJ		Work-load 360 h	ECTS 12 ECTS	scheduled 1st and 2nd Sem.	Frequency summer and winter	Duration 12 months
1	Course Workshop, Lecture, Seminar, Teamwork, Thesis		Contact hours 4 SWS for Lecture, Workshop etc.	Self-study 300 h incl. thesis and presentations		group size 20
2	Learning outcomes / Competencies This Module enables students - to work autonomously on a project of applied sciences - to pick topics and form a well-defined project solvable in 300h. - 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					
3	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 • Planing 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, <u>supervisions</u> • Analysis and conclusions					

4	Teaching and Didactics The Module has 4 compulsory sessions. 1. Kick-off workshop 2. Audience at final presentation of previous group 3. preliminary presentation 4. final presentation
5	Prerequisites Formal: - others:
6	Exam Scientific report (2/3 weight) and final presentation (1/3 weight)
7	Condition to award ECTS Attendance, and approved scientific report and final presentation
8	Recognition of Module in other study program
9	Weighing factor of exam according to credit points
10	Person in charge / Lecturers Prof. Dr. Frieder Kunz
11	Other information: Language: English. German or other Languages after approval by the board of examiners Literature: n.a.

Master Thesis

Master Thesis (THES)					
CODE MI-ES-THES	Work-load 900 h	ECTS 30 ECTS	scheduled 3rd Sem.	Frequency summer or winter	Duration 6 months
1	Course Scientific Project	Contact hours n.a.	Self-study	group size Normally an individual performance	
2	Learning outcomes / Competencies 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.				
3	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				
4	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.				
5	Prerequisites Formal: see examination regulations „Prüfungsordnung Masterstudiengang“ and „Allgemeine Prüfungsordnung“ others:				
6	Exam Written thesis, oral presentation and discussion				
7	Condition to award ECTS In time completion of thesis. Approval of thesis and presentation by supervisor				
8	Recognition of Module in other study program n.a.				
9	Weighing factor of exam according to credit points				
10	Person in charge / Lecturers Professor at Bingen University of Applied Science. Name has to be defined, before the thesis starts.				
11	Other information: Language: English. German or other Languages after approval by the board of examiners Literature: n.a.				

2: Electives / Wahlpflichtmodule

Academic English

Academic English (AcE)

CODE MI-ES-AcE	Workload 180 h	Credits 6	scheduled 1st or 2nd sem.	Frequency of the course winter semester	Duration 1
1	Course Lecture/ Tutorial	Contact hours 6 SWS / 90 h	Self-study 90 h	Group size 20 students	
2	Learning outcomes: 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				
3	Contents: ▪ 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				
4	Teaching method Interactive seminar and workshop				
5	Prerequisites: Formal: Content: More than sound B2 writing and speaking performance in English, C1 in comprehension of both written and oral English				
6	Examination a) Three brief or one extended presentation of 30 minutes in total b) One five-page paper				
7	Conditions for obtaining credits Attendance combined with both 6a) and 6 b)				
8	Optional use for other study programs M-UW				
9	Weight of grade for the final grade				
10	Course coordinator(s) and main lecturer(s) Mag. phil. Birgit Hoess				
11	Other information Language of instruction: English Literature: Appropriate state-of-the-art samples and sources				

Air Resources

Air Resources (AIRE)

CODE MI-ES-AIRE	Workload 90 h	Credits 3 ECTS	scheduled 1,2 semes- ter	Frequency Winter (not in 24/25)	Duration 1
1	Course -Lectures	Contact hours 30 h	Self-study 60 h	group size 20	
2	Learning outcomes / competencies 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".				
3	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				
4	Teaching and Didactics Lectures				
5	Prerequisites Formal: - others: -				
6	Exam Written examination				
7	Condition to award ECTS passed written examination				
8	Recognition of Module in other study program				
9	Weighing factor of exam according to credit points				
10	Lecturers Prof. Dr.-Ing. Dr. rer. nat. Sven Meyer				
11	Other information: Language: English Literature: Will be provided during the course				

Climate Risk Assessment

Climate Risk Assessment (CRA)

CODE	Workload	ECTS	scheduled	Frequency	Duration
MI-ES-CRA	90 h	3	1	Winter semester	1 Semester
1	Teaching method Lecture and Seminar	Contact time 30 h	Self-study 60 h	group size 20 students	
2	Learning outcomes / competencies 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.				
3	Module contents - 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.				
4	Teaching method Lecture and Seminar				
5	Participation requirements Formal: fluent English (B2) Substantial: Successful completion of the module Climate Change and Environmental Impacts is required				
6	Forms of examination The module examination could be a project work or online oral exam in accordance with the general examination regulations. From a group size of 15 people, the examination form could be the written test.				

7	Requirements for the credits Passed examination
8	Usage of the module in other study programs
9	The weight of note in the final note Weighting according to credits
10	Module responsible Dr. Borbála Gálos
11	-

Climate Change and Environmental Impacts

Climate Change & Environmental Impacts (CLIM)

CODE MI-ES-CLIM	Workload 90 h	ECTS 3 ECTS	Frequency Summer se- mester	Duration 1 semester	Workload 90 h
1	Course -Lectures -Seminar	Contact hours 30 h	Self-study 60 h	group size 20	
2	Learning outcomes / competencies 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 de- tailed knowledge of sustainable management instruments				
3	Content 1. 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 landuse changes on regional climate. 2. 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				
4	Teaching and Didactics Lecture (60 %), seminar (40 %)				
5	Prerequisites Formal: - others: -				
6	Exam Oral and written presentations or written exam				
7	Condition to award ECTS passed examination				
8	Recognition of Module in other study program				
9	Weighing factor of exam according to credit points				
10	Lecturers Prof. Dr. Oleg Panferov (Climate and Climate Change, Impacts on Ecosystems), Prof. Dr. Elke Hietel (Impacts on Biodiversity)				
11	Other information: Language: English Literature: Climate Change 2013 - The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the IPCC, www.ipcc.ch Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, www.ipcc.ch				

	Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, www.ipcc.ch IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. Lovejoy T.E., Hannah L.J. (eds.) (2005): Climate Change and Biodiversity. Yale University Press, New Haven & London.
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Conflicts and Synergies in Climate and Environmental Protection

Conflicts and Synergies in Climate and Environmental Protection (COSY)

CODE	Workload	Credits	Semester	Frequency	Duration
MI-ES-COSY	90 h	3	2. Semester	Winter semester	1 Semester
1	Teaching method Lecture	Contact time 2 SWS 30 h	Self-study 60 h	Group size app. 20 students	
2	Learning outcomes / competencies 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.				
3	Module contents - 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.				
4	Teaching method Lecture and Seminar				
5	Participation requirements Formal: none Substantial: Environmental Law, Economics, Climatology and Climate change, Air pollution control and Greenhouse gas inventory, Climate change mitigation and adaptation, English for Engineers 1				
6	Forms of examination The module examination could be a paper (max. 10 pages) or project work or portfolio or an equivalent performance in accordance with the general examination regulations. From a group size of 20 people, the examination form could be the written test.				

7	Condition to award ECTS Passed examination
8	Usage of the module for other courses
9	The weight of note in the final note Weighting according to credits
10	Module responsible Prof. Dr. Oleg Panferov
11	Other informations Language: English 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

Ecological intensification of agricultural systems

Ecological Intensification of Agricultural Systems (EIAS)

Code MI-ES- EIAS		workload 90 h	credits 3	study semester	frequency summer semester	duration 1 semester
1	Course Lecture / Tutorial		Contact hours 2 SWS / 30 h	Self-study 60 h	Group size 20-40 students	
2	Learning outcomes / Competencies 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					
3	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.					
4	Teaching Lecture, tutorial, working groups					
5	Prerequisites None					
6	Exam Case study assessment reports, including poster presentation (70%) Peer review assessment (30%)					
7	Condition to award ECTS Passed examination (at least 50%, respectively)					
8	Recognition of Module in other study program Master Landwirtschaft und Umwelt (WP)					
9	Weighting of the grade for the final grade according to credit points					
10	lecturer Prof. Dr. Elmar Schulte-Geldermann					
11	Other information Language: English					

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

Emission and Immission Lab. Air & Noise

Emission and Immission Lab. Air & Noise (ELAB)

CODE MI-ES-ELAB		Workload 90 h	ECTS 3	Semester 1,2	Frequency winter semester (not in 24/25)	Duration 1 semester
1	Course Laboratory		Contact hours 30 h	Self-study 60 h	group size 6	
2	Learning outcomes / competencies Upon completion of the module, students will • understand noise measurements • understand noise prediction in free space • understand air pollution measurements • understand air pollution prediction					
3	Content • Sound pressure measurement • Sound power measurement • binaural measurement of noise • Environmental noise prediction according to Crosso • Measurement of basic figures for emissions • Measurement of odors • Calculation of air pollution control units					
4	Teaching and Didactics Laboratory					
5	Prerequisites Formal: - others: - Air Resources and Environment Noise Control should be combined with this laboratory					
6	Exam Reports of Measurements and Calculations					
7	Condition to award ECTS completed Reports					
8	Recognition of Module in other study program					
9	Weighing factor of exam according to credit points					
10	Lecturers Prof. Dr.-Ing. Dr. rer. nat. Sven Meyer, Prof. Dr. Frieder Kunz					
11	Other information: Language: English Literature: Will be provided during the course					

Energetic Use of Renewable Materials

Energetic Use of Renewable Materials (EUOR)

Code	workload	credits	Semester	Frequency	Duration
MI-ES-EUOR	90 h	3	1 oder 2	winter semester	1 semester
1	Course lecture	Contact hours 30 h	Self-study 60 h	Group size 25 students	
2	Learning outcomes / competences - 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.				
3	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				
4	Teaching and didactics 2 SWS lecture				
5	Prerequisites Fluent English recommended (writing and orally, B2/C1); selection of EUOR excludes occupancy of ENNR and vice versa				
6	Exam Homework / seminar paper				
7	Recognition of module in other study program According to study plans				
8	Weighting factor of exam Weighting factor according to credit points				
9	Lecturers Prof. Dr. Oliver Türk				
10	Other information Language: English Literature: Lecture notes, literature list will be given in the lecture				

Environmental Controlling

Environmental Controlling (ENCO)

CODE		Workload	ECTS	Semester	Frequency	Duration
MI-ES-ENCO		180 h	6	1 or 2	winter/ biennial (next: 2024/25)	1 Term
1	Mode of teaching Lectures, Practicals, Fieldwork, Group Work, Seminars		Contact time 4 SWS / 60 h	Self-study 120 h incl. As- sessment	Estimated Size of Cohort approx. 20 students	
2	Learning Outcomes (Expertise 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, - Recognise 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 - Realise 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.					
3	Module Contents 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					
4	Teaching mode 60 hours lectures, seminars, excursions and guided learning towards the assessment task; digital learning environment where required and appropriate					
5	Prerequisites none					
6	Exam Coursework/ Presentation may be submitted in English or German:					
7	Condition to award ECTS Successful completion of assessment and Regular active participation in seminars (80%), which may be replaced by a colloquium if regular participation was not possible for good reasons. 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.					
8	Recognition of Module in other study program MSc Landwirtschaft und Umwelt					
9	Weighing factor of exam According to the applicable assessment regulations (SG-PO):					

10	Lecturers Prof. Rainer Hartmann
11	Other relevant information Language: English , Literature English and German Literature: An up-to-date literature list will be provided during the seminars.

Environmental Impact of Plastics

Environmental Impact of Plastics (EIOP)

Code MI-ES-EIOP		workload 180 h	ECTS 6	study se- mester 1 st – 3 rd se- mester	frequency winter semester	duration 1 semester
1	courses lecture		contact time 60 h		self-study 120 h	Group size 25
2	Learning outcomes / Competencies 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 pro- duction, 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					
3	Contents - 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					
4	Teaching and didactics 4 SWS lecture					
5	Prerequisites Fluent English recommended (writing and orally, B2/C1); selection of EIOP excludes occu- pancy of KUW and vice versa					
6	Exam seminar paper					
7	Recognition of module in other study program According to study plans					
8	Weighting factor of exam Weighting factor according to credit points					
9	Lecturers Prof. Dr. Oliver Türk					

10**Other information****Language:** English**Literature:**

Lecture notes, literature list will be given in the lecture

Türk, O.; Plastics – The environmental issue, DeGruyter, Berlin, 2022

Türk, O.; Stoffliche Nutzung nachwachsender Rohstoffe, Springer Vieweg, Wiesbaden, 2014

Environmental Noise Control

Environmental Noise Control (ENC)					
CODE MI-ES-ENC	Workload 90 h	ECTS 3 ECTS	study semester 1.-3. semester	Frequency Winter (not in 24/25)	Duration 1 semester
1	Course -Lectures	Contact hours 30 h	Self-study 60 h	group size 20	
2	Learning outcomes / competencies 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				
3	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				
4	Teaching and Didactics Lecture				
5	Prerequisites Formal: - others: - Module ELAB contains laboratories on Noise and Air Pollution and should be taken in parallel				
6	Exam written or oral examination				
7	Condition to award ECTS passed examination				
8	Recognition of Module in other study program				
9	Weighing factor of exam according to credit points				
10	Lecturers Prof. Dr. Frieder Kunz				
11	Other information: Language: English Literature: Will be provided during the course				

Fuel cells

Fuel Cells (FUCE)						
CODE MI-ES-FUCE		work load 90 h	credits 3	study semester 1 and 2	frequency winter semester	duration 1 Semester
1	courses Lecture		contact time 2 SWS / 30 h	self-study 60 h	group size ~20 students	
2	learning outcomes / competencies 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.					
3	contents 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					
4	teaching lecture					
5	requirements for participation in form and content formal: none content: introductory course in thermodynamics and / or physical chemistry					
6	kind of examination written examination					
7	Condition to award ECTS passed written exam					
8	Recognition of Module in other study program					
9	Weighing factor of exam weighting factor according to the course-specific examination regulations (SG-PO): 1					
10	module coordinator and full time lecturer Prof. Dr. Michael Mangold					
11	further information language: English 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.					

Geographic Information Systems

Geographic Information Systems (GIS)

CODE	Workload	ECTS	Semester	Frequency	Duration
MI-ES-GIS	90 h	3	1 st – 3 rd semester	Summer se- mester	1 Semester
1	Teaching method Lecture, Lab	Contact time 2 SWS 30 h	Self-study 60 h	Group size app. 20 students	
2	Learning outcomes / competencies 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 sur- face 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..				
3	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				
4	Teaching method Lecture and Lab				
5	Prerequisites Formal: none Substantial: none				
6	Exam Course paper (case study report).				
7	Condition to award ECTS Passed the case study report				
8	Recognition of Module in other study program				
9	Weighing factor of exam Weighting according to credits				
10	Sigrid Daub-Spielmann, Pollichia e.V., Deutschland				
11	Other information Language: English				

	Literature: - Lecture slides
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Georisks

Georisks (GEO)					
Code	Workload	Credits (ECTS)	Semester	Frequency	Duration
MI-ES-GEO	90 h	3	1	Summer semester	1 semester
1	Teaching method Lectures	Contact time 2 SWS / 30 h	Self-directed studies 60 h	Group size no limitation	
2	Learning outcomes / competences 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.				
3	Module Content Lectures and presentations to the following topics: ▪ Geophysical/geological natural hazards (e.g. earthquakes, landslides and volcanic activity) ▪ Hydrological hazards (e.g. floods, tsunami, avalanches) ▪ Climatological/meteorological hazards (e.g. storms, extreme temperatures, droughts, wild-fires) ▪ Definitions “Natural risks”, “Natural Disasters”, “Geohazards”, “Exposure” and “Vulnerability” ▪ Natural Disaster Risk Reduction and economic losses from natural disaster events				
4	Teaching method Lecture and Seminar				
5	Prerequisites Formal: - Others: basic knowledge natural sciences				
6	Examination Oral presentation or written exam, depending on group size				
7	Requirements for the allocation of credits Passed examination				
8	Optional use for other study programs ---				
9	Weighing factor of exam According to the applicable assessment regulations (SG-PO)				
10	Lecturer Dr. Anna Reusch (Rae)				
11	Other information Language: - English				

Literature:

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

Global Environment and Sustainability Management

Global Environment and Sustainability Management (GESM)

Code		Workload	Credits (ECTS)	Semester	Frequency	Duration
MI-ES-GESM		90 h	3	1	Winter semester	1 semester
1	Teaching method Lectures		Contact time 2 SWS / 30 h	Self-directed studies 60 h	Group size 10 - 30 students	
2	Learning outcomes / competences 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					
3	Module 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 analyzes - tools for stakeholder analyzes and engagement - tools for change management - reporting and communication requirements					
4	Teaching method Lectures					
5	Prerequisites Formal: - Others: -					
6	Examination Written examination					
7	Requirements for the allocation of credits Passed written examination					
8	Use of this module in other courses ---					
9	Weighing factor of exam According to the applicable assessment regulations (SG-PO)					

10	Lecturer Ingo Weiss
11	Other relevant information Language: - English 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 (https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en) - Corporate Sustainable Reporting Directive (https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=uriserv%3AOJ.L_.2022.322.01.0015.01.DEU&toc=OJ%3AL%3A2022%3A322%3AFULL) - European Sustainability Reporting Standards (ESRS) (https://www.efrag.org/lab6) - 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)

International Sales with Case Studies

International Sales with Case Studies (INSA)						
Code MI-ES-INSA		Workload 90 h	ECTS 3 ECTS	study semester 2 semester	frequency summer semester	duration 1 semester
1	Course -Lectures -Exercises		Contact hours 30 h	Self-study 60 h	Group size 25	
2	Learning outcomes / competencies 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 •					
3	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					
4	Teaching and Didactics Lectures (approx. 2/3) and exercises (approx. 1/3)					
5	Prerequisites Good command of English					
6	Exam Written exam					
7	Condition to award ECTS Presence in the lectures; passed exam					
8	Recognition of Module in other study program According to study plans					
9	Weighing factor of exam According to ECTS					
10	Lecturers Prof. Dr. Stefan Gabriel					
11	Other information:					

	Language: English Literature: Lecture presentation slides and handouts; Kotler, Philip: 'Marketing-Management', Pearson, international edition; Hollensen, Svend: 'Global Marketing – a decision oriented approach', Prentice Hall
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International Water and Waste Management

International Water and Waste Management (IWWM)

Code	Workload	ECTS	Semester	frequency	Duration
MI-ES-IWWM	180 h	6	1 or 2	Summer term	1 Term
1	Mode of teaching Lectures, Practicals, Fieldwork, Group Work, Seminars	Contact time 4 SWS / 60 h	Self-study 120 h incl. As- sessment	group size approx. 20 students	
2	Learning outcomes / Competencies 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 a local waste management strategy up. 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				
3	Content Students will be introduced to 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.				
4	Teaching mode 60 hours lectures, seminars, excursions and practicals; partially digital learning environment				
5	Prerequisites none				
6	Exam Coursework: Assignment, design study, research report; for large numbers exam				
7	Condition to award ECTS Successful completion of assessment, regular attendance				
8	Recognition of Module in other study program				

9	Weighing factor of exam According to the applicable assessment regulations (SG-PO):
10	Lecturer Prof. Rainer Hartmann, Prof. Mike Heath
11	Other relevant information Language: English , Literature English and German Literature: An up-to-date literature list will be provided during the seminars.

Life Cycle Assessment

Life Cycle Assessment (LCA)

Code	Workload	ECTS	Semester	Frequency	Duration
MI-ES-LCA	90 h	3	1 st semester	Winter semester	1 Semester
1	Teaching method Online Lecture	Contact time 30h	Self-study 60 h	group size app. 25 students	
2	Learning outcomes / competencies 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.				
3	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.				
4	Teaching method Lecture and Seminar				
5	Prerequisites Formal: Fluent English (writing and orally B2) Substantial: Own computer or notebook; 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. GaBi Education License Application Form can be downloaded here: https://gabi.sphera.com/software/gabi-universities/gabi-education-free/gabi-education-application/				
6	Forms of examination				

	The module examination could be a paper (max. 10 pages) or project work or portfolio or an equivalent performance in accordance with the general examination regulations. From a group size of 20 people, the examination form could be the written test.
7	Condition to award ECTS Passed examination
8	Recognition of Module in other study program According to study plans. Life Cycle Assessment – Case Studies
9	The weight of note in the final note Weighting according to credits
10	Lecturers Dr. habil. András POLGÁR
11	Other information Language: English 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, Luxembourg. - Journals with discussions on LCA methodology and case studies

Life Cycle Assessment – Case Studies

Life Cycle Assessment - Case Study (LCAS)

Code		Workload	ECTS	Semester	Frequency	Duration
MI-ES-LCAS		90 h	3	2nd Semester	Summer semester	1 Semester
1	Course Lectures		Contact hours 30 h	Self-study 60 h	Group max. 16 Students	
2	Learning outcomes / competencies 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					
3	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.					
4	Teaching and Didactics Lectures, work and discussion on the case study in groups and in the plenum					
5	Prerequisites Formal: Fluent English (writing and orally B2 or C1) Content: None					
6	Exam Written exam (90 min)					
7	Condition to award ECTS Passed written examination					
8	Recognition of Module in other study program According to study plans					
9	Weighing factor of exam 1					
10	Lecturer Prof. Dr.-Ing. Thilo Kupfer					

11	Other information Language: English Literature: - Lecture notes - ISO 14040
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Marine and Mediterranean Ecosystems

Marine and Mediterranean Ecosystems (MMES)

Code	Workload	ECTS	Semester	Frequency	Duration
MI-ES-MMES	180 h	6	1 or 2	Winter term/ biennial (next: 2025/26)	1 Semester
1	Mode of teaching Lectures, Practicals, Fieldwork, Group Work, Seminars	Contact hours 4 SWS / 60 h	Self-studies 120 h incl. Assessment	Group approx.. 20 students	
2	Learning Outcomes (Expertise and Skills) On successful completion of this module students will be able to: - Demonstrate their knowledge of the geographical and ecological principles of the terrestrial, littoral and marine Ecosystems of the northern Mediterranean region, - Demonstrate and apply the theory and basic principles of marine sciences, Mediterranean and marine ecology, - Students will understand and be able to explain the physical and ecological interdependencies in the Mediterranean and other seas - and undertake a critical evaluation of environmental protection in these environments - Students will be able to demonstrate their ability to handle scientific resources in a variety of European languages.				
3	Module Contents Students will be introduced to: - Scientific work in a multilingual environment - Fundamental Principles of Oceanology - The Mediterranean Region: Its history, geology, geography and ecology - Systematic structure and ecology of the terrestrial, marine and littoral habitats - Systematics of fauna and flora in the Mediterranean region - The different habitats and their communities in the Med. Region - Distribution of nutrients, role of plankton as basis of food chains/ webs - Pollution and alarm signals of affected environments, - The use of these environments as resources				
4	Teaching mode 60 hours lectures, seminars, field work and guided learning towards the assessment task; digital learning environment where required and appropriate				
5	Prerequisites none				
6	Exam Coursework and Presentation may be submitted in English or German:				
7	Requirements for the allocation of credits Successful completion of assessment and regular active participation in seminars (80%), which may be replaced by a colloquium if regular participation was not possible for good reasons.				

	The module MMES can only be credited if the student had not enrolled on this module or a similar module as part of a previous university degree.
8	Use of this module (on other courses) BSc Umweltschutz, BSc Klimaschutz und Anpassung, MSc Landwirtschaft und Umwelt,
9	Relevance of the Mark According to the applicable assessment regulations (SG-PO):
10	Module responsibility Prof. Rainer Hartmann
11	Other relevant informationen Language: This is a multilingual module. Not all lectures and information will be available in English!, Literature Englisch, German and other European languages. Literature: An up-to-date literature list will be provided during the seminars.

Material Flow Management

Material Flow Management (MFMG)

Code MI-ES-MFMG		Workload	credits	semester 1 st – 3 rd se- mester	frequency	duration 1 Semester
		90 h	3		winter semester	
1	Course Lecture		contact time 30 h	Self-study 60 h	Group size 25	
2	Learning outcomes / Competencies 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.					
3	Contents - 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					
4	Teaching and didactics 2 SWS lecture					
5	Prerequisites Fluent English recommended (writing and orally, B2/C1); selection of MFMG excludes occupancy of SSMA and vice versa					
6	Exam Homework / seminar paper					
7	Recognition of Module in other study program According to study plans					
8	Weighting factor of exam Weighting factor according to credit points					
9	Lecturer Prof. Dr. Oliver Türk					
10	Other information Language: English					

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

Professional English (PrE)					
Code MI-ES-PrE	Work-load 180 h	ECTS 6	scheduled 1.o.2. Sem.	frequency Summer Term	Duration 1 Semester
1	Course Lecture/ Tutorial	Contact time 6 SWS / 90 h	Self-study 900 h	Group size 20 students	
2	Learning Outcomes / Competencies 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				
3	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				
4	Teaching mode Interactive seminar and workshop				
5	Prerequisites Formal: Content: More than sound B2 writing and speaking performance in English, C1 in comprehension of both written and oral English				
6	Exam a) Three brief presentations totalling 30 minutes or one five-page written contribution or written exam b) One extended presentation of 30 minutes in total				
7	Condition to award ECTS passed exam successful participation in classes				
8	Recognition of Module in other study program M-LU M-UW				
9	Weighing factor of exam according to ETCS				
10	Lecturer Mag. phil. Birgit Hoess.				
11	Other information Language of instruction: English Literature: Appropriate state-of-the-art samples and sources				

Remote sensing of environmental changes

Remote Sensing of Environmental Changes (RESE)					
Code MI-ES-RESE	Workload 180	Credits 6	Semester 1 st – 3 rd semester	Frequency Winter- se- mester	Duration 1 Semester
1	Teaching method Lecture (2 SWS), Labs (2 SWS)		Contact time 4 SWS 60 h	Self-study 120 h	Group size app. 10-20 students
2	Learning outcomes / competencies 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.				
3	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. <u>Lab.</u> 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. <u>Lab.</u> 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. <u>Lab.</u> Multi-satellite approach implementation. 2.3 Investigation of an environmental change in one of the World regions using satellite observations. Methodological approach and realisation, <u>Lab.</u> Autonomous information search, data download, processing, analysis, preparation of resulting report.				
4	Teaching method Lectures and Labs				
5	Participation requirements Formal: none Substantial: Informatics, any programming language and/or statistical tools (e.g. R).				
6	Exam Course paper (case study report)				
7	Condition to award ECTS Passed examination				
8	Recognition of Module in other study program M-UW				
9	Weighing factor of exam Weighting according to credits				
10	Lecturers Dr. Elena Zakharova, EOLA enterprise, France				

11	Other information Language: English Literature: Lecture slides, scientific papers, satellite product descriptions (ATBD, Handbooks etc)
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Renewable Energies

Renewable Energy (REEN)

course number		workload	credits	study semester	frequency	duration
M-ES-REEN		90 h	3	1 st – 3 rd semester	summer semester	1 semester
1	courses lecture, excursion, seminar		contact time 2 SWS / 30 h	self-study 60 h	number of participants 25	
2	learning outcomes / competences Upon completion of the module, students will ☐ be conversant with criteria and issues related to sustainable energy sources. ☐ be able to identify relevant problems, collect and discuss relevant data and published information.					
3	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					
4	teaching Lectures, case studies, seminar (group and individual work with short presentations)					
5	requirements for participation in form and content formal: no content: basic knowledge in physics and engineering					
6	kind of examination written exam					
7	Requirements for the award of credit points passed examination					
8	Use of the module (in other study programs) Master program UMWELTSCHUTZ					
9	Weighting of the grade for the final grade Weighting factor according to credit points					
10	Module coordinator and full-time lecturer Prof. Dr. Frieder Kunz					
11	other information					

	language: Englisch Literature: Will be provided during the course
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Renewable Materials

Renewable Materials (REMA)						
Code		workload	credits	study semester	frequency	duration
MI-ES-REMA		180 h	6	1 st – 3 rd semester	winter semester	1 semester
1	courses lecture, (excursion)		contact time 60 h	self-study 120 h	Group size 25	
2	Learning outcomes / competencies 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 comparison with classical construction materials like metals and particularly petrochemical 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 cascade use of materials in connection with climatic change and limited petrochemical resources. - be able to prepare biobased materials for measurement in the laboratory, can conduct measurements with the materials and relevant analytical instruments.					
3	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					
4	teaching 4 SWS lecture					
5	Prerequisites					

	Fluent English recommended (writing and orally, B2/C1); selection of REMA excludes occupancy of BIMA and vice versa
6	Exam Homework / seminar paper
7	Recognition of module in other study program According to study plans
8	Weighting factor of exam Weighting factor according to credit points
9	Lecturer Prof. Dr. Oliver Türk
10	Other information Language: English Literature: Lecture notes, literature list will be given in the lecture Türk, O.; Plastics – The environmental issue, DeGruyter, Berlin, 2023 Türk, O.; Stoffliche Nutzung nachwachsender Rohstoffe, Springer Vieweg, Wiesbaden, 2014

Renewable Materials – Practical Course

Renewable Materials – Practical Course (REMA P)						
Code		workload	credits	study semester	frequency	duration
MI-ES-REMA P		180 h	6	1 st – 3 rd semester	winter semester	1 semester
1	courses laboratory		contact time 60 h	self-study 120 h	Group size 25	
2	Learning outcomes / competencies 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					
3	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					
4	teaching 4 SWS laboratory					
5	Prerequisites Fluent English recommended (writing and orally, B2/C1); selection of REMA-P excludes occupancy of BIMA-P and vice versa					
6	Exam seminar paper with the result of the laboratory trials					
7	Recognition of module in other study program According to study plans					
8	Weighting factor of exam Weighting factor according to credit points					
9	Lecturer Prof. Dr. Oliver Türk					
10	Other information Language: English					

	Literature: Lecture notes, literature list will be given in the lecture Türk, O.; Plastics – The environmental issue, DeGruyter, Berlin, 2023 Türk, O.; Stoffliche Nutzung nachwachsender Rohstoffe, Springer Vieweg, Wiesbaden, 2014
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Restoration Ecology

Restoration Ecology (RECO)						
Code MI-ES-RECO		workload 90 h	credits 3	study semester 1st – 3rd semester	frequency winter semester (not 24/25)	duration 1 semester
1	courses seminar, excursion		contact time 2 SWS / 30 h	self-study 60 h	Group size 25	
2	learning outcomes / competences 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					
3	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					
4	teaching seminar, excursion					
5	requirements for participation in form and content formal: no content: basic knowledge in biology and ecology					
6	Exam Coursework: 20 min presentation, handout (2 pages)					
7	Condition to award ECTS successful completion of assessment, regular attendance					
8	Recognition of Module in other study program					
9	Weighing factor of exam Weighting factor according to the course-specific examination regulations (SG-PO): 1					
10	Lecturer: Prof. Dr. Michael Rademacher					
11	other information language: English 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. Wiegand (2009): Renaturierung von Ökosystemen in Mitteleuropa. – Springer. - Kollmann et al. (2019): Renaturierungsökologie. – Springer. - Zerbe, S. (2019): Renaturierung von Ökosystemen im Spannungsfeld von Mensch und Umwelt
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Sustainable Agricultural Economics

Sustainable Agricultural Economics (SAE)

Code MI-ES-SAE		workload 90 h	credits 3	study semester 1st – 3rd semester	frequency winter semester	duration 1 semester
1	courses Lecture/Tutorial		contact time 2 SWS / 30 h	self-study 60 h	Group size 15	
2	Learning outcomes: 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.					
3	content International trade, new institutional economics, resource economics, production economics, greenhouse gas mitigation policy -					
4	teaching lecture and exercise					
5	requirements for participation in form and content formal: Admission to the Master's programme content: spreadsheet calculations (e.g. Microsoft Excel), skills in mathematics and statistics, economic comprehension, knowledge of agricultural production systems					
6	Exam written or oral examination					
7	Recognition of module in other study program According to study plans					
8	Recognition of Module in other study program					
9	Weighing factor of exam According to study plans					
10	Lecturer: Prof. Dr. Thore Toews					
11	other information language: English Literature: - Perman, R., Ma, Y., McGilvray, J., Common, M. (2003): Natural Resource and Environmental Economics. 3rd Edition. ISBN: 0273655590					

Sustainable Business Administration and Simulation

Sustainable Business Administration and Simulation (SBAS)						
Code		workload	credits	study semester	frequency	duration
MI-ES-SBAS		180 h	6	1st – 3rd semester	summer semester	1 semester
1	Course - Lectures - Business Simulation - Group work		Contact hours 45 h	Self-study 135 h	Group Size 30	
2	Learning outcomes / competencies 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 financial 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.					
3	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 enhanced 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					
4	Teaching Lectures, exercises & group work with computer-based business simulation (→TOPSIM Mastering Management including comments, presentations, papers)					
5	Prerequisites Formal: Admission to the Master's programme Content: Basics in economics					
6	Exam Presentation including colloquium –50 %					

	Outcome business simulation –50%
7	Condition to award ECTS Presence/ active participation in the simulation (min. 80 %) Successful presentation and successful participation in the business simulation
8	Recognition of Module in other study program
9	Weighing factor of exam Weighting factor according to credit points
10	Lecturer Prof. Dr. Martin Pudlik, Prof. Dr.-Ing. Christian Reichert
11	Other information Language: English 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 5-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 seminar start. - The number of participants for every seminar is limited. Registrations will be considered in the order of receipt and latest at the beginning of the respective semester. 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