HAWK Fakultät Ressourcenmanagement Göttingen

HOCHSCHULE HANNOVER
UNIVERSITY OF APPLIED SCIENCES AND ARTS
Fakultät II
Maschinenbau und Bioverfahrenstechnik

Module Handbook

Master's study program

Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy

Examination regulations version 2022

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Note: All modules take one semester to complete!

Module name	**Master Green-Engineering Module 1** **Biogenic raw materials**
Application	Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies	- Students have an understanding with respect to the cultivation and propagation of important raw material plants. - Students are able to demonstrate key harvest and post-harvest technology and raw material extraction processes. - They know about the cultivation and propagation of important energy crops and can evaluate supply concepts. Students **know** - the magnitude of net primary production and its determinants - the current and future land availability and its causes - the different biogenic energy carriers and their energy carrier-specific properties - the basic principles of renewable raw materials technology (RR) - important functions of RR for the environment, resource conservation, the economy and society - the cultivation and post-harvesting methods for different crops - the groups of ingredients and the technical processes for the extraction of raw materials, etc. **understand** - the term “sustainability” and its implications - the problem of energetic return of investment in biological production - the interrelationships of plant selection, use and cultivation **analyze** - different paths of material and energetic use of biomass **know and evaluate** - harvesting and post-harvest technologies and raw material extraction - specific supply chains - the methods for quantitative and qualitative determination of, among others, ingredient groups - the methodology and problems of potential surveys
Course contents	**Renewable raw materials of plant origin** - Crop science: Site requirements, crop rotation, cultivation techniques, diseases, pests, cultivation of the following crops: Cereals (wheat, triticale, corn) - Tuber and root crops (potato, sugar beet, Jerusalem artichoke, chicory) - Oil and fiber crops (rapeseed, sunflower, flax, other oil crops, hemp, nettle) - Grain legumes (peas, lupines) - Harvesting, storage and preparation of raw material crops - Technical processes for obtaining vegetable oils, - Starch, sucrose and inulin, cellulose, proteins, vegetable bast fibers **Cultivation, harvesting and provision of biogenic energy sources** - Overview of cultivation methods and production of energy cereals, energy grasses, Miscanthus, fast-growing tree species as solid energy sources as well as energy corn, fodder beets and various mixtures as substrates for biogas plants - Suitable harvesting methods for bioenergy sources: Conventional harvesting technologies from agriculture, special developments, post-harvesting and processing technologies (chopping, pelletizing, briquetting, bale breaking, ensiling)

		Biological raw material potential - The concept of potential - Net primary production and its determinants (world-wide, Europe-wide and Germany-wide) - Energetic return of investment in biological production - Land availability at present and in the future incl. causes - Sustainable production in agriculture and forestry, sustainable land use - The path idea (goal systems, goal conflicts, criteria, law of diminishing marginal returns) - Cascade utilization - Methodology and problems of potential surveys - Biogenic residual and waste materials - Agroforestry systems
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Written exam, 2 h
Credits		6
Work-load	**Course attendance**	60
	Home study	120
Special focus on Home study		- Study of literature - Course follow-up
Module is on offer in:		In the summer semester
Responsible for module		Prof. Dr. Biskupek-Korell
Teaching staff		Prof. Dr. Biskupek-Korell, Dr. Schmidt, Prof. Dr. Merkel

Module name		**Master Green-Engineering Module 2** **Energy and ecological framework conditions**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - know and understand the essential interrelationships in the energy industry. - know the characteristics, availability, areas of application and ecological risks of different resources (fossil, mineral, renewable) for the production and operation of energy conversion plants. know mechanisms of climate change and possibilities to limit it. - have knowledge of the main regulations of the energy law relevant to renewable energy generation plants and the application of these regulations. - have knowledge of the regulations on the licensing requirements for such plants, the licensing procedure, as well as emission control and building planning law requirements.
Course contents		**Resources, energy management, greenhouse effect** - Mineral and fossil raw material potential, significance for the energy industry and bioeconomy - Renewable energies and their potential - Ecological aspects of the use of mineral, fossil and renewable resources - Basic principles of the energy industry and energy supply - Commodity and energy policy in international economic relations - Climate change and its causes and consequences (formation and effect of greenhouse gases), possibilities of limitation **Energy law and basics of plant licensing** - Energy law, in particular connection and grid access of energy plants according to the EnWG, Combined Heat and Power Act (KWKG), Renewable Energies Act (EEG), Renewable Energies Heat Act (EEWärmeG), emissions trading - Basic principles of plant licensing: Requirement for approval, approval procedure, approvability: especially with regard to emission control requirements and construction planning law
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Seminar paper 10-15 pages (50%) and oral examination 15-20 minutes (50%)
Credits		6
Work-load	**Course attendance**	75
	Home study	105
Special focus on		- Study of literature

Home study	- Elaboration of the written part of the presentation - Preparation of the presentation
Module is on offer in:	In the summer semester
Responsible for module	Prof. Dr. Loewen
Teaching staff	Prof. Dr. Klein, Prof. Dr. Loewen

Module name		**Master Green-Engineering Module 3** **Planning, modeling, accounting**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - know the methodological basics of modeling natural and technical systems. - are able to develop models independently. - are able to analyze the characteristics of existing models. - are able to apply the methods to problems of applied research. - know the approach of life cycle analysis according to ISO 14040 and 14044. - are able to clearly represent material and energy flow models. - are able to carry out a life cycle assessment of simple systems. - are able to independently derive solution strategies from the data obtained.
Course contents		- System analysis and modeling - Mathematical models - Static models (linear, non-linear, one-dimensional and multi-dimensional models) - Discrete-time and dynamic models - Recording and visualization of material and energy flows - Software-based modeling and simulation of energy systems - Data basis for life-cycle analysis: Data collection and empirical databases - Functional unit and system limits - Impact categories and impact indicators - Sector coupling: Transition and interconnection of different forms of energy
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Project work 10-15 pages
Credits		6
Work-load	**Course attendance**	75
	Home study	105
Special focus on Home study		- Study of literature - Completion of a project - Preparation of the presentation
Module is on offer in:		In the summer semester
Responsible for module		Prof. Dr. Holler
Teaching staff		Prof. Dr. Holler, Herr Gievers

Module name		**Master Green-Engineering Module 4** **Biorefinery concepts 1**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - have an overview of current biorefinery concepts. - have knowledge of the material characterization of biogenic renewable raw materials. - have basic knowledge of downstream processing. - have basic knowledge of basic process engineering operations. - Basic knowledge of relevant basic process engineering operations. - have basic mathematical knowledge to describe the separation processes. - have basic knowledge of bio-processing.
Course contents		**Overview of biorefinery concepts and biogenic raw materials (1 SWS)** - Practical examples from state-of-the-art research, VDI guideline Sugar biorefinery, starch biorefinery, vegetable oil biorefinery, lignocellulosic biorefinery Biorefinery, green biorefinery, algae biorefinery - Biogenic raw materials: Oils/fats, starch, sucrose, fructans, fibers, proteins, Cellulose: - Biochemistry and biosynthesis - Occurrence and contents in different plant species - Methods for determining the quantity and quality **Separation and processing technology (2 SWS)** - Important biotechnological products - Cell disruption of microorganisms - Separation techniques in industrial production - Relevant process technology - Calculation bases and models for material transport - Design and description of separation techniques, balancing; new techniques **Bioprocess technology (1 SWS)** Cell culture technology, tissue engineering, downstream processing, protein chemistry, bioanalytics, biochip technology
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Written exam, 2 h (75%) and presentation 15-20 minutes (25%)
Credits		6
Work-load	**Course attendance**	60
	Home study	120
Special focus on Home study		- Study of literature - Preparation of the presentation
Module is on offer in:		In the summer semester
Responsible for module		Prof. Dr. Biskupek-Korell
Teaching staff		Prof. Dr. Biskupek-Korell, Prof. Dr. Ohlinger

Module name		**Master Green-Engineering Module 5** **Hydrogen / decentralized power generation**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - know the different technologies for hydrogen production and transport and are able to compare and assess their technologies. - know the different possibilities for hydrogen utilization, the necessary technical requirements as well as the advantages and disadvantages. - know the different processes for decentralized power generation and can assign them to individual bioenergy processes on the basis of their respective suitability and evaluate them for their respective strengths and weaknesses. - are familiar with technologies for waste heat recovery and electricity storage and can evaluate their use in various application scenarios.
Course contents		**Hydrogen technology** - Production (electrolysis, steam reforming, hydrogen liquefaction) - Distribution (pipelines, trailer and container vehicles, alternative storage) - Applications (combustion engines, fuel cells, infrastructure, refueling stations for hydrogen) **Power generation technologies incl. thermodynamics and concepts** - Gasoline, diesel, gas and Stirling engines - Steam piston and steam screw engines, ORC processes - Cogeneration of heat and power (types, structure, key figures, efficiency) - Waste heat utilization by means of heat pumps - Electricity storage
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents:** Basic knowledge of energy and process technology
Examination		Written exam, 2 h
Credits		6
Work-load	**Course attendance**	75
	Home study	105
Special focus on Home study		- Study of literature
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Loewen
Teaching staff		Prof. Dr. Loewen, Prof. Dr. Meyer

Module name		**Master Green-Engineering Module 6** **Biorefinery concepts 2**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - have in-depth knowledge of different chemical and biotechnological processes for the material use of biogenic raw materials. - know examples of concrete processes and products from biorefineries. - know the importance and strategies for the industrial use of biogenic raw materials in terms of the implementation of bioeconomy strategies. - recognize the relationships between the property profiles of raw materials and the products made from them. - have in-depth knowledge of the most important test methods and are able to transfer this knowledge. - are able to understand and analyze the interrelationships between microstructural composition and macroscopic processing and usage properties of products/materials and evaluate alternative material application possibilities of renewable raw materials. - have in-depth knowledge of different chemical and biotechnological processes for the material use of biogenic raw materials. - know examples of concrete processes and products from biorefineries. - know the importance and strategies for the industrial use of biogenic raw materials in terms of the implementation of bioeconomy strategies.
Course contents		- Chemical and biotechnological processes for the material utilization of biogenic raw, residual and waste materials: Advanced studies on the contents of Module 4 - Extraction of platform chemicals for the chemical industry - Exemplary processes and products from various biorefineries - Use of biogenic raw materials and (intermediate) products in industrial applications / implementation of bioeconomy strategies
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Written exam, 2 h
Credits		6
Work-load	**Course attendance**	60
	Home study	120
Special focus on Home study		- Study of literature
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Siebert-Raths

Teaching staff	Prof. Dr. Siebert-Raths

Module name		**Master Green-Engineering Module 7** **Biorefinery concepts 3**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - know biological, chemical and physical processes for the production of liquid and gaseous energy carriers and are able to evaluate them with regard to their possible applications, advantages and disadvantages. - know the different thermal processes for the production of synthesis gas, BtL fuels, pyrolysis oils and biochar and are able to evaluate them with regard to their potential applications as energy sources or raw materials for the chemical industry. - Have knowledge of plant operations, raw materials to be used, and options for treatment or utilization of by-products.
Course contents		- Raw materials, production processes and properties of various liquid biofuels (vegetable oil, biosiesel, bioethanol, DME, ETBE, HVOs, etc.). - Basics of the biogas process (process engineering, process biology, operating parameters, process disturbances, feedstocks etc.) - Biogas processing and utilization - Processing and use of fermentation residues - Thermal processes for the production of synthesis gas, pyrolysis oils and biochar (feedstocks; gasification, pyrolysis, hydro-/vapotherm. carbonization) - Further processing and use of synthesis gases and pyrolysis oils (synfuels, chemical industry, motor uses, etc.) - Properties / use of biochar (agriculture, energetic, industrial)
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Written exam, 2 h
Credits		6
Work-load	**Course attendance**	60
	Home study	120
Special focus on Home study		- Study of literature
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Loewen
Teaching staff		Dr. Krieg, Prof. Dr. Loewen

Module name		**Master Green-Engineering Module 8** **Current research projects**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - have an overview of current research topics in the field of material and energetic biomass utilization. - know the different ways of acquiring research projects (application to public project sponsors, industrial projects). - are familiar with various pilot-scale test facilities and laboratory equipment and have carried out some practical activities as examples.
Course contents		- Current research topics in the field of material and energetic biomass utilization (in general and at other research institutions) - Examples of research projects at HAWK and Hannover University of Applied Sciences and Arts - Application to public project sponsors (EU, BMBF, FNR etc.) - Contract research for industry - Experiment evaluation - Reporting - Practical activities at individual experimental plants and in the laboratory (e.g. feeding of continuously operated biogas plant, measurement of gas quantities produced and gas composition)
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Lab report 10-15 pages
Credits		6
Work-load	**Course attendance**	60
	Home study	120
Special focus on Home study		- Preparation and conducting of experiments - Completion of a lab report
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Loewen
Teaching staff		Diverse

Module name		**Master Green-Engineering Module 9** **Compulsory elective – Agile project management**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - are able to apply relevant concepts and techniques of agile project management. - understand advantages and disadvantages of agile project management, also in comparison to conventional and hybrid project management. - are able to define necessary requirements for the project culture. - understand agile approaches to organizational design.
Course contents		- Opportunities and risks of agile project management - Tasks, competencies and responsibilities of the different roles - The future of the enterprises: successful collaboration through agility (self-organization, values, mindset, etc.) - Agility as an approach to corporate management and control - Agile methods and tools, e.g. design thinking - Taking sustainability into account in agile projects
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Oral examination 15-20 minutes
Credits		3
Work-load	**Course attendance**	30
	Home study	60
Special focus on Home study		- Preparation and follow-up of the course
Module is on offer in:		In the summer semester
Responsible for module		Prof. Dr. Brüseke
Teaching staff		Prof. Dr. Brüseke

Module name		**Master Green-Engineering Module 9** **Compulsory elective – Medicinal plants – botany, ingredients and use**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students understand secondary metabolism in plants, particularly the groups of substances used in the field of herbal medicine. They know technical aspects of the preparation of the plant material and the extraction of the ingredients as well as important quality aspects. Students are able to classify the most important medicinal and dyeing plants in terms of their agronomic and technological properties and areas of use. The module also includes lab experiments and field inspections and a field trip.
Course contents		- Terminology and legal regulations - Important metabolic groups of the secondary metabolism in plants - Botany, state of the art of cultivation and cultivation of important medicinal plants. - Basics of harvesting and preparation techniques and storage - Extraction and further processing of the ingredients - Quality criteria and analytics - Excursion to phytopharmaceutical producers, if applicable
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents:** Knowledge of the contents of Module 1
Examination		Written exam, 1 h (80%) and lab report 10-15 pages (20%)
Credits		3
Work-load	**Course attendance**	30
	Home study	60
Special focus on Home study		- Preparation and follow-up of the course
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Biskupek-Korell
Teaching staff		Prof. Dr. Biskupek-Korell

Module name		**RREE 14: Compulsory elective District Heating Systems**
Application		Master's study program in Industrial Engineering/RREE
Learning goals / Competencies		Students … - know the concept of district heating systems. - learn about the potential for urban waste heat recovery in EU27. - identify why awareness is important (of the possibility to recover urban waste heat) and how it can be done. - analyze technical solutions for waste heat reuse in European cities. - analyze transformation strategies for district heating systems.
Course contents		- Introduction of district heating - The role of urban waste heat recovery in district heating and the mapping of waste heat potential - The stakeholder and value chain of the urban waste heat recovery, its bankability and the business models - The ReUseHeat demonstrator in Madrid involving heat recovery from service sector (hospital), the technical characteristics of the recovery system and the lessons learnt - The experiences, challenges and lessons learnt from the ReUseHeat project case on heat recovery from underground transport infrastructure - The ReUseHeat demonstrator involving waste heat recovery from a datacenter in Braunschweig, the technical characteristics of the recovery system and the lessons learnt - REWARDHeat Serious game: Smart networks integrating renewable and waste energy source
Forms of teaching and learning		Seminar teaching, business management game
Module language		English
Prerequisites		**Formal**: none **Contents:** Basic principles of energy supply
Examination		Term paper (18-20 pages)
Credits		5
Work-load	**Course attendance**	30
	Home study	120
Special focus on Home study		- Preparation and follow-up on the lecture contents - Study of literature - Writing of term paper
Module is on offer in:		In the summer semester
Responsible for module		Prof. Dr. Holler
Teaching staff		Prof. Dr. Holler, Dr. Dmitry Romanov, Dr. Kristina Lygnerud (Halmstad University, Sweden)

Module name		**Master Green-Engineering Module 9** **Compulsory elective - Plant biotechnology**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		- Students master the fundamentals of the use of biotechnological methods in the production of commodity crops both in theory and in the laboratory. - They are able to apply important working techniques in the molecular biology laboratory. - Students have gained extensive theoretical and practical insight into the production and cultivation of plant in vitro cultures.

Course contents		- Basic principles of molecular biology and genetic engineering in plants
		- Opportunities and risks of genetic engineering in the production of RR crops
		- Transformation methods in plants
		- Development and use of molecular markers
		- Selection of some working methods in the molecular biology laboratory
		  - DNA isolation from plant material
		  - Various PCR techniques
		  - Detection of genetic modifications in plant material
		- Use and importance of in vitro cultures in the cultivation and production of secondary ingredients
		
		- Creation of *in vitro* cultures (callus cultures, anther or microspore cultures)
		- Sterile work at a clean-bench

Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents:** Knowledge of the contents of Module 1
Examination		Lab report 10-15 pages
Credits		3
Work-load	**Course attendance**	30
	Home study	60
Special focus on Home study		- Study of literature - Completion of the term paper
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Biskupek-Korell
Teaching staff		Prof. Dr. Biskupek-Korell

Module name		**Master Green-Engineering Module 9** **Compulsory elective – Quality and sustainability management**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - know the methods and tools of quality and sustainability management and are able to apply them practically. - know industrial processes and are able to evaluate operational processes. - have trained improvement work on practical exercises. - are able to describe and evaluate quality management systems. - know the most important norms, rules and standards as well as their effect in the operational environment.
Course contents		- Quality management methods and tools - Basic principles of total quality management, total sustainability management and environmental management - Basic principles of quality management systems (ISO 9001, ISO 14001) - Error and risk analysis techniques - Practical application of QM tools and methods - Digitalization in quality management - Product liability
Forms of teaching and learning		Seminar teaching, exercises, case studies, group work, presentations
Module language		German
Prerequisites		**Formal**: none **Contents:**
Examination		Written exam, 2 h
Credits		3
Work-load	**Course attendance**	30
	Home study	60
Special focus on Home study		- Independent completion of exercises provided - Study of literature
Module is on offer in:		In the summer semester
Responsible for module		Prof. Dr.-Ing. Harms
Teaching staff		Prof. Dr.-Ing. Harms

Module name		**Master Green-Engineering Module 9** **Compulsory elective – The conflicting priorities of optimal land use and sustainable rural development**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		Students - are qualified to participate in discussions on the topic of renewable resources and land use in the national and international arena. - have knowledge of facts, analysis, and opportunities for sustainable land use planning.
Course contents		- Framework conditions: Global and national developments and challenges - Global resource issues and development - Food security and land use - Energy transition in Germany - Impact of raw material production on the environment and society - Special focus on bioenergy - Contribution to the greenhouse gas problem - Ecological impact - Impact on society - Recommendations WGBU - Ways to resolve conflicts - Increase in resource efficiency - International and intergovernmental agreements - Development of adapted land use concepts (spatial planning) - Sustainable Land Management (SLM) - Adapted production systems - Modern information technology as a tool in land use planning and monitoring - Recording, description and modeling of landscapes - Remote exploration, theory and practice - Spatially Explicit Landscape Modelling - Future outlook
Forms of teaching and learning		Lecture, exercises, seminar papers
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Seminar paper 10 pages and oral examination 15 minutes (50% each)
Credits		3
Work-load	**Course attendance**	30
	Home study	60
Special focus on Home study		- Study of literature - Course follow-up
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Rohe
Teaching staff		Dr. Ley

Module name		**Master Green-Engineering Module 9** **Compulsory elective – Wind energy and hydropower**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		- Knowledge of the scientific and technical principles of wind energy and hydropower - Possible applications under consideration of local conditions - Development potentials and economic efficiency
Course contents		**Wind energy** - Current significance in Germany, EU and worldwide - Potentials of wind energy utilization, physical basics (Betz boundary, elevation model of wind resources) - Power generation by means of wind power, construction of large wind turbines, power characteristic curve - Technical concepts for the generation and utilization of wind power (aerodynamics at the rotor, rotor blade design, gearbox / direct drive, generator) - Future use of wind power (off-shore, repowering, forest sites) - Integration into existing supply systems, energy-technical, ecological and economic aspects (amortization, yield calculation) **Hydroelectric power** - Potentials of hydropower utilization, basic physical principles - Electricity generation from hydropower, turbine shapes and their applications - Technical concepts for the generation and utilization of hydropower (large-scale power plants, run-of-river power plants, pumped storage power plants, small hydropower) - Design of hydropower plants (works performance plan) - Integration into existing supply systems, energy-technical, ecological and economic aspects
Forms of teaching and learning		Seminar teaching, exercises
Module language		German
Prerequisites		**Formal**: none **Contents**: none
Examination		Seminar paper
Credits		3
Work-load	**Course attendance**	30
	Home study	60
Special focus on Home study		- Preparation and follow-up of the course
Module is on offer in:		Winter semester
Responsible for module		Prof. Dr. Osterried
Teaching staff		Prof. Dr. Osterried

Module name		**Master Green-Engineering Module 10** **Applied project**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		- Ability to work on a four-week project and self-reliantly handle project organization, control and execution - Application and verification of theoretical knowledge in practice - Ability for team work and conflict resolution - Execution of an application-oriented project The students work on a task (e.g. study, project planning, operational task) and derive recommendations for action.
Course contents		- Carrying out a project, with a practice partner, if necessary - The topic of the project includes a subject from the field of bioeconomy. - The project is carried out by a team of 3-5 students. - The project team organizes the cooperation by themselves and coordinates the procedure with the supervisor. - Preparation of a final project report and presentation of the results
Forms of teaching and learning		Coaching The students are supervised during their work on the project.
Module language		German
Prerequisites		**Formal**: none **Contents:** Recommendation: previous completion of Modules 1-9
Examination		Project report 10-15 pages
Credits		6
Work-load	**Course attendance**	30
	Home study	150
Special focus on Home study		- Completion of a project report
Module is on offer in:		Every semester
Responsible for module		Prof. Dr. Loewen
Teaching staff		Diverse

Module name		**Master Green-Engineering Module 11** **Master's thesis**
Application		Green Engineering – Sustainable Energy and Process Engineering for the Bioeconomy
Learning goals / Competencies		- The master's thesis is the student's own research or development project, focusing on a subject area in the degree program (see also Section 19 Para. 1 General Part of the Examination Regulations). - The final thesis should demonstrate that the student is able to work independently on a defined engineering topic in an appropriate and results-oriented manner using scientific methods. - Students should be able to present results coherently and reflect on them in a self-critical manner. - Students apply project, self, and time management methods to meet the specified completion deadline. The Master's thesis includes: - Literature research, presentation and critical discussion of relevant academic opinions - Presentation of the individual research approach - Independent development of new approaches to solving a scientific problem - Presentation of the procedure and the results in the form of a paper - Presentation of the main results in an understandable form as well as critical discussion of the results - When setting the task, care must be taken to ensure that the student's own creative contribution is secured by working on the topic.
Course contents		Individual: Topics from the field of study
Forms of teaching and learning		Coaching During the processing of the Master's thesis, supervision is provided by the first and second examiners of the thesis (Section 19 (5) General Part of the Examination Regulations).
Module language		German or English
Prerequisites		**Formal:** Proof of at least 45 credits **Contents:** Recommendation: previous completion of Modules 1-10
Examination		Preparation of the Master's thesis (ca. 80 pages) and colloquium (30-45 minutes)
Credits		24
Work-load	**Course attendance**	0
	Home study	720
Special focus on Home study		Work on the topic, regular progress reports and discussion of the interim results with the supervising examiners.
Module is on offer in:		Every semester
Responsible for module		Dean of Studies

Teaching staff	Diverse