Hochschule Nordhausen

Fachbereich Ingenieurwissenschaften

Modulhandbuch für den Studiengang

Renewable Energy Systems

Erstellungsdatum: 29.10.2024

Modulübersicht für den Studiengang Renewable Energy Systems

0. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
870	Basics in Electrical Engineering	2	5.0	PFLICHT
871	Basics in Thermal Engineering	2	5.0	PFLICHT
872	Introduction in Renewable Energy Systems	1	5.0	PFLICHT
873	Scientific Practice and Writing	1	5.0	PFLICHT
908	German as a Foreign Language I	2	5.0	PFLICHT
1012	Basics of Mechanical Engineering	1	5.0	PFLICHT
1. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
568	Project Management	1	5.0	PFLICHT
732	Lifecycle Assessment	1	5.0	PFLICHT
733	Environmental and Sustainability Management	1	5.0	PROFIL
761	Bussystems in Energy and Sensor Networks	1	5.0	WAHLPFLICHT
762	Data Science in Python	2	5.0	WAHLPFLICHT
854	Bioenergy Systems I Solid Biomass	1	5.0	PFLICHT
863	Fuel Cell Technology	1	5.0	WAHLPFLICHT
867	Numerical Methods in Heat and Mass Transfer	1	5.0	WAHLPFLICHT
910	German as a Foreign Language II	2	5.0	PROFIL
1010	Power-to-X	1	5.0	PROFIL
1111	Project Module RES	1	5.0	PROFIL
2. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
738	(ET) Renewable Raw Material	1	5.0	PROFIL
851	Wind Power Plants	1	5.0	PROFIL
852	Photovoltaic Systems	1	5.0	PROFIL
858	Scientific Project	1	10.0	PFLICHT
859	Solar Thermal Laboratory	1	5.0	PROFIL
864	(ET) Bioengineering	1	5.0	PROFIL
869	Computer Aided (Process) Engineering	1	5.0	WAHLPFLICHT
1112	Project Module RES	1	5.0	PROFIL
8000	Study success and career progression	1	5.0	WAHLPFLICHT
3. Fachsemester				
ID	**Modulname**	**Version**	**ECTS**	**Verwendbarkeit**
860	Master Thesis Module Renewable Energy Systems	1	30.0	PFLICHT

Modul-No.	568	MA	
Modul name	**Project Management**		
Modul coordinator	Rutz, Michael		
Titel	Project Management		
Titel of examination	Project Management		
Course Type / SWS	3 SWS Lecture / 1 SWS Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
1 Basics
• definition and characteristics of projects • short history of Project Management • Project Life Cycle
2 Initialisation
• project goals • Stakeholder Analysis • rough planning • Project Organisation
3 Planning
• Project Structuring • Time Management • Resource Planning
4 Execution
• role of Project Manager and Project Team • Team Development • Project Management • Communication • Risk Management • Quality Management
5 Project Closing
6 Agile Project Management
• advantages of agile methods • Scrum

Learning objectives: Students are able to plan projects and organise their implementation. They have learned the basics of project management for industrial applications. They have an overview of selected methods, tools (software) and information systems for planning and controlling industrial projects. The students are able to plan, organise and document a project with the help of a project example. They are able to present the project idea, the progress and the results.

Recommended Literature

Dionisio, Cynthia Snyder (2018): A project manager´s book of tools and techniques. a companion to the PMBOK Gui-de. Hoboken, New Jersey: Wiley.
Lester, Albert (2014): Project Management, planning and control. Managing Engineering, Construction and Manufac-turing Projects to PMI, APM and BSI Standards. 6. Aufl. Oxford: Butterworth-Heinemann.
Project Management Institute, Inc. (2021): A Guide to the Project Management Body of Knowledge (PMBOK Guide) and The Standard for Project Management. 7. Aufl.

Forms of teaching / Prequentense for participation

This module is a classical lecture combined with exercises. There are no formal requirements for participation.

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

no formal requirements

ECTS credit points and grading

Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination: written examination with a duration of 120 min. Alternative types of examination are possible The grade corresponds to the grading of the written examination or the submitted project documentation. When com-pleting the unit successfully, students are granted 5 credit points (ECTS).

Frequency of offer / Duration of module

SOMMER	The module is lectured in one semester.

Work load

The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with with integrated exercises (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about 50 hours.

Modul-No.	732	MA	
Modul name	**Lifecycle Assessment**		
Modul coordinator	Rutz, Michael		
Titel	Lifecycle Assessment		
Titel of examination	Lifecycle Assessment		
Course Type / SWS	2 SWS Lecture / 2 SWS Lecture/Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
In order to approach the subject of energy, substance and environmental assessments, knowledge of the associated relationships (politics, economy, society) is necessary. It is not the raw calculation of balances, but the consideration of the correct description of the problem. In this context the setting of system boundaries is important too. In workshops, each lasting 4 hours, students will learn to recognize problems in teams and to provide solutions with the help of assessment tools (knowledge based and software).

1. Recognizing and evaluating environmental issues in the media – workshop
2. Introduction to material flows - workshop
3. Consideration and definition of boundaries - workshop
4. Energy/Substance/Environment assessments - workshop
5. Human-Environment-Future - Workshop to select the examination topic based on current environmental issues

Learning objectives:
Students will be able to recognize environmental connections in texts that do not seem to be related to environmental issues (unit 1).
After the unit 2, students will be able to recognize, classify and evaluate material flows.
Establishing system boundaries is a basic requirement for every life cycle assessment. After the workshop 3, students will know how to set system boundaries correctly.
After the workshop 4, students will be able to create the relevant assessment sheets and read data from sheets that have already been created. Students also got an insight into software for creating these assessments.
After the workshop 5 students have to choose a topic for your scientific work and explained it to the person responsible for the module.

Recommended Literature

For preparation the following international/national standards and scientific books are recommended:

- ISO 14001 Environmental management systems — Requirements with guidance for use
- ISO 14040 Environmental management – Life cycle assessment – Principles and Framework
- ISO 14041 Goal and Scope definition and inventory analysis
- ISO 14042: Environmental management — Life cycle assessment — Life cycle impact assessment
- ISO 14043 Environmental management — Life cycle assessment — Life cycle interpretation
- ISO 14044 Environmental management – Life cycle assessment – Requirements and Guidelines
- DIN EN ISO 14040 Umweltmanagement – Ökobilanz – Grundsätze und Rahmenbedingungen
- DIN EN ISO 14044 Umweltmanagement – Ökobilanz – Anforderungen und Anleitungen
- Klöpffer, W.; Grahl, B.: Ökobilanz (LCA): Ein Leitfaden für Ausbildung und Beruf, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2009, Print ISBN:9783527320431 |Online ISBN:9783527627158
- Frischknecht, R.: Lehrbuch der Ökobilanzierung, Springer Spektrum, 2020.
- Klöpffer, W., Grahl, B.: Ökobilanz (LCA), Wiley-VCH, 2019.

Forms of teaching / Prequentense for participation

Workshop with Lecture.

There are no formal requirements for participation.

Usability of module

This module is mandatory for: Renewable Energy Systems
Requirements for receiving ECTS credit points
Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination written scientific report (10 pages) and Power Point Presentation (15 minutes + 5 minutes Q&A).
ECTS credit points and grading
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Frequency of offer / Duration of module

SOMMER	The module is held within one semester.

Work load
Course Participation = 20 h Preparation and follow-up (of the lecture) = 20 h Preparation for examination = 110 h The entire workload encompasses 150 hours, which equals 5 ECTS credit points.

Modul-No.	733	MA	
Modul name	**Environmental and Sustainability Management**		
Modul coordinator	Samtleben, Jantje		
Titel	Environmental and Sustainability Man.		
Titel of examination	Environmental and Sustainability Management		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

- Strategic instruments of environmental management
- Organization and environmental protection
- Assessment of environmental protection investments
- Operational issues of environmental management
- Environmental management systems and environmental audit
- Sustainability accounting
- Material flow analyzes
- Procedure for evaluating ecological and social impacts: selected approaches in ecological and sustainability accounting
- Environmental cost management
- Environmental controlling

Learning objectives:

Students are able to classify, apply and evaluate approaches to sustainability accounting. They are familiar with not monetary methods of ecological and sustainability accounting and are familiar with the documentation and analysis of environmental costs. They also know how to position strategic product programs, taking ecological and social aspects into account. In operational environmental management, students have knowledge of models for environmentally oriented production planning, transport and route planning as well as warehouse planning and can use these in practice in the relevant decision-making areas. You will be able to set up appropriate optimization theorems and select suitable solution methods or heuristics. After completing the module, the students are also familiar with elements of certification in the environmental and sustainability area. The students develop technical and methodological as well as system and social skills.

Recommended Literature

For preparation and follow-up the following textbooks are recommended:

- Debnath, Somnath: Environmental Accounting, Sustainability and Accountability. Indien, SAGE Publications, 2019
- Handbook of Sustainability Management. Singapur, World Scientific, 2012
- Towards Life Cycle Sustainability Management. Niederlande, Springer Netherlands, 2011
- Brady, John, et al. Environmental Management in Organizations: The IEMA Handbook. Vereinigtes Königreich, Taylor & Francis, 2013
- Wang, L.: Handbook of Environmental Engineering: Integrated Natural Resources Management, Springer, 2021
- Azapagic, A.; Perdan, S. (Hrsg.): Sustainable Development in Practice. Case Studies for Engineers and Scientists, John Wiley & Sons, Ltd., 2011, Print ISBN:9780470718711 |Online ISBN:9780470972847
- Kurth; Oexle, Handbook of Recycling and Raw Materials Management, 2013
- Sailer, Ulrich: Nachhaltigkeitscontrolling, 3. Auflage Stuttgart UTB GmbH, 2020, : 978-3-8252-5332-5
- Müller-Christ, Georg: Nachhaltiges Management: über den Umgang mit Ressourcenorientierung und widersprüchlichen Managementrationalitäten, Handbuch für Studium und Praxis, 3. Auflage, Baden-Baden, Nomos, 2020, ISBN 978-3-8487-4956-0
- Engelfried, Justus: Nachhaltiges Umweltmanagement Schritt für Schritt, Uni-Taschenbücher-GmbH, 2017, ISBN 978-3-8385-8671-7

Forms of teaching / Prequentense for participation

Lecture

There are no formal requirements for participation.

Usability of module	
This module is a profile module for: Renewable Energy Systems	
Requirements for receiving ECTS credit points	
Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination: written examination with a duration of 90 min. Alternative types of examination are possible.	
ECTS credit points and grading	
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS	
Frequency of offer / Duration of module	
SOMMER	The module is held within one semester.
Work load	
Course Participation = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire workload encompasses 150 hours, which equals 5 ECTS credit points.	

Modul-No.	738	MA	
Modul name	**(ET) Renewable Raw Material**		
Modul coordinator	Schreiber, Anja		
Titel	(ET) Renewable Raw Material		
Titel of examination	(ET) Renewable Raw Material		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

Various types of renewable materials

Students are given a comprehensive picture of the various types of renewable raw materials. In addition to the subdivision of renewable raw materials into divergent groups – for example wood, annual plants - the occurrence, cultivation and harvest of selected materials should also be subject of the course.

Use of renewable raw materials

Students are introduced to the various areas of application and limits of renewable raw materials. Selected products made from renewable raw materials are explained and the process engineering for their production will be examined.
The module also deals with the Kassadian modelling use of renewable raw materials and their recyclability.

Energetic utilization of renewable raw materials

Students learn about the various energetic utilization possibilities of renewable raw materials. The types of process engineering for energy generation are demonstrated.

Learning objectives:

Students acquire in-depth knowledge in renewable materials. In addition to scientific and engineering knowledges which reflect the link between renewable materials and technical implementation, historical and up-to-date engineering processes are shown especially considering the economically and ecologically feasibility. In this way the students are enabled, to recognize and evaluate application possibilities and limits of using renewable materials.

Recommended Literature

For preparation and follow-up the following textbooks are recommended:

- Forest Products Laboratory. 2010. Wood handbook—Wood as an engineering material. General Technical Report FPL-GTR-190. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 508 p.
- Wellmer, F.W.; Buchholz, P.; Gutzmer, J.; Hagelüken, C.; Herzig, P.; Littke, R.; Thauer, R.K. (2019): Raw Materials for Future Energy Supply. Springer International Publishing, 225 S.
- Imhof P.; van der Waal J-K.; van der Waal J.C. (2013): Catalytic Process Development for Renewable Materials. Wiley VCH Verlag GmbH, Weinheim
- Ulber, R.; Sell, D.; Hirth T. (2011): Renewable Raw Materials - New Feedstocks for the Chemical Industry. Wiley VCH Verlag GmbH, Weinheim, 230 S.
- Deng, L.; Liu, Y.; Wang, W.: Biogas Technology. Springer Verlag, 2020, ISBN 978-981-15-4940-3
- Jayasinghe, G. Y. ; Dassanayake, K. B.; Wijesinghe, D. T. N: Organic waste anaerobic digestion. Lambert Academic Publishing, 2015, ISBN 365-939-60-60
- Lamb, L. J.: Anaerobic Digestion: From Biomass to Biogas. Sico Publishing, 2020, ISBN 9788269203318
- Kaltschmitt, M.; Hartmann,H. ; Hofbauer, H. (2016): Energie aus Biomasse - Grundlagen, Techniken und Verfahren. Springer Vieweg, Berlin, 2016.
- Diepenbrock, W.: Nachwachsende Rohstoffe. Utb GmbH, 2014.

Forms of teaching / Prequentense for participation

Lecture

There are no formal requirements for participation.

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points	
Students need to pass the module examination, which encompasses all contents of the lecture. Type of examination: written examination with a duration of 90 min. Alternative types of examination are possible.	
ECTS credit points and grading	
Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS.	
Frequency of offer / Duration of module	
WINTER	The module is held within one semester.
Work load	
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire workload encompasses 150 hours, which equals 5 ECTS credit points.	

Modul-No.	761	MA	
Modul name	**Bussystems in Energy and Sensor Networks**		
Modul coordinator	Hühn, Thomas		
Titel	Bussystems in Energy and Sensor Networks		
Titel of examination	Bussystems in Energy and Sensor Netw.		
Course Type / SWS	2 SWS Lecture / 2 SWS Internship		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Objective
This lecture looks at the issue of evaluation of large amounts of data with Python. It encompasses cleansing, manipulating and aggregating data to preparing datasets for further analysis and processing and presenting the results. To achieve the goal of data data science, which is to make predictions that support business decision-making, pattern must be found in the data and the accuracy of these predictions must be verified. Module content: 1. Introduction to Data Science 2. Anaconda, IPython and Jupyter Notebook - Introduction to tools and development environments. 3. Basic syntax of the Python programming language (data types, structures, functions, classes, modules and packages) 4. Array processing with Numpy 5. Data processing with Pandas 6. Visualisation with Matplotlib / Seaborn 7. Introduction to Machine Learning

Learning goals:
After successfully completing the module, students have a deeper knowledge about efficient processing and preparation of large data packages with the help of the Python programming language. To do this, they first familiarise themselves with the necessary software tools. They learn the syntax of the Python programming language and consolidate the knowledge acquired in the lecture by independently working on complex programming tasks during the practical course. Knowledge is acquired in dealing with Python modules and packages. The functions of the Python packages required for data processing are examined in more detail. The application of the Data Science functions is carried out on realistic datasets. Finally, the students learn basic terms from the field of machine learning and apply selected methods to extract features, detect trends or make estimates of properties.

Recommended Literature

Jake Vanderplas: Python Data Science Handbook, O'REILLY, 2016 or
(Python Data Science Handbook | Python Data Science Handbook (jakevdp.github.io))

On-line Lecture notes and training material will be available.

Forms of teaching / Prequentense for participation

No course specific requirements

Usability of module

This module is elective for: Renewable Energy Systems

Requirements for receiving ECTS credit points

- Assessment is performed as a group work with a final oral presentation and a written essay.
- Students need to pass the module examination, based on the presentation and the written essay.

ECTS credit points and grading

The course grade is the grade of the examination.

Frequency of offer / Duration of module

SOMMER	1 semester

Work load

150 h of total work load, therefrom

- 80 h of presence at lectures
- 30 h of self-study
- 40 h preparation for examination (essay and presentation)

Modul-No.	**762**	**MA**	
Modul name	**Data Science in Python**		
Modul coordinator	Lustermann, Birgit		
Titel	Data Science in Python		
Titel of examination	Data Science in Python		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise/Internship		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Objective
This lecture looks at the issue of evaluation of large amounts of data with Python. It encompasses cleansing, manipulating and aggregating data to preparing datasets for further analysis and processing and presenting the results. To achieve the goal of data data science, which is to make predictions that support business decision-making, pattern must be found in the data and the accuracy of these predictions must be verified.

Module content:

1. Introduction to Data Science
2. Anaconda, IPython and Jupyter Notebook - Introduction to tools and development environments.
3. **Fundamentals of Machine Learning - with Scikit-Learn** (regression, classification, training, prediction and verification, support vector machines, decision trees, random forests , dimensionality reduction, unsupervised learning techniques)
4. **Neural Networks and Deep learning - with Keras and Tensorflow** (Introduction in artificial neural networks with Keras, training Deep Neural Networks, custom models with Tensorflow, loading and processing data with Tensorflow)

Learning goals:
After successfully completing the module, students have a deeper knowledge about efficient processing and preparation of large data packages with the help of the Python programming language. To do this, they first familiarise themselves with the necessary software tools. They consolidate the knowledge acquired in the lecture by independently working on complex programming tasks during the practical course. Knowledge is acquired in dealing with Python modules and packages. The functions of the Python packages required for machine learning algorithms are examined in more detail. The application of the Data Science functions is carried out on realistic datasets. The students learn basic terms from the field of machine learning and neural networks and apply selected methods to extract features, detect trends or make estimates of properties.

Recommended Literature

1. Jake Vanderplas: Python Data Science Handbook, O'REILLY, 2016 or
(Python Data Science Handbook | Python Data Science Handbook (jakevdp.github.io))

2. Aurélien Géron: Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition

On-line Lecture notes and training material will be available.

Forms of teaching / Prequentense for participation

Lecture with integrated exercises

course specific requirements:

1. Basic syntax of the Python programming language (data types, structures, functions, classes, modules and packages)
2. Array processing with Numpy (basics)
3. Data processing with Pandas (basics)
4. Visualisation with Matplotlib / Seaborn (basics)

Usability of module

This module is elective for: Renewable Energy Systems

Requirements for receiving ECTS credit points	
Assessment is performed as a written examination (90 minutes)	
ECTS credit points and grading	
The course grade is the grade of the examination (4 ECTS credits) + machine learning project + (1 ECTS credit)	
Frequency of offer / Duration of module	
JEDES	1 Semester
Work load	
150 h of total work load, from: 45 h of presence at lectures/exercises 55 h of self-study + project preparation 50 h of preparation for examination + exam project	

Modul-No.	851	MA	
Modul name	**Wind Power Plants**		
Modul coordinator	Link, Thomas		
Titel	Wind Power Plants		
Titel of examination	Wind Power Plants		
Course Type / SWS	4 SWS Lecture / 1 SWS Internship		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

- Classification of Wind Turbines
- Aerodynamics of Wind Turbines
- Betz's Theory and Schmitz's Design rules
- Aerodynamic of the Darrieus Turbine
- Control of Wind Turbines
- Wind Turbine Design
- Wind Characteristics and Resources
- Hands-on-Training with an Aero-Elastic-Code

Learning goals:

The participants know the fundamental physical procedures that are vital for the usage of wind energy. They can use lift diagrams and calculate lift and resistance for given diagrams. The students are able to evaluate the optimal shapes for predefined profiles using Betz's law and determine efficiency and the power coefficient of wind turbines under idealized conditions. They are familiar with the different regulation concepts used in wind energy systems and are able to show the constructive peculiarities of the installations. The students know the advantages and disadvantages of applied construction variants of wind turbines. They are able to work with probability density functions and capable of calculating wind velocity for given roughness lengths to then estimate the power output of wind turbines using power curves.
Due to their internship, the participants are able to utilize the basic functions of the software Bladed. They can design a wind turbine with predefined features and select different design options using Bladed.

Recommended Literature

1. R. Gasch, J. Twele, Wind Power Plants, Springer, 2012
2. J.-P. Molly, Windenergie: Theorie, Anwendung, Messung, Verlag C. F. Müller, 1990
3. E. Hau, Wind Turbines, Springer, 2006
4. J. F. Manwell, et. al., Wind Energy Explained: Theory, Design and Application, Wiley, 2009

Forms of teaching / Prequentense for participation

Lecture with included exercises. Practical training in small groups with the wind farm planning tool Wind Pro (only RES). Experimental work in small groups in the wind tunnel lab.

Master students: Requirement for earning credit points is a test performance rated at least „sufficient“ in the module exam (written exam, 90 min) and a completed practical training as well the completed wind tunnel lab.

Bachelor students: Requirement for earning credit points is a test performance rated at least „sufficient“ in the module exam (written exam, 90 min). In the exam 4 questions out of 5 can be chosen. Additional the wind tun-nel lab has to be completed.

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Requirement for earning credit points is a test performance rated at least „sufficient“ in the module exam (written exam, 90 min) and a completed internship as a prerequisite.	
ECTS credit points and grading	
The grade corresponds to the grading of the exam. When completing the unit successfully, students are granted 5 credit points (ECTS).	
Frequency of offer / Duration of module	
WINTER	The module is lectured in one semester
Work load	
Master students: The workload consists of visiting lectures (33,75 h) preparation and debriefing of the subject matters (45,25 h), participation and preparation of the practical training (16 h), participation and preparation of the wind tunnel laboratory (20 h). Preparation of the written exam (35 h). Bachelor students: The workload consists of visiting lectures (33,75 h) preparation and debriefing of the subject matters (53,25 h), participation and preparation of the wind tunnel laboratory (20 h). Preparation of the written exam (43 h). The total workload amounts to 150 h which corresponds to 5 ECTS.	

Modul-No.	852	MA	
Modul name	**Photovoltaic Systems**		
Modul coordinator	Gerstenberg, Lukas		
Titel	Photovoltaic Systems		
Titel of examination	Photovoltaic Systems		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:
The students should achieve consolidated knowledge about installation, dimensioning and application of photovoltaic systems. In addition, the students get a profound introduction to the physics of solar cells.

1. Introduction:
   History of photovoltaics - current trends and actors
2. Basics:
   Introduction to semiconductor theory - generation and recombination processes - the solar cell as a p-n junction - modelling a real solar cell - thermodynamics of solar energy conversion
3. Technology:
   Production process for silicon solar cells - production process for thin-film solar cells – measuring in photovoltaics
4. System technology:
   From the single solar cell to a solar generator – control of solar generators - operation of grid-connected photovoltaic systems - operation of off-grid photovoltaic systems
5. System design
   Irradiation analysis - shading effects - mounting and interconnection - converters – grid connection – energy yield forecast - operation and maintenance of photovoltaic systems - economics

Learning goals:
After successfully completing the module, the students have a deeper knowledge about solar cells as a semiconductor. They confidently deal with cell and module characteristics and use them, for example, to understand phenomena in interconnecting single modules to generators. Furthermore, the students are able to plan a photovoltaic system using standard design software and estimate the energy yield.

Recommended Literature

[1] Mertens: Photovoltaics: Fundamentals, Technology and Practice. John Wiley & Sons Inc, 2018. (introducing)
[2] Deutsche Gesellschaft für Sonnenenergie (DGS): Planning and Installing Photovoltaic Systems. A Guide for In stallers, Architects and Engineers, 3rd Edition. (introducing)
[3] Wesselak/Voswinckel: Photovoltaik, Springer 2016 (introducing – only in german)
[4] Luque/Hegedus: Handbook of Photovoltaic Science and Engineering, Wiley, Chichester, 2011 (deepening)
[5] Würfel: Physics of Solar Cells, Wiley, Chichester, 2009 (deepening)

Forms of teaching / Prequentense for participation

The course takes the form of a lecture with integrated exercises and with the active involvement of the students. Exercises and case studies on the central topics of the lecture are presented, discussed and solved together. In addition, one practical laboratory experiment will be carried out in small groups of three students. Each group works out a report for the experiment. The report is graded zero to five points.

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points

B.Eng.: The assessment is performed as written examination Students need to pass the module examination (60 min.), which encompasses the practical contents of the lecture (section 1, 4, and 5). The prerequisite for the award of credit points is successful participation in the practical laboratory experiment (preliminary examination) with a grading of one to five points for

the report and successful passing of the examination.
M.Eng.: The assessment is performed as written examination Students need to pass the module examination (90 min.), which encompasses all contents of the lecture (section 1-5). The prerequisite for the award of credit points is successful participation in the practical laboratory experiment (preliminary examination) with a grading of one to five points for the report and successful passing of the examination.

ECTS credit points and grading	
5 ECTS credits	
Frequency of offer / Duration of module	
SOMMER	The module is lectured in one semester
Work load	
The workload for this module is 150 h; this corresponds to 5 ECTS credits. This workload results from the attendance of lectures with active participation of the students (45 h) as well as the preparation and follow-up of the two laboratory experiments (15 h). Within the framework of self-study, the material covered in the lecture is to be reworked and discrete computer exercises should be carried out (about 75 hours). The preparation and execution of the examination is about 30 hours.	

Modul-No.	854	MA	
Modul name	**Bioenergy Systems I Solid Biomass**		
Modul coordinator	Voswinckel, Sebastian		
Titel	Bioenergy Systems I Solid Biomass		
Titel of examination	Bioenergy Systems I Solid Biomass		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Objective

The objective of this course is to understand state of-the-art technologies for thermal biomass conversion. Based on the properties of different biofuels and the fundamentals of thermal conversion processes the course covers conversion processes as combustion, gasification, torrefaction and pyrolysis. Furthermore, emissions from thermal biomass conversion are addressed; methods for their reduction are explained. Additionally, economical aspects of solid biofuel systems are covered.

Module content:

- Biomass for thermal processes: origins and properties
- Fundamentals of thermal biomass conversion processes
- Combustion of biomass: technologies
- Gaseous and particulate emissions: formation processes and abatement technologies
- Power generation from solid biomass, technologies and plant layout
- Synthesis gas production: Biomass gasification
- Mastering the tar problem in biomass synthesis gas
- Pyrolysis and torrefaction: additional pathways for solid biomass conversion
- Hydrothermal conversion processes
- Economical aspects of thermal bioenergy conversion processes

Learning goals:

Students acquire competent knowledge in modern technologies of thermal biomass conversion. In addition to fundamental knowledge of the physical and chemical properties, students are familiar with the formation of gaseous emissions and particulate matter and their abatement. Students are enabled to recognize and evaluate the application and limitations of solid biomass technologies compared to conventional technologies and to draw appropriate conclusions considering technical and economic aspects.

Recommended Literature

- John Love (Editor): Biofuels and Bioenergy , Wiley Blackwell 2017
- Andreas Hornung: Transformation of Biomass: Theory to Practice, Wiley, 2014

On-line Lecture notes and training material will be available.

Forms of teaching / Prequentense for participation

Lecture in combination with an excursion to a biomass- CHP - plant

No course specific requirements

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

- Participation in the the integrated excursion is mandatory
- Assessment is performed either as written examination (90 minutes) or oral examination
- Students need to pass the module examination, which encompasses all contents of the lecture.

ECTS credit points and grading	
5 ECTS credits	
Frequency of offer / Duration of module	
SOMMER	1 semester
Work load	

150 h of total work load, therefrom
- 80 h of presence at lectures
- 40 h of self-study
- 30 h preparation for examination

Modul-No.	858	MA	
Modul name	**Scientific Project**		
Modul coordinator	Leibbrandt, Pascal		
Titel	Scientific Project		
Titel of examination	Scientific Project		
Course Type / SWS	8 SWS Project		
Language / CP / Workload	Englisch	10.0	300
Requirements for attendance	no		

Content and objectives
Content: In the second semester, the students in this course should complete one scientific project, which runs over the entire semester. The topic of the project is a complex assignment out of renewable energy engineering. The module also aims to teach students how to work in groups on large projects. Students are expected to combine individual partial results into an overall result. Finally, students are required to document the result in the form of a final project report, a presentation and a publication. The project work is done in groups of 5 - 10 students and concludes with an oral presentation of the project results and a written project documentation. **Learning goals:** The students should learn within a team to structure complex tasks, define reasonable work packages and to process them in a limited time. Periodical milestone discussions with the supervising lecturers and the other groups help the project team and the individual student to complete the task in an efficient and goal-oriented manner. The intermediate results are regularly discussed in the form of a seminar with all students The final documentation, presentation and publication of the project results prepares the prospective Master of Engineering for a project-oriented work in industry and economy.
Recommended Literature
The literature will be announced in the lecture
Forms of teaching / Prequentense for participation
Teaching forms as stated above Successful participation in the modules 870 Basics in Electrical Engineering, 871 Basics in Thermal Engineering, 873 Scientific Practice and 568 Project Management
Usability of module
This module is mandatory for: Renewable Energy Systems
Requirements for receiving ECTS credit points
Assessment is performed with the submission and presentation of the project; both will be graded.
ECTS credit points and grading
10 ECTS credits
Frequency of offer / Duration of module

WINTER	The module is lectured in one semester

Work load
The total workload for this module is 300 hours; this corresponds to 10 ECTS credits. This workload results mainly from the independent and self-responsible handling of the project (220 hours), the participation in the milestone meetings (40 hours) as well as from the preparation of the final report and presentation (40 hours).

Modul-No.	859	MA	
Modul name	**Solar Thermal Laboratory**		
Modul coordinator	Leibbrandt, Pascal		
Titel	Solar Thermal Laboratory		
Titel of examination	Solar Thermal Laboratory		
Course Type / SWS	4 SWS Lecture with Internship		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

- Solar collectors, components and systems
  - Collector types, characteristics
  - Collector loop, operating mode
  - Heat storage, heat exchanger, controls
- System design, economics
  - System types, characteristics
- Laboratory experiments
  - Collector front glazing – STL 1
  - Collector test (QDT) – STL 2
- Current research

Learning goals:

The students have knowledge about the various solar thermal collector types, design and function. They can dimension various solar loop types and design them using typical key figures. The economic viability of the investments and the basics of investment calculation is known to the students. By using typical and standardizes test methods (test rig design, data acquisition and evaluation) the students are able to test solar collectors and solar loop components in laboratory.

Recommended Literature

[1] Duffie; Beckman: Solar Engineering of Thermal Processes. 4th Edition. Wiley & Sons, Hoboken (2013)
[2] Schabbach; Leibbrandt: Solarthermie – Wie Sonne zu Wärme wird. Springer, Berlin (2017)
[3] Nellis; Klein: Heat Transfer. 1st Edition. Cambridge University Press, Cambridge (2008)
[4] Wesselak, Schabbach; Link; Fischer: Regenerative Energietechnik. Springer Vieweg, Berlin (2017)

Forms of teaching / Prequentense for participation

Solar Thermal Laboratory

There are no formal requirements for participation. Basics in physics, mathematics and mechanics are recommend-ed. Basic knowledge in renewable energies and heat transfer is useful.

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Assessment is performed as written examination (120 minutes).

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module

WINTER	The module is lectured in one semester

Work load

The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with an active participation of the students in the laboratory (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about. 50 hours.

Modul-No.	860	MA	
Modul name	**Master Thesis Module Renewable Energy Systems**		
Modul coordinator	Voswinckel, Sebastian		
Titel	A: Master Thesis B: Presentation and Defence		
Titel of examination	Master Thesis Module Renewable Energy Systems		
Course Type / SWS			
Language / CP / Workload	Englisch	30.0	900
Requirements for attendance	no		

Content and objectives

Content:
A: Master Thesis:
With the master thesis the students develop an independent scientific work. The results are usually derived from the practical activity to a given topic in a company or in another enterprise of professional scientific experience.

B: Presentation and Defence
In the Colloquium, students should present the results of their master thesis in an oral presentation and answer the questions of the supervisors and the audience.

Learning goals:
By completing the master thesis module, the students prove their professional qualification, to solve a practice-relevant engineering problem within a given time limit independently and with scientific methods, to present the results succinctly in a professional manner and to defend it in a colloquium.

Recommended Literature

There are no specific literature recommendations for this module

Forms of teaching / Prequentense for participation

A: Preparation of a scientific work supervised by an examiner of the university and a supervisor of the company/enterprise
B: Independent presentation of the results during a colloquium

A: The requirements are documented in §21 of the examination regulations.
B: The requirements are documented in §23 of the examination regulations.

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

A: Assessment is performed with an at least sufficient graded master thesis.
B: Assessment is performed with an at least sufficient graded colloquium.

ECTS credit points and grading

A: 26 ECTS credits
B: 4 ECTS credits

Frequency of offer / Duration of module

JEDES	One semester

Work load

The total workload for this module is 900 hours; this corresponds to 30 ECTS credits. This workload results mainly from the independent and self-responsible handling of the master thesis project (700 hours), the preparation of the master thesis (100 hours) and the presentation (100 hours).

Modul-No.	863	MA	
Modul name	**Fuel Cell Technology**		
Modul coordinator	Wesselak, Viktor		
Titel	Fuel Cell Technology		
Titel of examination	Fuel Cell Technology		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Objective

The objective of this course is to understand the electrochemical fundamentals of fuel cells and their operation, the differences between cells types and the design of fuel cell systems. Additionally, aspects of manufacturing fuel cells, their application and the economy of fuel cell systems are addressed.

Module contents:

- Introduction to fuel cells, types of fuel cells and historical aspects
- Electrochemistry basics; double layer phenomena, electrochemical equilibrium, reaction kinetics
- Mass transport
- Steady-state behaviour of fuel cells
- Overview of fuel cell systems
- Fuel processing; fuels, handling and production of hydrogen
- Fuel Cell Characterization
- Manufacturing of fuel cells
- Fuel cell systems for combined heat and power generation and transport, application and economical aspects
- Environmental Impact of Fuel Cells

Learning goals:

Students have acquired competent knowledge in state of the art fuel cell technologies. In addition to fundamental knowledge of fuel cell systems, students are familiar with the design of fuel cell systems and their application in combined heat and power generation as well as in transportation, considering technical and economic aspects. Students are enabled to recognize and evaluate the application and limitations of of fuel cell systems compared to conventional technologies and to draw appropriate conclusions.

Recommended Literature

Andrew Dicks, David A J Rand: Fuel Cell Systems Explained, Wiley, 2018
Ryan O'Hayre,, Suk-Won Cha , Whitney Colella, Fritz B. Prinz :Fuel Cell Fundamentals Wiley, 2016

Forms of teaching / Prequentense for participation

Teaching forms as stated above

No formal requirements. Basic knowledge on thermodynamics, and chemistry is advantageous.

Usability of module

This module is elective for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Assessment is performed either as written examination (90 minutes) or oral examination. Students need to pass the module examination, which encompasses all contents of the lecture.

ECTS credit points and grading

5 ECTS credits

Frequency of offer / Duration of module	
SOMMER	1 semester

Work load

150 h of total work load, therefrom

- 80 h of presence at lectures
- 40 h of self-study
- 30 h preparation for examination

Modul-No.	864	MA	
Modul name	**(ET) Bioengineering**		
Modul coordinator	Breuer, Uta		
Titel	(ET) Bioengineering		
Titel of examination	(ET) Bioengineering		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

- I Microbiology and Physiology of Microorganisms: cell biology, biochemical basic processes in the microbial metabolism, enzyme kinetics, microbial growth (kinetic and process management)
- II Bioprocess Engineering: bioreactors, sterilization and sterile technology, measurement and regulation technology at bioreactors, upstream and downstream processing
- III Biotechnological Syntheses: biomass (feed and food, agriculture, pharmacy), low-molecular products (methane, alcohols, organic acids, amino acids, lipids and fatty derivatives, nucleotides und coenzymes, vitamins, sweeteners) macromolecules (microbial enzymes, Insulin, recombinant drugs, products of secondary metabolism)
- IV Biotechnological Remediation Procedures: aerobic and anaerobic degradation, composting and special systems, anaerobic processes and process variants, liquid and gaseous emissions as well as treatments of wastes, bioremediation of pollutants in soil and ground water, bioleaching, phytoremediation
- V Biodegradables Materials: biologically degradable materials, renewable biomass, PHA – PHB
- VI Environmental Microbiology: C-, S-, N-, Fe-cycles, biosensors

Learning objectives:

Students acquire in-depth knowledge in bioengineering with microbial and biochemical-biotechnological focus. In addition to scientific and engineering knowledges which reflect the link between microbial performance and technical implementation, historical and up-to-date engineering processes are shown especially considering the economically and ecologically feasibility. In this way students are enabled, to recognize and evaluate application possibilities and limits of bioengineering as well as to compare with conventional technologies.

Recommended Literature

For preparation and following-up the following textbooks are suitable:

1. Colin Ed. Ratledge and Björn Kristiansen, Basic Biotechnology, Cambridge University, 3rd ed. 2006, ISBN13: 9780521549585
2. Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl: Brock Biology of Microorganisms, Pearson Education, 15th ed. 2017, ISBN 978-0134261928
3. D.L. Nelson, M.M. Cox: Lehninger Principles of Biochemistry: International Edition, WH Freeman, 7th ed. 2017, ISBN 978-1319108243
4. J.L. Slonczewski, J.W. Foster: Microbiology: An Evolving Science, WW Norton & Co Inc., 2013, ISBN 978-0393123678

Further literature will be announced during the lectures.

Forms of teaching / Prequentense for participation

Lecture

Knowledges and abilities which are demonstrated in lectures as bioenergy or biogas (B.Eng. RET) as well as bioengineering (B.Eng. URT). These prior knowledges could also be acquired by individual study or appropriate textbooks.

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Students need to pass a module examination which encompasses all contents of the lecture. Exam: Written exam with a duration of 120 min. Alternative forms of exam are possible.
ECTS credit points and grading
Modules are assessed by a module examination which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Frequency of offer / Duration of module

WINTER	The module is held within one semester.

Work load
- course participation = 50 h - preparing and following-up of the lecture contents = 55 h - exam Preparation = 45 h Total workload 150 h = 5 ECTS

Modul-No.	867	MA	
Modul name	**Numerical Methods in Heat and Mass Transfer**		
Modul coordinator	Leibbrandt, Pascal		
Titel	Numerical Methods in Heat and Mass Transfer		
Titel of examination	Numerical Methods in Heat and Mass Transfer		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

1. Introduction, applications
2. Basics on heat transfer
3. CFD-workflow, basic software components (CAD-modeller, mesher, physics, plots and reports)
4. Basics on CFD, mesh generation and diagnostics, physics models
5. Optimization of heat transfer problems, automation

Learning goals:

The students have knowledge about the phenomena of heat transfer and the simulation of heat transfer processes. They are able to use a commercial CFD software and interpret the simulation results. They understand the problems of residual and discretization convergence. The students can solve engineering problems like investigation and optimization of heat transfer problems.

Recommended Literature

- Baehr; Stephan: Wärme- und Stoffübertragung. 7. Auflage. Springer, Heidelberg, Dordrecht, London, New York (2010)
- Duffie; Beckman: Solar Engineering of Thermal Processes. 4th Edition. Wiley & Sons, Hoboken (2013)
- Kreith; Bohn: Principles of Heat Transfer. 6th Edition. Brooks/Cole, Pacific Grove (2001)
- Polifke; Kopitz: Wärmeübertragung. 2. Auflage. Pearson Studium, München (2009)
- Ferziger; Peric: Numerische Strömungsmechanik. 1. Auflage. Springer, Berlin, Heidelberg (2008)
- Hirsch: Numerical Computation of Internal & External Flows. 2nd Edition. Butterworth-Heinemann, Burlington (2007)

Forms of teaching / Prequentense for participation

The module consists of a lecture with integrated exercises.

There are no formal requirements for participation. Basics in physics, mathematics and mechanics are recomended. Basic knowledge in renewable energies and heat transfer is useful.

Usability of module

This module is elective for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Assessment is performed as written examination (120 minutes).

ECTS credit points and grading

The grade corresponds to the grading of the exam. When completing the unit successfully, students are granted 5 credit points (ECTS).

Frequency of offer / Duration of module

SOMMER	The module is lectured in one semester.

Work load

The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with with integrated exercises (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about 50 hours.

Modul-No.	869	MA	
Modul name	**Computer Aided (Process) Engineering**		
Modul coordinator	Rathje, Rio		
Titel	Computer Aided (Process) Engineering		
Titel of examination	Computer Aided (Process) Engineering		
Course Type / SWS	4 SWS Seminar		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Contents:

1. repetition of already learned software skills (equation solver) (if possible, via an online self-study)
2. extension of the software knowledge (via an online self-study)
3. construction of a thermodynamic cycle with detailed problem analysis in the context of the course
4. project work

Learning Goals:

Supported by various tools (teaching script, video tutorials, examples, etc.), students will be shown an entry point to self-study for learning (new) software skills.
Learning the ability to abstract complex technical relationships to calculate them in the limits of technical possibilities. Systems or processes to be determined by transient processes and/or using differential equations are considered. These calculations are followed by parameter studies to evaluate system design changes and/or altered environmental influences on overall systems. Application from the state of the art to the transfer of the latest research results into the calculation program.

Recommended Literature

- Wesselak; Schabbach; Link; Fischer: Handbuch Regenerative Energietechnik. Berlin: Springer Vieweg, 2017
- H. Struchtrup, Thermodynamics and Energy Conversion. Berlin, Heidelberg: Springer Berlin Heidelberg, 2014.
- S. Bhattacharjee, Thermodynamics. New York: Pearson, 2016.
- Nellis; Klein: Heat Transfer. 1st Edition. Cambridge University Press, Cambridge (2008)
- VDI, VDI Heat Atlas. Berlin London: Springer, 2010.

Forms of teaching / Prequentense for participation

The course is divided into three parts that build on each other. At the beginning, the students themselves learn how to use an equation solver with the help of supporting teaching materials (lecture notes, video tutorials, sample programs) and a weekly seminar. In the second part, a thermal circuit (cooling circuit, steam circuit, etc.) is constructed together and the individual components and their interaction are discussed and calculated. The third part is a project work including documentation/ project report with final presentation.
To ensure sufficient supervision, the maximum number of participants is limited to 20.

Requirements

The module "Computer Aided (Process) Engineering" can generally be used in all master’s programs of the Faculty of Engineering Sciences as an elective course, provided that the technical requirements for participation (see below) are met.

- For students with a bachelor’s degree of 180 ECTS must successfully complete the module "Basics in Thermal Engineering" (M871)
- For students with a bachelor’s degree of 210 ECTS advanced knowledge of thermodynamics, heat transfer and fluid mechanics is required.

Usability of module

This module is elective for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Students must complete the self-study (online tutorial) before they can participate in the second and third parts of the course. During the tutorial, students must answer test questions before new lessons are unlocked.
ECTS credit points and grading
Assessment is performed with the submission and presentation of the project; both will be graded. Other permissible forms of examination (written or online examination, oral, homework, etc.) or combinations are possible if they are announced by the person responsible for the module at the beginning of the semester.
Frequency of offer / Duration of module

SOMMER	The module is lectured in one semester.

Work load
The total workload is therefore 150 h, which corresponds to 5 ECTS. This workload results from the attendance in the lectures with an active participation of the students in the (virtual) laboratory (approx. 45 hours). During the self-study, the handouts are to be worked on (approx. 55 hours). The execution of the project amounts to approx. 50 hours.

Modul-No.	870	MA	
Modul name	**Basics in Electrical Engineering**		
Modul coordinator	Wang, Jiayi		
Titel	Basics in Electrical Engineering		
Titel of examination	Basics in Electrical Engineering		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise / 0.5 SWS Internship		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content

Part 1: DC Systems

- Resistances and Temperatures
- Serial and parallel connections Feld
- Voltage & Current Divider
- Kirchhoff's Laws
- Mesh Flow Analyses

Part 2: Single Phase Systems

- Complex Numbers
- Complex Operators
- Simple circuits driven by sinusoidal voltage
- Real, Reactive and Apparent Power
- Power Factor and compensation

Part 3: Three Phase Systems

- Introduction multiphase systems
- Star and Delta connection
- Basics Generators
- Basics Transformers

Learning goals:

The students will get a basic introduction of Electrical Engineering. Part I contains the knowledge to analyze easy circuits, feed by direct voltage. Resistances as a function of the temperature and serial and parallel connections will be treated. Finally Kirchhoff's Laws will be introduced. All contents of part I also can be applied for Part II & III. Complex numbers will be used to deal with sinusoidal functions as a basic procedure.

Part II will be focused to the basic calculation of simple circuits, driven by DC voltage. The meaning of the Power Factor and the apparent power will be clarified.

Part III will be more practical orientated. The students will deal with the multiphase systems and the possibility to connect the systems into Star- or Delta-Connection. Generators and Transformers will be introduced with their practical applications. Complicate calculations etc. will be avoided.

Recommended Literature

Literatur:

- Lecture Scripts will be uploaded
- Sample task will be uploaded

Forms of teaching / Prequentense for participation

Teaching forms as stated above

There are no formal requirements for participation. Basics in physics, mathematics and mechanics are recommended. Basic

knowledge in thermodynamics, heat transfer and renewable energies is useful. Lecture Scripts will be uploaded and sample task will be uploaded
Usability of module
This module is mandatory for: Renewable Energy Systems
Requirements for receiving ECTS credit points
Assessment is performed as written examination (90 minutes). Other permissible forms of examination (online, oral, homework, etc.) are possible if they are announced by the person responsible for the module at the beginning of the semester.
ECTS credit points and grading
The grade of the module M870 corresponds to the grade of the exam. With the grading, 5 credit points (ECTS) are awarded.
Frequency of offer / Duration of module

WINTER	1 Semester

Work load
The total workload for this module is 150 hours; this corresponds to 5 ECTS credits. This workload results from the presence at the lectures with an active participation of the students in the (virtual) laboratory (about 45 hours). As part of the self-study, the lecture material should be reworked (about 55 hours). The preparation and execution of the examination is about 50 hours.

Modul-No.	871	MA	
Modul name	**Basics in Thermal Engineering**		
Modul coordinator	Rathje, Rio		
Titel	Basics in Thermal Engineering		
Titel of examination	Basics in Thermal Engineering		
Course Type / SWS	4 SWS Lecture / 0.5 SWS Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Contents:

Thermodynamics

1. Thermodynamics
2. Systems, States, and Processes
3. First Law of Thermodynamics (Conservation of Energy)
4. The Second Law of Thermodynamics (Entropy and the Trend Toward Equilibrium)
5. Energy conversion and the second law
6. Properties and property relations of fluids (pure substances, multiphase, mixtures, psychrometrics)
7. Thermodynamic processes in closed and open systems and cycles
8. Thermodynamic Machines and Components: Efficiencies and Irreversible Losses

Heat Transfer

1. Conduction (steady state, transient)
2. Convection (external and internal flow and free convection)
3. Boiling and Condensation
4. Radiation

Learning Goals:

The students have reviewed the principles of thermodynamics and heat transfer and their calculation. Even if these basics were not part of the first bachelor's course, they have acquired the necessary knowledge in these areas to be able to take more advanced courses in this area at master's level in the following semesters.
In the virtual lab, students learned how to use thermodynamic and computational fluid dynamics software to calculate complex processes such as cyclic processes and multiphase flows.

Recommended Literature

- Wesselak; Schabbach; Link; Fischer: Handbuch Regenerative Energietechnik. Berlin: Springer Vieweg, 2017
- H. Struchtrup, Thermodynamics and Energy Conversion. Berlin, Heidelberg: Springer Berlin Heidelberg, 2014.
- S. Bhattacharjee, Thermodynamics. New York: Pearson, 2016.
- Nellis; Klein: Heat Transfer. 1st Edition. Cambridge University Press, Cambridge (2008)
- VDI, VDI Heat Atlas. Berlin London: Springer, 2010.

Forms of teaching / Prequentense for participation

The Basics in Thermal Engineering are mainly taught in a classical lecture. The lecture is supplemented by exercises in which application examples are discussed and a practical laboratory course.

There are no formal prerequisites for participation. Basic knowledge in physics, mathematics and mechanics is recommended. Basic knowledge in thermodynamics, fluid dynamics and heat transfer is helpful.

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

The assessment will take the form of a written, presence-based exam (90 minutes). Other permissible forms of examination (online, oral, homework, etc.) are possible if they are announced by the responsible person of the module at the beginning of the semester.
ECTS credit points and grading
The grade of the module M871 corresponds to the grade of the exam. With the grading, 5 credit points (ECTS) are awarded.
Frequency of offer / Duration of module

WINTER	The module is lectured in one semester.

Work load
The total workload for this module is 150 hours, corresponding to 5 ECTS. This workload results from the attendance of lectures including an active participation of the students in the (virtual) laboratory (approx. 45 hours) and supervised exercises in a tutorial (approx. 11 hours). Self-study should include a review of the lecture material (approximately 50 hours). Preparing for and taking the exam requires approximately 44 hours.

Modul-No.	872	MA	
Modul name	**Introduction in Renewable Energy Systems**		
Modul coordinator	Voswinckel, Sebastian		
Titel	Introduction in RES		
Titel of examination	Introduction in RES		
Course Type / SWS	4 SWS Lecture		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Contents:
Basics in combustion – Part A

- Thermodynamics of combustion
- Chemical kinetics on combustion
- Fundamentals of complete and incomplete combustion

In addition, a lecture series - **Part B** - regarding actual questions from the engineering practice of renewable energy systems are presented. The lectures are based on the current research projects of the Nordhausen University of Applied Sciences and focus on the following topics (examples)

- Modelling and simulation of complex technical processes
- Optimization of energy converters
- Energy system modelling
- Supply concepts for buildings and quarters
- Energy policy
- CFD simulation
- Test rig planning and data evaluation

Learning goals:
The students are familiar with current scientific issues in the field of energy systems, photovoltaics, solar and geothermal energy, bioenergy or wind power. They know about methods and tools for the design and optimization of renewable energy systems and its components. They are familiar with the fundamentals of combustion.

Recommended Literature

The literature will be announced in the lecture

Forms of teaching / Prequentense for participation

Teaching forms as stated above.

No course specific requirements.

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Students are required to pass the module examination, which encompasses all contents of the lecture series. Types of examination: written examination,

ECTS credit points and grading

Module is assessed with a module examination credited with 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).

Frequency of offer / Duration of module

WINTER	The module must be completed within one semester.

Work load
Participation in the course (45 h); preparation and follow-up (to the lectures) (60 h); Preparation for the examination (45 h) **The entire workload encompasses 150 hours, which corresponds to 5 ECTS credit points.**

Modul-No.	**873**	**MA**		
Modul name	**Scientific Practice and Writing**			
Modul coordinator	Wesselak, Viktor			Aberle, Alexandra
Titel	A: Scientific Practice B: Scientific Writing			
Titel of examination	Scientific Practice and Writing			
Course Type / SWS	4 SWS Lecture			
Language / CP / Workload	Englisch	5.0	150	
Requirements for attendance	no			

Content and objectives

A: Scientific Practice

Contents:

Students are taught the acquisition, evaluation and preparation of technical information as a central working technique in the engineering sciences, both in preparation for their master thesis and for their professional life.

1. What does scientific research mean?
2. Literature research
   Libraries and databases for the engineering sciences - Search techniques - Online search in free and fee-based databases - Content indexing of a library using the example of the University of Applied Sciences Nordhausen - Dealing with thessaurs
3. Technical standards
   Objectives and procedures of technical standardization - National and international standards boards - Researching and reading technical standards
4. Patents and industrial property rights
   Objectives and procedures in industrial property protection – patents, utility models, trademarks and designs - national and international patent organizations – German employee invention law - searching and reading patents - patentability of software
5. Writing of academic texts and lectures
   Presentation and structure - Literature references - Lecture structure - Presentation techniques - Examples of bad practice

Learning goals:

After successful completion of the module, students are able to research scientific or technical information, to procure it and to classify the research results with regard to their completeness and credibility. Furthermore, they are aware of the importance and practice of correct citation.

B: Scientific Writing

Contents:

1. Analysing academic languages: style and register, language structures
2. Elements of writing professional and/or academic texts: writing a paragraph; referencing, citing, quoting
3. Writing different text types: e.g. writing a tender, a quote, report and/or article

Learning goals:

Students have essential theoretical knowledge of writing different types of texts, e.g. typical professional documents. They have knowledge of the linguistic characteristics of the written language English as a scientific language, but also for use in a professional context. Students can gather information from specialised texts and internet sources and produce their own texts on topics relevant to their studies in English. They can deal with primary and secondary sources as well as the usual reference methods and citation styles.

Recommended Literature

1. Griffiths, P. (2007), Scientific Writing, Reading.
2. Macgilchrist, F. (2014), Academic Writing, Paderborn.
3. McCarthy, M. / O'Dell, F. (2011) English Vocabulary in use, Cambridge.
4. McCarthy, M. / O'Dell, F. (2016), Academic Vocabulary in Use, Cambridge, Stuttgart.
5. Oshima, A. / Hogue, A. / Curtis, J. (2020), Longman Academic Writing Series, White Plains, NY.

Forms of teaching / Prequentense for participation

The module is a lecture with practical exercises and with active participationt of the students. The students apply their knowledge in writing short acedemic texts on a given technical topic.

No course specific requirements

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Prerequisite for the award of credit points is regular course participation and:
A: the successful completion of the academic paper and its timely submission or presentation,
B: written and/or oral examination.

ECTS credit points and grading

The module grade corresponds to the arithmetic mean of the successfully completed examinations in the two parts A and B. With an examination grade of at least 4.0, 2.5 credit points (ECTS) are awarded in each part, with the module grade thus totalling 5 credit points.

Frequency of offer / Duration of module

WINTER	The module must be completed within one semester.

Work load

Participation in both courses (50 h); preparation and follow-up (to the lectures/seminars) (25 h); writing an academic paper in part A (50 h), preparation for examination in part B = 25 h. The entire workload encompasses 150 hours, which corresponds to 5 ECTS credit points.

Modul-No.	908	MA	
Modul name	**German as a Foreign Language I**		
Modul coordinator	Aberle, Alexandra		
Titel	German as a Foreign Language I		
Titel of examination	German as a Foreign Language I		
Course Type / SWS	4 SWS Seminar		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

The module consists of 4 SWS and takes the promotion of individual language skills in the context of obtaining a UNIcert certificate into account.

A1.1
Vocabulary: introduction; communication in a very simple manner in relation to everyday needs, place of living, family and friends, hobbies and preferences
Grammar: simple word order; different sentence types (statement, question and command); adjectives; singular and plural nouns; present tense of special verbs; definite and indefinite articles; personal pronouns

A2.1
Vocabulary: communication about one's past and education; showing emotions; expressing advantages and disadvantages
Grammar: sub-clauses (weil, dass, wenn), adjectives (comparative and superlative), preterite forms of modal verbs, reflexive verbs, genitive with names, possessive articles in dative

B1.1
Vocabulary: expressing reasons for preferences and dislikes; arrange/book a holiday; understand announcements; write a comment; express past experiences, describe changes in life; apply for a job/internship; environmental protection
Grammar: Use of Infinitiv mit zu and the verb lassen; subordinate clauses with weil, da and obwohl; prepositions: genitive (trotz and wegen), prepositions used with time (dative and genitive); subordinate clauses with damit and um zu; conjunctive II with modal verbs, sein and haben

Recommended Literature

Bahn, Steve et al.: Kurs DaF A2, Deutsch für Studium und Beruf. Stuttgart: Klett 2024.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu A1B1. Klett, 2019.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu B1. Klett, 2021.
Jin, Friederike and Ute Voss: Grammatik aktiv: A1 –B1. Üben, Hören, Sprechen. Berlin: Cornelsen, 2023.

Forms of teaching / Prequentense for participation

Interactive Language Course

Usability of module

This module is mandatory for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Active seminar participation obligatory

ECTS credit points and grading

ECTS: 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Types of examination: written examination (60 min.) and oral examination.
The final grade is the arithmetic mean of the examinations.

Frequency of offer / Duration of module

WINTER	1 Semester

Work load
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire work load encompasses 150 hours, which equals 5 ECTS credit points.

Modul-No.	910	MA	
Modul name	**German as a Foreign Language II**		
Modul coordinator	Aberle, Alexandra		
Titel	Deutsch als Fremdsprache II		
Titel of examination	German as a Foreign Language II		
Course Type / SWS	4 SWS Seminar		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

The module consists of 4 SWS and takes the promotion of individual language skills in the context of obtaining a UNIcert certificate into account.

A1.2
Vocabulary: simple and direct communication skills in routine situations; participants understand commonly used expressions related to them directly (personal information, education, shopping and geography)
Grammar: details of time, manner and place; perfect tense of haben and sein; auxiliary and modal verbs; separable and inseparable verbs; nominative and dative nouns and prepositions; imperative forms

A2.2
Vocabulary: enquire: ask for information and direction; express one´s opinion; give recommendations; express apologies, complaints and consequences; ask for a favour; describe a picture in detail
Grammar: indirect questions; conjunctive II (sollte) to give a recommendation; adverbs: deshalb, trotzdem; changing prepositions (dative and accusative); verbs used with dative and accusative; subordinate clauses with als and wenn; verbs with fixed prepositions; indefinite pronouns

B1.2
Vocabulary: understand and describe relationships; discuss/solve conflict situations; offer, accept and/or reject help; participate in a discussion; selective reading (finding key words in articles); descriptions of people and processes
Grammar: Plusquamperfekt; subclauses used with time (bevor, bis, nachdem, seit, während); sentence structure (use of nicht); the passive voice (Präsens, Präteritum, Perfekt and modal verbs); adjectives used as nouns, articles used as pronouns (irgendein/-eine/-welche); sentences with je..., desto/umso...; use of participle I and II as adjectives

Recommended Literature

Bahn, Steve et al.: Kurs DaF A2, Deutsch für Studium und Beruf. Stuttgart: Klett 2024.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu A1B1. Klett, 2019.
Dengler, Stefanie; Paul Rusch, Helen Schmitz and Tanja Sieber: Netzwerk neu B1. Klett, 2021.
Jin, Friederike and Ute Voss: Grammatik aktiv: A1 –B1. Üben, Hören, Sprechen. Berlin: Cornelsen, 2023.

Forms of teaching / Prequentense for participation

Interactive Language Course

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Active seminar participation obligatory

ECTS credit points and grading

ECTS: 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).
Types of examination: written examination (60 min.) and oral examination.
The final grade is the arithmetic mean of the examinations.

Frequency of offer / Duration of module

SOMMER	1 Semester
Work load	
Participation in the course = 50 h Preparation and follow-up (of the lecture) = 55 h Preparation for examination = 45 h The entire work load encompasses 150 hours, which equals 5 ECTS credit points.	

Modul-No.	1010	MA	
Modul name	**Power-to-X**		
Modul coordinator	Voswinckel, Sebastian		
Titel	Power-to-X		
Titel of examination	Power-to-X		
Course Type / SWS	4 SWS Lecture/Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Contents:

1. Introduction
   Energy demand in crucial sectors
2. Power-to-heat (PtH)
   electrode heater – heat pumps
3. Power-to-gas (PtG)
   electrolysis of water - water gas shift reaction – Sabatier process – products – transport and distribution
4. Power-to-Liquid (PtL)
   Reforming – Cracking - Fischer-Tropsch synthesis – products – transport and distribution
5. Problems
   energy and carbon dioxid balancing principles – carbon sources – limited of organic materials – sustainability

Learning goals:

The students know the principle and purpose of Power-to-X technologies. They know the main products and process routes for its production. They can quantify the inputs and outputs of PtX systems and calculate the efficiencies of the process routes and the carbon footprint of the products. The students are able to define technically and economically based preferences products and process routes under given boundary conditions.

Recommended Literature

The literature will be announced in the lecture

Forms of teaching / Prequentense for participation

Teaching forms as stated above

No course specific requirements

Usability of module

This module is a profile module for: Renewable Energy Systems

Requirements for receiving ECTS credit points

B.Eng.: The assessment is performed as written examination Students need to pass the module examination, which encompasses all contents of the lecture.

M.Eng.: The assessment is performed as written examination and by the submission of a term paper. Students need to pass the module examination, which encompasses all contents of the lecture

ECTS credit points and grading

B.Eng.: The module grade corresponds to the grading of the successfully completed examination. With an examination grade of at least 4.0, 5 credit points (ECTS) are awarded.

M.Eng.: The module grade corresponds to the arithmetic mean of the successfully completed examination and the successful completion of the term paper and its timely submission.With an total grade of at least 4.0, 5 credit points (ECTS) are awarded.

Frequency of offer / Duration of module

SOMMER	The module must be completed within one semester.

Work load

B.Eng.: Participation in the course (45 h); preparation and follow-up (55 h); preparation for examination (50 h)

M.Eng.: Participation in the course (45 h); preparation and follow-up (25 h); writing an academic paper (55 h); preparation for examination (25 h)

The entire workload encompasses 150 hours, which corresponds to 5 ECTS credit points.

Modul-No.	1012	MA	
Modul name	**Basics of Mechanical Engineering**		
Modul coordinator	Link, Thomas		
Titel	A: Mechanical Engineering B: Fluid Dynamics		
Titel of examination	Basics of Mechanical Engineering		
Course Type / SWS	2 SWS Lecture / 2 SWS Exercise		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

Content:

A: Mechanical Engineering

1. Static and dynamic equilibrium for forces and torques
2. Loads of components and load distribution in components
3. Material Properties of components
4. Mechatronic components for machines
5. Design of mechanical elements
6. Manufacturing of mechanical elements

B: Fluid Dynamics

1. Bernoulli's equation in branched systems
2. Linear Momentum Equation and Rankine’s Momentum Theory
3. Angular Momentum Equation
4. Euler’s pump and turbine equation
5. Flow past blunt bodies
6. Compressible flows
7. Similarity theory

Competence

The students define Static and dynamic equilibrium for forces and torques. This is the base for the calculation of the loads in the components. With the knowledge of the material properties they are able to design mechanical elements. The students get an overview on mechatronic components and can use them to design complex mechanical components. At the end they learn how to manufacture this parts.

Students can apply Bernoulli's equation in branched systems. Using the momentum theorem, they are able to calculate forces on components with flow around and through them for two- and three-dimensional flow problems. Students are familiar with Rankine's jet theory and thus have the basics to understand Betz's theory for wind turbines. They are familiar with the differences between incompressible and compressible flows and are able to calculate simple compressible flow cases. Students are familiar with the application of the pi theorem in similarity theory and are able to derive similarity indices for a wide variety of problems and thus correctly transfer measurements on a model scale to large-scale designs.

Recommended Literature

- Munson et. al. Introduction to Fluid Dynamics. Wiley
- Mark Huber. The Beginner's Guide to Engineering: Mechanical Engineering
- Erik Oberg et. al. Machinery's Handbook

Forms of teaching / Prequentense for participation

The course takes the form of a lecture with 2 SH. Accompanying and partly integrated into the lecture, exercises of 2 SH are offered.

No course specific requirements.

Usability of module	
This module is mandatory for: Renewable Energy Systems	
Requirements for receiving ECTS credit points	
Assessment is performed as written examination (120 minutes).	
ECTS credit points and grading	
5 ECTS credits	
Frequency of offer / Duration of module	
WINTER	1 Semester
Work load	
150 h of total work load, from: • 45 h of presence at lectures/exercises • 55 h of self-study • 50 h of preparation for examination	

Modul-Nr.	**1111**	**MA**	
Bezeichnung	**Project Module RES**		
Verantwortlicher	Wesselak, Viktor		
Titel der Lehrveranstaltung(en)	Praxismodul RES		
Prüfungsbezeichnung	Project Module RES		
Lehrformen / SWS	4 SWS Projektarbeit		
Sprache / CP / Workload	Deutsch	5.0	150
Formale Teilnahmebedingungen	keine		

Inhalte und Qualifikationsziele

Inhalte
Die Studierenden sollen im 2. Fachsemester eine Projektarbeit mit komplexer Aufgabenstellung absolvieren, die sich über das gesamte Semester erstreckt. Die ausgegebenen Themen sind vorzugsweise in aktuellen Forschungsprojekten angesiedelt. Die zu bearbeitenden Fragestellungen können theoretischer, experimenteller oder konstruktiver Natur sein.

Die Projektarbeit ist auf eine Laufzeit von 15 Wochen ausgelegt. Nach einer Woche ist von den Studierenden ein Projektplan zu erstellen. Zwischenergebnisse sind jeweils nach einem und zwei Monaten innerhalb eines Vortrags zu präsentieren. Die Projektarbeit schließt mit Vorlage einer schriftlichen Projektdokumentation.

Lernziele
Studierende haben im Verlauf der über ein gesamtes Semester angelegten Projektarbeit erlernt, komplexe Aufgabenstellungen (Projektaufträge) zu gliedern, in sinnvolle Arbeitspakete zu zerlegen und diese in begrenzter Zeit zu bearbeiten. Zahlreiche Zwischengespräche (Meilensteintermine) mit den betreuenden Fachgebietsleitern helfen, die gestellte Aufgabe effizient und zielorientiert zu absolvieren. Durch die Präsentation der Zwischenergebnisse sowie die abschließende Dokumentation sind die angehenden Absolventen auf zukünftige projektorientierte Tätigkeit in Wirtschaft oder Forschung vorbereitet.

Literaturempfehlungen

Literaturempfehlungen werden in der Lehrveranstaltung bekanntgegeben

Lehr- und Lernformen / Voraussetzung für die Teilnahme

Lehr- und Lernformen wie oben angegeben

Keine formalen Teilnahmevoraussetzungn

Verwendbarkeit

Dieses Modul ist ein Profilmodul für: Renewable Energy Systems

Voraussetzungen für die Vergabe von ECTS-Leistungspunkten

Voraussetzung für die Vergabe von Leistungspunkten ist eine mindestens mit „ausreichend“ bewertete Prüfungsleistung. Die Prüfungsleistung besteht aus den o.g. Zwischenpräsentationen, der Abschlusspräsentation und dem Abschlussbericht.

ECTS-Leistungspunkte und Benotung

Die Note wird aus den Teilnoten der beiden Zwischenpräsentationen (je 10 %), der Abschlusspräsentation (20 %) und dem Abschlussbericht (60 %) berechnet. Mit der Modulbenotung werden 5,0 Leistungspunkte (ECTS) vergeben.

Häufigkeit des Angebots / Dauer des Moduls

SOMMER	Das Modul umfasst jeweils 1 Semester.

Arbeitsaufwand (work load)

Die Arbeitsbelastung besteht im Wesentlichen in der selbstständigen und eigenverantwortlichen Bearbeitung des Projekts (100 h), der Teilnahme an den Meilensteinbesprechungen (20 h) sowie in der Ausarbeitung von Abschlussbericht und Präsentation (30 h). Die gesamte Arbeitsbelastung umfasst 150 h; dies entspricht 5,0 ECTS credits.

Modul-Nr.	**1112**	**MA**	
Bezeichnung	**Project Module RES**		
Verantwortlicher	Wesselak, Viktor		
Titel der Lehrveranstaltung(en)	Praxismodul RES		
Prüfungsbezeichnung	Project Module RES		
Lehrformen / SWS	4 SWS Projektarbeit		
Sprache / CP / Workload	Deutsch	5.0	150
Formale Teilnahmebedingungen	keine		

Inhalte und Qualifikationsziele

Inhalte
Die Studierenden sollen im 2. Fachsemester eine Projektarbeit mit komplexer Aufgabenstellung absolvieren, die sich über das gesamte Semester erstreckt. Die ausgegebenen Themen sind vorzugsweise in aktuellen Forschungsprojekten angesiedelt. Die zu bearbeitenden Fragestellungen können theoretischer, experimenteller oder konstruktiver Natur sein.

Die Projektarbeit ist auf eine Laufzeit von 15 Wochen ausgelegt. Nach einer Woche ist von den Studierenden ein Projektplan zu erstellen. Zwischenergebnisse sind jeweils nach einem und zwei Monaten innerhalb eines Vortrags zu präsentieren. Die Projektarbeit schließt mit Vorlage einer schriftlichen Projektdokumentation.

Lernziele
Studierende haben im Verlauf der über ein gesamtes Semester angelegten Projektarbeit erlernt, komplexe Aufgabenstellungen (Projektaufträge) zu gliedern, in sinnvolle Arbeitspakete zu zerlegen und diese in begrenzter Zeit zu bearbeiten. Zahlreiche Zwischengespräche (Meilensteintermine) mit den betreuenden Fachgebietsleitern helfen, die gestellte Aufgabe effizient und zielorientiert zu absolvieren. Durch die Präsentation der Zwischenergebnisse sowie die abschließende Dokumentation sind die angehenden Absolventen auf zukünftige projektorientierte Tätigkeit in Wirtschaft oder Forschung vorbereitet.

Literaturempfehlungen

Literaturempfehlungen werden in der Lehrveranstaltung bekanntgegeben

Lehr- und Lernformen / Voraussetzung für die Teilnahme

Lehr- und Lernformen wie oben angegeben

Keine formalen Teilnahmevoraussetzungn

Verwendbarkeit

Dieses Modul ist ein Profilmodul für: Renewable Energy Systems

Voraussetzungen für die Vergabe von ECTS-Leistungspunkten

Voraussetzung für die Vergabe von Leistungspunkten ist eine mindestens mit „ausreichend“ bewertete Prüfungsleistung. Die Prüfungsleistung besteht aus den o.g. Zwischenpräsentationen, der Abschlusspräsentation und dem Abschlussbericht.

ECTS-Leistungspunkte und Benotung

Die Note wird aus den Teilnoten der beiden Zwischenpräsentationen (je 10 %), der Abschlusspräsentation (20 %) und dem Abschlussbericht (60 %) berechnet. Mit der Modulbenotung werden 5,0 Leistungspunkte (ECTS) vergeben.

Häufigkeit des Angebots / Dauer des Moduls

SOMMER	Das Modul umfasst jeweils 1 Semester.

Arbeitsaufwand (work load)

Die Arbeitsbelastung besteht im Wesentlichen in der selbstständigen und eigenverantwortlichen Bearbeitung des Projekts (100 h), der Teilnahme an den Meilensteinbesprechungen (20 h) sowie in der Ausarbeitung von Abschlussbericht und Präsentation (30 h). Die gesamte Arbeitsbelastung umfasst 150 h; dies entspricht 5,0 ECTS credits.

Modul-No.	8000	MA	
Modul name	**Study success and career progression**		
Modul coordinator	Aberle, Alexandra		
Titel	Study success and career progression		
Titel of examination	Study success and career progression		
Course Type / SWS	2 SWS Seminar		
Language / CP / Workload	Englisch	5.0	150
Requirements for attendance	no		

Content and objectives

A: Students are familiar with the formal and legal aspects of being a student at a German university embodying requirements, enrolment processes as well as examination regulations, master thesis, finals and colloquium/defence. They know how to plan and structure learning routines successfully. This includes time-management, meeting tight deadlines, avoiding procrastination, progression control and learning intervals. Students manage to prepare for examinations and identify special types of examinations and their requirements. They use personalized strategies for memorizing, reviewing and testing knowledge as well as self-evaluation, motivation and stress reduction.
B: Students are familiar with work and working conditions (dos and don´ts) in Germany. They are aware of important regulations and the legal German framework. They are able to apply for jobs or internships in Germany and know the contents of the relevant documents (CV, cover letter etc.), application strategies and processes. Students master typical interview situations and are able to talk about personal qualities, career skills and achievements.

Recommended Literature

Bosewitz, Annette und René (2022). Erfolgreiche Vorstellungsgespräche auf Englisch, Haufe.
Bosewitz, Annette und René (2021). Professionell bewerben auf Englisch. Haufe.
Bowler, Jade (2021). The Only Study Guide You'll Ever Need: Simple tips, tricks and techniques to help you ace your studies and pass your exams! Blink Publishing.
Laufer, Coley (2015). Conquering Exams, Never Fail Exams Again. CreateSpace Independent Publishing Platform.

Forms of teaching / Prequentense for participation

Seminar: face-to-face teaching, speaking and writing practices and group-work activities

Usability of module

This module is elective for: Renewable Energy Systems

Requirements for receiving ECTS credit points

Students need to pass both parts of the module examination in order to acquire ECTS. Part A: Oral exam/presentation (30 mins). Part B: Written examination (60 min.). The final grade is the arithmetic mean of the examinations.
Active seminar participation is obligatory.

ECTS credit points and grading

The module is assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).

Frequency of offer / Duration of module

WINTER	1 semester

Work load

Participation in the course = 60 h, preparation and follow-up = 50 h, preparation for examination = 40 h. The entire work load encompasses 150 hours, which equals 5 ECTS credit points.