Biotechnology & Environmental Engineering

- Courses in English -

- Applied Hydrobiology and Ecotoxicology
- Energy Economics
- Renewable Energy Systems 2* – Fuel Cells Systems and their applications
- Renewable Energy Systems 2* - Photovoltaics

* This is a two-part module with one exam

This programme is offered in the summer semester (April-July) only.
Faculty of Life Sciences; August 2024

Course Name: Applied Hydrobiology and Ecotoxicology		
Degree programme: **Environmental Engineering** (Bachelor)	Responsible Lecturer: Prof.Dr. Carolin Floeter	
Workload: 210 hours	**Lecture hours per week:** 4 SWS	**ECTS Credits:** 5

Course objectives:

Applied Hydrobiology:

The students …

- gain basic knowledge in hydrobiology (freshwater and marine)
- learn methods for an ecological and ecotoxicological risk assessment
- identify impacts on freshwater and marine ecosystems
- develop risk reduction measures to improve the water quality of freshwater and marine ecosystems
- apply the knowledge on freshwater case studies: the rivers Bille and Elbe
- apply the knowledge on marine case studies: North Sea and Baltic Sea
- evaluate water and sediment quality of european freshwater and marine ecosystems according to international, european and national regulation (e.g. EU Water Framework Directive and EU Marine Strategy Directive)
- gain insight into occupational areas of applied hydrobiology and ecotoxicology

Social – and Selfcompetencies

The students …

- learn to work in small teams together with international students in English.
- gain insight into occupational areas of environmental risk assessment and can develop their emphasis further.
- are able to think interdisciplinary, assess environmental impacts and develop risk mitigation measures.

Contents:

Applied Hydrobiology:

- Basic hydrobiology: physical and chemical properties of water, classification of lakes due to stratification and circulation, nutrient cycles (C-, N and P), river continuum concept, aquatic biocoenosis and food webs, marine ecosystems;
- Methods and parameter to assess the water and sediment quality according to European regulation (EU Water Framework Directive and EU Marine Strategy Directive);
- Ecological methods for the assessment of water and sediment quality of rivers: macrozoobenthos (invertebrates living in the sediment) analysis and evaluation according to the EU Water Framework Directive;
- Ecotoxicological methods for the risk assessment of water/sediment samples and for single substances: biomarker, bioassays and mesocosm studies, as well as biomonitoring;
- Impacts on aquatic ecosystems: e.g. pollution by point and diffuse sources, cooling water extraction and discharge, waste water discharge, hydrological constructions, e.g. weirs, shipping, dredged material management, tourism, fishery;
- different risk assessment procedures according to international and national regulation: for pesticides, waste water and sediments (dredged material management); PBT (Persistence, Bioaccumulation, Toxicity and "veryP veryB") Concept, Predicted Environmental Concentration (PEC), Predicted No Effect Concentration (PNEC), Risk Quotient method, mixture toxicity, Endocrine Disruptors (EDs);

- risk assessment, risk mitigation and risk management;
- Bille and Elbe river: impact analysis and management scenarios;
- North Sea/ Baltic Sea: insight into environmental impact assessment, e.g. of offshore windparks and risk mitigation measurements.

About didactics and workload distribution:

Taught seminar (PowerPoint presentations, blackboard, films, cards) with case examples; papers, work in small groups; discussion of current topics; presentations by external experts; excursions
210 h, thereof 96 h lesson time (6 hours per week), 114 h of self-study

Requirements for participation:
Selection of environmental assessment as course specialisation required.

Recommended prior knowledge: Module 3 and 4 (Physics 1, Physics 2); Module 6 (Cellular and Microbiology; Biological and Chemical Parameters for Environmental Assessment); Module 7 and 8 (General, inorganic and organic chemistry and Biochemistry); Module 15 (Biology 1, Biology 2)

Course language:
English

Type of exam:
Oral Presentation in groups of two and written summary

Requirements for credit point allocation:
Applied Hydrobiology – Presentation

Literature:

- Working material of lecturers
- Robert G. Wetzel (2001): Limnology: lake and river ecosystems. 3. Aufl., Acad. Press. ISBN: 0-12-744760-1
- Jacob Kalff (2003): Limnology: inland water ecosystems. Prentice Hall. Pearson Education. ISBN 0-13-033775-7
- Jürgen Schwoerbel, Heinz Brendelberger (2010): Einführung in die Limnologie. 9. Aufl., Elsevier, Spektrum Akad. Verl.. ISBN:3-8274-1498-9
- Winfried Lampert; Ulrich Sommer (2007): Limnoecology: the ecology of lakes and streams. 2. ed. Univ. Press. ISBN: 978- 0- 19-921393-1
- Christer Brönmark; Lars-Anders Hansson (2005): The biology of lakes and ponds. 2. ed., reprint (with corr.). Oxford Univ. Press. ISBN: 0-19-851612-6 0-19-851613-4
- Michael C. Newman (2010): Fundamentals of ecotoxicology. 3rd Ed. CRC Press. ISBN: 978-1-420-06704-0
- Walker, C.H., Hopkin, S.P., Sibly, R.M. & Peakall, D.B. (2006): Principles of Ecotoxicology. 3rd Edition CRC Press. ISBN 0- 8493-3635-X
- Karl Fent (2007): Ökotoxikologie: Umweltchemie, Toxikologie, Ökologie. Thieme. 3., überarb. und aktualisierte Aufl. ISBN: 3- 13-109993-3
- Futher literature (e.g. reports from OSPARCOM, HELCOM and Federal Environmental Agency (Umweltbundesamt (UBA) will be recommended in the lectures
- VDI-Richtlinien: Biologische Messverfahren

Course Name: Energy Economics

Degree programme: **Environmental Engineering** (Bachelor)	Responsible Lecturer: Prof. Dr. Timmerberg

Workload: 90 hours	**Lecture hours per week:** 2	**ECTS Credits:** 3

Course objectives:

The students develop a systemic view of the energy industry. They learn to:

- Understand the ways in which energy is provided
- Develop energy utilisation within sectors against the background of specific requirements and market mechanisms
- Calculate energy costs and name the basics of pricing
- Understand the concept of energy services and develop and evaluate supply concepts

To be able to categorise demands / proposals for adjustments to the energy industry (develop an attitude) in order to be able to select energy services for individual companies with foresight.

Contents:

- Forms of energy (primary, secondary, final, useful energy)
- Supply chains of primary energy (carriers)
- Availability of energy resources
- Supply characteristics of renewable energy sources
- Cost structures of energy supply
- Energy requirements in the electricity, heating and transport sectors
- Economic efficiency calculations
- Sensitivity analyses
- Legal / economic framework conditions

About didactics and workload distribution:

36 hours in-person lectures, 54 hours self-study

Requirements for participation:

Basic understanding of thermodynamics and renewable energy technologies (wind energy, solar)

Course language:

English

Type of exam:

Written exam, oral exam, presentation or term paper. The exam form will be set by the lecturer at the beginning of the semester.

Requirements for credit point allocation:

Successfully passing the final examination

Literature:

Karl, J. Dezentrale Energiesysteme. Hamburg: Oldenbourg Verlag

Course Name: Renewable Energy Systems - Part one: Fuel Cells

Degree programme: **Environmental Engineering** (Bachelor)	Responsible Lecturer: Prof. Dr. Marion Siegers

Workload: 75 hours	**Lecture hours per week:** 2	**ECTS Credits:** 2.5

Course objectives:

The students improve their knowledge about renewable energies in the area of fuel cells and gain an insight into low-emission power generation via fuel cells.

Contents:

This course deals with fuel cell systems and their application:

Basic Principles of a Fuel Cell

- Principle of a Fuel Cell
- Thermodynamics (excerpts)
- Efficiency
- Voltage-Current-Characteristics

Fuel Gas Supply

- Reformer Technology (Steam Reforming (SR), Partial Oxidation (POX), Autothermal Reformation (ATR))
- CO Removal Technology
- Internal Reforming

Applications

- Mobile Applications
- Stationary Applications
- Portable Applications

About didactics and workload distribution:

Lectures in the form of a seminar, exercises

Requirements for participation:

Basic knowledge of science and engineering

Course language:

English

Type of exam:

Written exam

Requirements for credit point allocation:

Attendance and participation in class; successful completion of the written exam
For credit point allocation of 6 CPs, see the requirements of Photovoltaic Applications too.

Literature:

- Heinzel, Mahlendorf, Roes, Brennstoffzellen – Entwicklung, Technologie, Anwendung, C.F. Müller
- Larminie, Dicks, Fuel Cell Systems Explained, Wiley
- Kurzweil, Brennstoffzellentechnik, Vieweg Verlag
- Kordesch, Simader, Fuel Cells and Their Applications, VCH-Verlag

Course Name: Renewable Energy Systems - Part two: Photovoltaics (PV)

Degree programme:	Responsible Lecturer:
B.Sc. Environmental Engineering (Bachelor)	**Prof. Dr. Timon Kampschulte**

Workload: 105 hours	**Lecture hours per week:** 3 h per week	**ECTS Credits:** 3.5

Course objectives:

Students are going to learn about how a sustainable energy supply can be realized by photovoltaic (PV) solar systems.

Contents:

1. Introduction
   a. potential of solar energy
   b. general concepts of solar systems
   c. economic importance of solar energy
2. Solar Radiation
   a. black body radiation
   b. physics of the sun
   c. irradiance onto horizontal and tilted surfaces on earth
3. Solar Cells
   a. physics of solar cells
   b. electrical properties of solar cells
   c. materials and concepts of modern solar cells
4. Photovoltaic application
   a. photovoltaic modules
   b. grid connected photovoltaic (PV) systems
   c. PV stand-alone and hybrid systems

About didactics and workload distribution:

The course is taught as a seminar style lecture of 3 h per week. Within the lecture several exercises are integrated.
15 weeks x 3 h = 45 h of attendance
60 h for studying at home and preparing the exam

Requirements for participation:

Participants should have basic knowledge of physics and electrical engineering from a bachelor programme on engineering. Basic understanding of electronics or semiconductor physics is advantageous.

Course language:

English

Type of exam:

Several types of exams are possible:

written exam, oral exam, portfolio exam, student's presentation, homework

At the beginning of the semester the lecturer will decide which type of exam applies.

Please note: the exam is part of the module "Renewable Energy 2", which includes this course and the course of "Fuel Cells and their Applications".

Requirements for credit point allocation:

Passing the exam. The lecturer can ask for mandatory attendance to the course during the full semester.

Literature:

- Mertens, K.: Photovoltaics - Fundamentals, Technology and Practice, Wiley, Chichester 2018
- lecture notes
- more literature will be given in the lecture