TUHH

Technische Universität Hamburg-Harburg

Module Manual

Joint Master of Science

Joint European Master in Environmental Studies - Cities and Sustainability

Winter Term 2014

Table of Contents

Program description

Content:

Core qualification

Module: Waste and Energy

Courses:

Title	Typ	Hrs/wk
Waste Recycling Technologies	Vorlesung	2
Waste Recycling Technologies	Gruppenübung	1
Waste to Energy	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kerstin Kuchta

Admission Requirements:
none

Recommended Previous Knowledge:
Basics of process engineering

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to describe and explain in detail techniques, processes and concepts for treatment and energy recovery from wastes.

Capabilities:
The students are able to select suitable processes for the treatment and energy recovery of wastes. They can evaluate the efforts and costs for processes and select economically feasible treatment Concepts. Students are able to evaluate alternatives even with incomplete information. Students are able to prepare systematic documentation of work results in form of reports, presentations and are able to defend their findings in a group.

Personal Competence:
Social Competence:
Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development of collegues. Furthermore, they can give and accept professional constructive criticism.

Autonomy:
Students can independently tap knowledge of the subject area and transform it to new questions. They are capable, in consultation with supervisors, to assess their learning level and define further steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Environmental Engineering: Vertiefung Waste and Energy: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Kernqualifikation: Compulsory
Renewable Energies: Vertiefung Bio energies: Compulsory suffrage

Course: Waste Recycling Technologies (Vorlesung)

Lecturer:
Prof. Kerstin Kuchta

Language:
EN

Cycle:
SS

Content:

- Fundamentals on primary and secondary production of raw materials (steel, aluminum, phosphorous, copper, precious metals, rare

metals)
- Use and demand of metals and minerals in industry and society
- collection systems and concepts
- quota and efficiency
- Advanced sorting technologies
- mechanical pretreatment
- advanced treatment
- Chemical analysis of Critical Materials in post-consumer products
- Analytical tools in Resource Management (Material Flow Analysis, Recycling Performance Indicators, Criticality Assessment, statistical analysis of uncertainties)

Literature:

Course: Waste Recycling Technologies (Übung)

Lecturer:
Prof. Kerstin Kuchta

Language:
EN

Cycle:
SS

Content:

- Fundamentals on primary and secondary production of raw materials (steel, aluminum, phosphorous, copper, precious metals, rare metals)
- Use and demand of metals and minerals in industry and society
- collection systems and concepts
- quota and efficiency
- Advanced sorting technologies
- mechanical pretreatment
- advanced treatment
- Chemical analysis of Critical Materials in post-consumer products
- Analytical tools in Resource Management (Material Flow Analysis, Recycling Performance Indicators, Criticality Assessment, statistical analysis of uncertainties)

Literature:

Course: Waste to Energy (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Rüdiger Siechau

Language:
EN

Cycle:
SS

Content:

- Project-based lecture
- Introduction into the " Waste to Energy " consisting of:
  - Thermal Process (incinerator , RDF combustion)
  - Biological processes (Wet-/Dryfermentation)
  - technology , energy , emissions, approval , etc.
- Group work
  - design of systems/plants for energy recovery from waste
  - The following points are to be processed :
    - Input: waste (fraction collection and transportation, current quantity , material flows , possible amount of development)
    - Plant (design, process diagram , technology, energy production)
    - Output (energy quantity / type , by-products)
    - Costs and revenues
    - Climate and resource protection (CO2 balance , substitution of primary raw materials / fossil fuels)
    - Location and approval (infrastructure , expiration authorization procedure)
    - Focus at the whole concept (advantages, disadvantages , risks and opportunities , discussion)
- Grading: No Exam , but presentation of the results of the working group

Literature:
Literatur:

Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010
Powerpoint-Folien in Stud IP

Literature:
Introduction to Waste Management; Kranert Martin , Klaus Cord - Landwehr (Ed.), Vieweg + Teubner Verlag , 2010

PowerPoint slides in Stud IP

Module: Urban Environmental Management

Courses:

Title	Typ	Hrs/wk
Noise Protection	Vorlesung	2
Urban Infrastructures	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Stephan Köster

Admission Requirements:
none

Recommended Previous Knowledge:

- Urban planning
- Measures for climate protection and climate change adaptation
- Basics of urban drainage

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Civil Engineering: Vertiefung Structural Engineering: Compulsory suffrage
Civil Engineering: Vertiefung Geotechnical Engineering: Compulsory suffrage
Civil Engineering: Vertiefung Coastal Engineering: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Kernqualifikation: Compulsory
Logistics, Infrastructure and Mobility: Vertiefung Infrastructure and Mobility: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory

Course: Noise Protection (Vorlesung)

Lecturer:
NN

Language:
EN

Cycle:
SS

Content:

Literature:

Course: Urban Infrastructures (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Stephan Köster

Language:
EN

Cycle:
SS

Content:
Problem/Project Based Learning
Main topics are:

- Design of future cities, concepts and technical approaches for future-proof drinking water supply and wastewater disposal
- Climate Change Impacts, Adaptation and Mitigation
- Rainwater Management & urban flash floods
- New water sources: rainwater harvesting and wastewater reuse
- Urban greening & urban agriculture
- Water sensitive urban design
- How to better link urban planning and urban water issues

Literature:

Module: Management of Surface Water

Courses:

Title	Typ	Hrs/wk
Modelling of Flow in Rivers and Estuaries	Vorlesung	3
Nature-Oriented Hydraulic Engineering / Integrated Flood Protection	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Peter Fröhle

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering. Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows and waves. They can also depict the concepts of nature oriented hydraulic engineering.
Capabilities:
Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. Furthermore, the students are able to set up flood-risk management concepts and are able to apply basic concepts of renaturation to practical problems.

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Environmental Engineering: Kernqualifikation: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Kernqualifikation: Compulsory
Water and Environmental Engineering: Vertiefung Water: Compulsory
Water and Environmental Engineering: Vertiefung Environment: Compulsory
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Modelling of Flow in Rivers and Estuaries (Vorlesung)

Lecturer:
Prof. Peter Fröhle

Language:
DE/EN

Cycle:
SS

Content:
Basics of numerial models / application of models

- classification of models
- model concept
- modelling

1D Working Equation
Mathematical description of physical processes

- Equation of motions
  - conservation of mass
  - conservation of momentum
- Initial conditions and boundary conditions

Numerical Methods

- Time step procedure
- Finite differences

- Finite volumes

Literature:
Vorlesungsskript

Course: Nature-Oriented Hydraulic Engineering / Integrated Flood Protection (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Peter Fröhle

Language:
DE/EN

Cycle:
SS

Content:

- Regime-Theory and application for the development of environmental guiding priciples of rivers
- Engineering - biological measures for the stabilization of rivers
- Risk management in flood protection
- Design techniques in technical flood protection
- Methods for the assessment of flood caused damages

Literature:
Vorlesungsumdruck

Module: Water & Wastewater Systems

Courses:

Title	Typ	Hrs/wk
Ecological Town Design - Water, Energy, Soil and Food Nexus	Vorlesung	2
Water & Wastewater Systems in a Global Context	Vorlesung	2

Module Responsibility:
Prof. Ralf Otterpohl

Admission Requirements:
Bachelor's degree

Recommended Previous Knowledge:
Basic knowledge of the global situation with rising poverty, soil degradation, migration to cities, lack of water resources and sanitation

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can describe the facets of the global water situation. Students can judge the enormous potential of the implementation of synergistic systems in Water, Soil, Food and Energy supply.
Capabilities:
Students are able to design ecological settlements for different geographic and socio-economic conditions for the main climates around the world.

Personal Competence:
Social Competence:
Autonomy:
Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Environmental Engineering: Kernqualifikation: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Ecological Town Design - Water, Energy, Soil and Food Nexus (Vorlesung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
SS

Content:

- Participants Workshop: Design of the most attractive productive Town
- Keynote lecture and video
- The limits of Urbanization / Green Cities
- The tragedy of the Rural: Soil degradation, agro chemical toxification, migration to cities
- Global Ecovillage Network: Upsides and Downsides around the World
- Visit of an Ecovillage
- Participants Workshop: Resources for thriving rural areas, Short presentations by participants, video competion
- TUHH Rural Development Toolbox
- TUHH Rural Development Toolbox (cont.)
- Integrated New Town Development
- Participants workshop: Design of New Towns: Northern, Arid and Tropical cases

- Outreach: Participants campaign
- City with the Rural: Resilience, quality of live and productive biodiversity
- Exam with color pencils: Design of a New Town

Literature:

- Ralf Otterpohl 2013: Gründer-Gruppen als Lebensentwurf: "Synergistische Wertschöpfung in erweiterten Kleinstadt- und Dorfstrukturen", in „Regionales Zukunftsmanagement Band 7: Existenzgründung unter regionalökonomischer Perspektive, Pabst Publisher, Lengerich
- http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation)
- TEDx New Town Ralf Otterpohl: http://youtu.be/_M0J2u9BrbU

Course: Water & Wastewater Systems in a Global Context (Vorlesung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
SS

Content:

- Participants Workshop: Awareness of global water problems; role play's, theatre, pantomime, developing a song and else
- Keynote lecture and video
- Water & Soil: Water availability as a consequence of healthy soils
- Water and it's utilization, Integrated Urban Water Management
- Water & Energy, lecture and panel discussion pro and con for a specific big dam project
- Rainwater Harvesting on Catchment level, Holistic Planned Grazing, Multi-Use-Reforestation
- Sanitation and Reuse of water, nutrients and soil conditioners, Conventional and Innovative Approaches
- Video contest: Participants groups search, introduce, show and discuss excellent short water videos
- Why are there excreta in water? Public Health, Awareness Campaigns
- Seminar: Participants prepare and give 5 min presentations
- Rehearsal session, Q&A
- Exam

Literature:

- Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press
- Liu, John D.: http://eempc.org/hope-in-a-changing_climate/ (Integrated regeneration of the Loess Plateau, China, and sites in Ethiopia and Rwanda)
- http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation)

Module: Internationale Logistics and Transport Systems

Courses:

Title	Typ	Hrs/wk
Mobility of Goods, Logistics, Traffic	Vorlesung	2
International Logistics and Transport Systems	Problemorientierte Lehrveranstaltung	3

Module Responsibility:
Prof. Heike Flämig

Admission Requirements:
none

Recommended Previous Knowledge:

- Introduction to Logistics and Mobility
- Foundations of Management
- Legal Foundations of Transportation and Logistics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to...

- give definitions of system theory, (international) transport chains and logistics in the context of supply chain management
- explain trends and strategies for mobility of goods and logistics
- describe elements of integrated and multi-modal transport chains and their advantages and disadvantages
- deduce impacts of management decisions on logistics system and traffic system and explain how stakeholders influence them
- explain the correlations between economy and logistics systems, mobility of goods, space-time-structures and the traffic system as well as ecology and politics

Capabilities:
Students are able to...

- Design intermodal transport chains and logistic concepts
- apply the commodity chain theory and case study analysis
- evaluate different international transport chains
- cope with differences in cultures that influence international transport chains

Personal Competence:
Social Competence:
Students are able to...

- develop a feeling of social responsibility for their future jobs
- give constructive feedback to others about their presentation skills
- plan and execute teamwork tasks

Autonomy:
Students are able to improve presentation skills by feedback of others

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
International Management and Engineering: Vertiefung II. Logistics: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Kernqualifikation: Compulsory
Logistics, Infrastructure and Mobility: Vertiefung Production and Logistics: Compulsory suffrage
Logistics, Infrastructure and Mobility: Vertiefung Infrastructure and Mobility: Compulsory suffrage

Course: Mobility of Goods, Logistics, Traffic (Vorlesung)

Lecturer:

Prof. Heike Flämig

Language:
EN

Cycle:
SS

Content:
The intention of this lecture is to provide a general system analysis-based overview of how transportation chains emerge and how they are developed. The respective advantages and disadvantages of different international transportation chains of goods are to be pointed out from a micro- and a macroeconomic point of view. The effects on the traffic system as well as the ecological and social consequences of a spatial devision of economical activities are to be discussed.
The overview of current international transportation chains is carried out on the basis of concrete material- and appendant information flows. Established transportation chains and some of their individual elements are to become transparent to the students by a number of practical examples.

1. A conceptual systems model
2. Elements of integrated and multi-modal transportation chains
3. interaction of transport and traffic, demand and supply on different layers of the transport system
4. Global Issues in Supply Chain Management
5. Global Players and networks
6. Logistics and corporate social responsibility (CSR)
7. Methods and data for assessment of international transport chains
8. Influence of cultural aspects on international transport chains
9. New solutions using different focuses of the transport and logstics system

Literature:
David, Pierre A.; Stewart, Richard D.: International Logistics: The Management of International Trade Operations, 3rd Edition, Mason, 2010
Schieck, Arno: Internationale Logistik: Objekte, Prozesse und Infrastrukturen grenzüberschreitender Güterströme, München, 2009
BLOECH, J., IHDE, G. B. (1997) Vahlens Großes Logistiklexikon, München, Verlag C.H. Beck
IHDE, G. B. (1991) Transport, Verkehr, Logistik, München, Verlag Franz Vahlen, 2. völlig überarbeitete und erweiterte Auflage
NUHN, H., HESSE, M. (2006) Verkehrsgeographie, Paderborn, München, Wien, Zürich, Verlage Ferdinand Schöningh
PFOHL, H.-C. (2000) Logistiksysteme - Betriebswirtschaftliche Grundlagen, Berlin, Heidelberg, New York, Springer-Verlag, 6. Auflage

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Course: International Logistics and Transport Systems (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Heike Flämig

Language:
EN

Cycle:
SS

Content:
The problem-oriented-learning lecture consists of case studies and complex problems concerning the systemic characteristics of different modes of transport as well as the organization and realization of transport chains. Students get to know specific issues from practice of logistics and mobility of goods and work out recommondations for solutions.

Literature:
David, Pierre A.; Stewart, Richard D.: International Logistics: The Management of International Trade Operations, 3rd Edition, Mason, 2010
Schieck, Arno: Internationale Logistik: Objekte, Prozesse und Infrastrukturen grenzüberschreitender Güterströme, München, 2009

Specialisation Energy

Module: Waste Treatment Technologies

Courses:

Title	Typ	Hrs/wk
Waste and Environmental Chemistry	Laborpraktikum	2
Biological Waste Treatment	Problemorientierte Lehrveranstaltung	3

Module Responsibility:
Prof. Kerstin Kuchta

Admission Requirements:
none

Recommended Previous Knowledge:
chemical and biological basics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to explain the design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treatment plants for biological waste treatment plants and explain different methods for waste analytics.

Capabilities:
The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.

Personal Competence:
Social Competence:
Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give and accept professional constructive criticism.

Autonomy:
Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define further steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Civil Engineering: Vertiefung Structural Engineering: Compulsory suffrage
Civil Engineering: Vertiefung Geotechnical Engineering: Compulsory suffrage
Civil Engineering: Vertiefung Coastal Engineering: Compulsory suffrage
Environmental Engineering: Kernqualifikation: Compulsory
International Management and Engineering: Vertiefung II. Energy and Environmental Engineering: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Waste and Environmental Chemistry (Laborpraktikum)

Lecturer:
Prof. Kerstin Kuchta

Language:
DE/EN

Cycle:

WS

Content:

The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student.
In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation.
Experiments ar e.g.
Screening and particle size determination
Fos/Tac
AAS
Chalorific value

Literature:

Scripte

Course: Biological Waste Treatment (Problemorientierte Lehrveranstaltung)

Lecturer:

Prof. Kerstin Kuchta

Language:

EN

Cycle:

WS

Content:

1. Introduction
2. biological basics
3. determination process specific material characterization
4. aerobic degradation (Composting, stabilization)
5. anaerobic degradation (Biogas production, fermentation)
6. Technical layout and process design
7. Flue gas treatment
8. Plant design practical phase

Literature:

Module: Special Aspects of Waste Resource Management

Courses:

Title	Typ	Hrs/wk
Advanced Topics in Waste Resource Management	Problemorientierte Lehrveranstaltung	3
International Waste Management	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Kerstin Kuchta

Admission Requirements:
none

Recommended Previous Knowledge:
basics in waste treatment technologies

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to describe waste as a resource as well as advanced technologies for recycling and recovery of resources from waste in detail. This covers collection, transport, treatment and disposal in national and international contexts.
Capabilities:
Students are able to select suitable processes for the treatment with respect to the national or cultural and developmental context. They can evaluate the ecological impact and the technical effort of different technologies and management systems.

Personal Competence:
Social Competence:
Students can work together as a team of 2-5 persons, participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development of colleagues. Furthermore, they can give and accept professional constructive criticisms.
Autonomy:
Students can independently gain additional knowledge of the subject area and apply it in solving the given course tasks and projects.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Environmental Engineering: Vertiefung Waste and Energy: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Advanced Topics in Waste Resource Management (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Rüdiger Siechau

Language:
EN

Cycle:
WS

Content:
Focus of the course "Advanced topics of waste resource management" lies on the organisational structures in waste management – such as planning, financing and logistics. One excursion will be offered to take part in (incineration plant, vehicle fleet and waste collection systems).
The course is split into two parts:
1. part: “Conventional” lecture (development of waste management, legislation, collection, transportation and organisation of waste management, costs, fees and revenues).
2. part: Project base learning: You will get a project to work out in groups of 4 to 6 students; all tools and data you need to work out the project were given before during the conventional lecture. Course documents are published in StudIP and communication during project work takes place via StudIP.
The results of the project work are presented at the end of the semester. The final mark for the course consists of the grade for the presentation.

Literature:
Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010
PowerPoint slides in Stud IP

Course: International Waste Management (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Kerstin Kuchta

Language:
EN

Cycle:
WS

Content:
Waste avoidance and recycling are the focus of this lecture. Additionally, waste logistics (Collection, transport, export, fees and taxes) as well as international waste shipment solutions are presented.
Other specific wastes, e.g. industrial waste, treatment concepts will be presented and developed by students themselves
Waste composition and production on international level, wast eulogistic, collection and treatment in emerging and developing countries.
Single national projects and studies will be prepared and presented by students

Literature:
Basel convention

Courses:

Title	Typ	Hrs/wk
Integrated Pollution Control	Vorlesung	2
Health, Safety and Environmental Management	Vorlesung	2
Exercise Health, Safety and Environmental Management	Gruppenübung	1

Module Responsibility:
Prof. Stephan Köster

Admission Requirements:
none

Recommended Previous Knowledge:

- Environmental Technologies
- Environmental Legislation
- Environmental Assessment

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to describe the basics of regulations, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.

Capabilities:
Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.

Personal Competence:
Social Competence:
The students can work together in international groups.

Autonomy:
Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Energy and Environmental Engineering: Vertiefung Environmental Engineering: Compulsory suffrage
Environmental Engineering: Kernqualifikation: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage
Product Development, Materials and Production: Vertiefung Product Development: Compulsory suffrage
Product Development, Materials and Production: Vertiefung Production: Compulsory suffrage
Product Development, Materials and Production: Vertiefung Materials: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory
Water and Environmental Engineering: Vertiefung Cities: Compulsory

Course: Integrated Pollution Control (Vorlesung)

Lecturer:
Prof. Stephan Köster

Language:
EN

Cycle:
WS

Content:
The lecture focusses on:

- The Regulatory Framework
- Pollution & Impacts, Characteristics of Pollutants
- Approaches of Integrated Pollution Control
- Sevilla Process, Best Available Technologies & BREF Documents
- Case Studies: paper industry, cement industry, automotive industry
- Field Trip

Literature:

Course: Health, Safety and Environmental Management (Vorlesung)

Lecturer:
Dr. Constantin Stephan

Language:
EN

Cycle:
WS

Content:
Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace Crisis management

Literature:
C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315)

Course: Exercise Health, Safety and Environmental Management (Übung)

Lecturer:
Dr. Constantin Stephan

Language:
EN

Cycle:
WS

Content:
Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace Crisis management

Literature:
C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

Module: Environmental Biotechnology

Courses:

Title	Typ	Hrs/wk
Technical and Environmental Microbiology	Laborpraktikum	3
Environmental Microbiology	Vorlesung	2

Module Responsibility:
Prof. Rudolf Müller

Admission Requirements:
none

Recommended Previous Knowledge:
basic knowledge in organic chemistry and microbiology

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
At the end of this module the students are able to:
- explain methods for the detection of microorganisms in the environment
- explain the mechanisms that exist for the biological degradation of pollutants

Capabilities:
At the end of this module the students are able:
- to judge, in which technical processes microbially mediated problems may occur
- to propose methods for the elimination of microorganisms from the environment
- to evaluate environmental problems derived from pollutants and their consequences,
- to isolate bacteria from water and soil samples,
- to perform and document experiments concerning biological degradation of pollutants,

to use modern molecular biology methods for the characterization of mixed bacterial communities,
to transfer the mechanisms for the degradation of environmental pollutants to new chemicals whose degradation is not known yet.

Personal Competence:
Social Competence:
The students can:
- perform experiments in teams of 4 students

Autonomy:
The students are able:
- to extract new knowledge from scientific articles, summarize them and compare it to the contents of the lecture

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Biotechnology: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage

Course: Technical and Environmental Microbiology (Laborpraktikum)

Lecturer:
Prof. Rudolf Müller, Prof. Garabed Antranikian, Dr. Kerstin Sahm

Language:
EN

Cycle:
WS

Content:
Working with Microorganisms under aerob and anaerob conditions,
Detection of microorganisms in the ground, water and air
Cultivation of monocultures
Growth curves

Production and detection of enzymes

Literature:

Süßmuth, R.; Eberspächer, J.; Haag, R.; Springer, W.: Biochemisch- mikrobiologisches Praktikum. Thieme Verlag, Stuttgart.
Schlegel, H. G.: Allgemeine Mikrobiologie. Georg Thieme Verlag, Stuttgart, New York, 5. Auflage, 1981.
Drews, D.: Mikrobiologisches Praktikum. Springer Verlag, Berlin, Heidelberg, New York, 3. Auflage, 1976.
Gottschalk, G.: Bacterial Metabolism. Springer Verlag, New York, Berlin, Heidelberg, Tokyo, 2nd Edition, 1988.
(sowie Literatur zu den entsprechenden Vorlesungen)

Course: Environmental Microbiology (Vorlesung)

Lecturer:

Prof. Rudolf Müller

Language:

EN

Cycle:

WS

Content:

1. Microbial Ecology
2. Detection of microorganisms
3. Disinfection and sterilisation
4. Sources for environmental pollutants
5. Biodegradability tests
6. Toxicity, use and degradation of pollutants:
- Alkanes, alkenes, alkines
- Benzene, toluene, xylenes, cresols
- Polycyclic aromatic compounds
- Chlorinated aliphatic and aromatic compounds
- Sulfonated compounds
- Nitrated compounds, amines, azo-dyes
- Herbicides, Pharmaceuticals
7. Enzymes involved in the degradation of pollutants
8. Plasmids involved in the degradation of pollutants
9. Construction of novel strains for the degradation of pollutants

Literature:

Brock Biology of Microorganisms,
M.T. Madigan, J.M.Martinko, J.Parker, Prontice Hall International, Inc.•Antisepsis, Disinfection, and Sterilization: Types, Action, and Resistance,
Gerald E. McDonnell, ASM Press, ISBN: 978-1-55581-392-5•Bioremediation Engineering
J.T. Cookson•Biodegradation and Bioremediation, Martin Alexander, Academic Press•Handbook on Biodegradation and Biological Treatment of Hazardous Organic Compounds, Martin H. van Agteren, Sytze Keuning and Dick B. Janssen, Kluwer Academic Publishers

Module: Wastewater Systems and Reuse

Courses:

Title	Typ	Hrs/wk
Wastewater Systems - Collection, Treatment and Reuse	Vorlesung	2
Wastewater Systems - Collection, Treatment and Reuse	Hörsaalübung	1
Sustainable Water Management	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Ralf Otterpohl

Admission Requirements:
Bachelor's degree

Recommended Previous Knowledge:
Knowledge of water and wastewater management and the key processes involved in water and wastewater treatment.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to outline key areas of the full range of treatment systems in water and waste water management, as well as their mutual dependence for sustainable water protection. They can describe relevant economic, environmental and social factors.
Capabilities:
Students are able to pre-design and explain the available water and wastewater treatment processes and the scope of their application in municipal and for some industrial treatment plants.

Personal Competence:
Social Competence:
Through partial PBL students have learned to research and to interact with other students on the subjects covered.
Autonomy:
Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Environmental Engineering: Kernqualifikation: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage

Course: Wastewater Systems - Collection, Treatment and Reuse (Vorlesung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
SS

Content:
•Understanding the global situation with water and wastewater
•Regional planning and decentralised systems
•Overview on innovative approaches
•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
•Mathematical Modelling of Nitrogen Removal
•Exercises with calculations and design

Literature:
Henze, Mogens:
Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
George Tchobanoglous, Franklin L. Burton, H. David Stensel:
Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy
McGraw-Hill, 2004 - 1819 pages

Course: Wastewater Systems - Collection, Treatment and Reuse (Übung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
SS

Content:
•Understanding the global situation with water and wastewater
•Regional planning and decentralised systems
•Overview on innovative approaches
•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
•Mathematical Modelling of Nitrogen Removal
•Exercises with calculations and design

Literature:
Henze, Mogens:
Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
George Tchobanoglous, Franklin L. Burton, H. David Stensel:
Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy
McGraw-Hill, 2004 - 1819 pages

Course: Sustainable Water Management (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Mathias Ernst

Language:
EN

Cycle:
WS

Content:
The course provides knowledge on the sustainable treatment and management of the resource water. Used water is an alternative resource and can be recycled in any field of the urban water cycle after adequate treatment. The resulting water quality is the decisive issue. In the course the central quality parameters of drinking- as well as wastewater assessment will be presented and discussed. Moreover the legal frame for water reuse in the EU and examples from all over the world will be communicated. The students receive the task to develop a conceptual design study of an indirect potable reuse facility in given boundary conditions. To fulfill this task, the students will work in small groups representing a consulting firm. Later in the course the firms will present their concepts. In preparation to the team presentation further knowledge on alternative water resources and sustainable management will be provided. International case studies will be presented and discussed. Next to the communication of technical details, planning tools for the implementation of alternative water management will be given also Option for an effective public perception program of later water users.

Literature:

- Milestones in Water Reuse, V. Lazarova, T. Asano, A. Bahri, J. Anderson, IWA Publishing 2013
- Current UN World Water Development Reports
- Water Security for Better Lives, OECD Studie 2013
- PPT's provided during the course

Module: Bioresources and Biorefineries

Courses:

Title	Typ	Hrs/wk
Biorefinery Technology	Vorlesung	2
Biorefinery Technologie	Gruppenübung	1
Bioresource Management	Vorlesung	2
Bioresource Management	Gruppenübung	1

Module Responsibility:
Dr. Ina Körner

Admission Requirements:
Non

Recommended Previous Knowledge:
Basics on engineering;
Basics of waste and energy management

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can give on overview on principles and theories in the field's bioresource management and biorefinery technology and can explain specialized terms and technologies.
Capabilities:
Students are capable of applying knowledge and know-how in the field's bioresource management and biorefinery technology in order to perform technical and regional-planning tasks. They are also able to discuss the links to waste management, energy management and biotechnology.

Personal Competence:
Social Competence:
Students can work goal-oriented with others and communicate and document their interests and knowledge in acceptable way.
Autonomy:
Students are able to solve independently, with the aid of pointers, practice-related tasks bearing in mind possible societal consequences.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 96, Study Time in Lecture: 84

Assignment for the Following Curricula:
Environmental Engineering: Vertiefung Waste and Energy: Compulsory suffrage
Environmental Engineering: Vertiefung Biotechnology: Compulsory suffrage
International Management and Engineering: Vertiefung II. Energy and Environmental Engineering: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage

Course: Biorefinery Technology (Vorlesung)

Lecturer:
Dr. Ina Körner

Language:
EN

Cycle:
WS

Content:
The Europe 2020 strategy calls for bioeconomy as the key for smart and green growth of today. Biorefineries are the fundamental part on the way to convert the use of fossil-based society to bio-based society. For this reason, agriculture and forestry sectors are increasingly deliver bioresources. It is not only for their traditional applications in the food and feed sectors such as pulp or paper and construction material productions, but also to produce bioenergy and bio-based products such as bio-plastics. However although bioresources are renewable, they are considered as limited resources as well. The bioeconomy's limitation factor is the availability land on our world. In the context of the development of the bioeconomy, the sustainable and reliable supply of noon-food biomass feedstock is a critical success factor for the long-term perspective of bioenergy and other bio-based products production. Biorefineries are complex of technologies and process cascades using the available primary, secondary and tertiary bioresources to produce a multitude of products - a product mix from material and energy products.
The lecture gives an overview on biorefinery technology and shall contribute to promotion of international biorefinery developments.

Lectures:

- What is a biorefinery: Overview on basic organic substrates and processes which lead to material and energy products
- The way from a fossil based to a biobased economy in the 21st century
- The worlds most advanced biorefinery
- Presentation of various biorefinery systems and their products (e.g. lignocellulose biorefinery, green biorefinery, whole plant biorefinery, civilization biorefinery)
- Example projects (e.g. combination of anaerobic digestion and composting in practice; demonstration project in Hamburgs city quarter Jenfelder Au)

The lectures will be accompanied by technical tours. Optional it is also possible to visit more biorefinery lectures in the University of Hamburg (lectures in German only).
In the exercise students have the possibility to work in groups on a biorefinery project or to work on a student-specific task.

Literature:
Biorefineries - Industrial Process and Products - Status Qua and Future directions by Kamm, Gruber and Kamm (2010); Wiley VCH, available on-line in TUHH-library
Powerpoint-Präsentations / selected Publications / further recommendations depending on the actual developments
Industrial Biorefineries and White Biorefinery, by Pandey, Höfer, Larroche, Taherzadeh, Nampoothiri (Eds.); (2014 book development in progress)

Course: Biorefinery Technologie (Übung)

Lecturer:
Dr. Ina Körner

Language:
EN

Cycle:
WS

Content:
1.) Selection of a topic within the thematic area "Biorefinery Technologie" from a given list or self-selected.
2.) Self-dependent recherches to the topic.
3.) Preparation of a written elaboration.
4.) Presentation of the results in the group.

Literature:
Vom Thema abhängig. Eigene Recherchen nötig.
Depending on the topic. Own recheches necassary.

Course: Bioresource Management (Vorlesung)

Lecturer:
Dr. Ina Körner

Language:
EN

Cycle:
WS

Content:
In the context of limited fossil resources, climate change mitigation and increasing population growth, Bioresources has a special role. They have to feed the population and in the same time they are important for material production such as pulp and paper or construction materials. Moreover they become more and more important in chemical industry and in energy provision as fossil substitution. Although Bioresources are renewable, they are also considered as limited resources. The availability of land on our planet is the main limitation factor. The sustainable and reliable supply of non-food biomass feedstock is a critical for successful and long term perspective on production of bioenergy and other bio-based products. As the consequence, the increasing competition and shortages continue to happen at the traditional sectors. On the other side, huge unused but potentials residue on waste and wastewater sector exist. Nowadays, a lot of activities to develop better processes, to create new bio-based products in order to become more efficient, the inclusion of secondary and tertiary bio-resources in the valorisation chain are going on.
The lecture deals with the current state-of-the-art of bioresource management. It shows deficits and potentials for improvement especially in the sector of utilization of organic residues for material and energy generation:
Lectures on:

- Bioresource generation and utilization including lost potentials today
- Basic biological, mechanical, physico-chemical and logistical processes
- The conflict of material vs. energy generation from wood / waste wood
- The basics of pulp & paper production including waste paper recycling
- The Pros and Cons from biogas and compost production

Special lectures by invited guests from research and practice:

- Pathways of waste organics on the example of Hamburg`s City Cleaning Company
- Utilization options of landscaping materials on the example of grass

- Increase of process efficiency of anaerobic digestions
- Decision support tools on the example of an municipality in Indonesia

Optional: Technical visits

Literature:
Power-Point presentations in STUD-IP

Course: Bioresource Management (Übung)

Lecturer:
Dr. Ina Körner

Language:
EN

Cycle:
WS

Content:
In the context of limited fossil resources, climate change mitigation and increasing population growth, Bioresources has a special role. They have to feed the population and in the same time they are important for material production such as pulp and paper or construction materials. Moreover they become more and more important in chemical industry and in energy provision as fossil substitution. Although Bioresources are renewable, they are also considered as limited resources. The availability of land on our planet is the main limitation factor. The sustainable and reliable supply of non-food biomass feedstock is a critical for successful and long term perspective on production of bioenergy and other bio-based products. As the consequence, the increasing competition and shortages continue to happen at the traditional sectors. On the other side, huge unused but potentials residue on waste and wastewater sector exist. Nowadays, a lot of activities to develop better processes, to create new bio-based products in order to become more efficient, the inclusion of secondary and tertiary bio-resources in the valorisation chain are going on.
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- Increase of process efficiency of anaerobic digestions
- Decision support tools on the example of an municipality in Indonesia

Optional: Technical visits

Literature:
Power-Point presentations in STUD-IP

Module: Project Work JEMES

Courses:

Title	Typ	Hrs/wk
Projekt Work JEMES	Projektseminar	2

Module Responsibility:
Dozenten des Studiengangs

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
12 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 332, Study Time in Lecture: 28

Assignment for the Following Curricula:
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory

Course: Projekt Work JEMES (Projektseminar)

Lecturer:
Dozenten des Studiengangs

Language:
EN

Cycle:
WS/SS

Content:

Literature:

Specialisation Water

Module: Water Protection

Courses:

Title	Typ	Hrs/wk
Geo-Information-Systems in Water Management and Hydraulic Engineering	Problemorientierte Lehrveranstaltung	1
Water Protection and Wastewater Management	Vorlesung	2
Water Protection and Wastewater Management	Hörsaalübung	1

Module Responsibility:
Prof. Stephan Köster

Admission Requirements:
none

Recommended Previous Knowledge:

- Basic knowledge in water management;
- Good knowledge in urban drainage;
- Good knowledge of wastewater treatment techniques;
- Good knowledge of pollutants (e.g. COD, BOD, TS, N, P) and their properties;

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students can describe the basic principles of the regulatory framework related to the international and European water sector. They can explain limnological processes, substance cycles and water morphology in detail. Thereby they are able to assess complex water related problems. Finally, the students can demonstrate to achieve significant improvements in the full range of existing water quality problems. They are able to judge environmental and wastewater related issues and to widely consider innovative solutions, remediation measures and further interventions as well as conceptual problem solving approaches.

Capabilities:
Students can accurately assess current problems and situations in a country-specific or local context. They can suggest concrete actions to contribute to the planning of tomorrow's urban water cycle. Furthermore, they can suggest appropriate technical, administrative and legislative solutions to solve these problems.

Personal Competence:
Social Competence:
The students can work together in international groups.

Autonomy:
Students are able to organize their work flow to prepare themselves before presentations and discussion. They can acquire appropriate knowledge by making enquiries independently.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Civil Engineering: Vertiefung Structural Engineering: Compulsory suffrage
Civil Engineering: Vertiefung Geotechnical Engineering: Compulsory suffrage
Civil Engineering: Vertiefung Coastal Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Water: Compulsory suffrage
International Management and Engineering: Vertiefung II. Civil Engineering: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory
Water and Environmental Engineering: Vertiefung Environment: Compulsory
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Geo-Information-Systems in Water Management and Hydraulic Engineering (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Peter Fröhle

Language:
DE/EN

Cycle:
WS

Content:
Theoretical basics of Geo-Information-Systems

- Data models, geographical coordinates, geo-referencing, map-views
- Data mining and – analyses of geo-data
- Analysis techniques

Literature:
None

Course: Water Protection and Wastewater Management (Vorlesung)

Lecturer:
Prof. Stephan Köster

Language:
EN

Cycle:
WS

Content:
The lecture focusses on:

- Regulatory Framework (e.g. WFD)
- Main instruments for the water management and protection
- In depth knowledge of relevant measures of water pollution control
- Urban drainage, treatment options in different regions on the world
- Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration
- Case Studies and Field Trips

Literature:
The literature listed below is available in the library of the TUHH.

- Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.
- Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). . New York, NY: McGraw-Hill.
- Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course: Water Protection and Wastewater Management (Übung)

Lecturer:
Prof. Stephan Köster

Language:
EN

Cycle:
WS

Content:
The lecture focusses on:

- Regulatory Framework (e.g. WFD)
- Main instruments for the water management and protection
- In depth knowledge of relevant measures of water pollution control
- Urban drainage, treatment options in different regions on the world
- Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration
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- Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). . New York, NY: McGraw-Hill.

- Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Module: Membrane Technology

Courses:

Title	Typ	Hrs/wk
Membrane Technology	Vorlesung	2
Membrane Technology	Gruppenübung	1
Membrane Technology	Laborpraktikum	1

Module Responsibility:
Prof. Mathias Ernst

Admission Requirements:
Bachelor's degree

Recommended Previous Knowledge:
Basic knowledge of water chemistry. Knowledge of the core processes involved in water, gas and steam treatment

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students will be able to rank the technical applications of industrially important membrane processes. They will be able to explain the different driving forces behind existing membrane separation processes. Students will be able to name materials used in membrane filtration and their advantages and disadvantages. Students will be able to explain the key differences in the use of membranes in water, other liquid media, gases and in liquid/gas mixtures.
Capabilities:
Students will be able to prepare mathematical equations for material transport in porous and solution-diffusion membranes and calculate key parameters in the membrane separation process. They will be able to handle technical membrane processes using available boundary data and provide recommendations for the sequence of different treatment processes. Through their own experiments, students will be able to classify the separation efficiency, filtration characteristics and application of different membrane materials. Students will be able to characterise the formation of the fouling layer in different waters and apply technical measures to control this.

Personal Competence:
Social Competence:
Students will be able to work in diverse teams on tasks in the field of membrane technology. They will be able to make decisions within their group on laboratory experiments to be undertaken jointly and present these to others.
Autonomy:
Students will be in a position to solve homework on the topic of membrane technology independently. They will be capable of finding creative solutions to technical questions.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Bioprocess Engineering: Vertiefung B - Industrial Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Energy and Environmental Engineering: Vertiefung Energy and Environmental Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Membrane Technology (Vorlesung)

Lecturer:
Prof. Mathias Ernst

Language:
EN

Cycle:
WS

Content:

The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane materials and the characterization of membrane material by simple methods and advanced analysis. The functions, advantages and drawbacks of different membrane housings and modules are explained. Students learn how an industrial membrane application is designed in the succession of treatment steps like pre-treatment, water conditioning, membrane integration and post-treatment of water. Besides theory, the students will be provided with knowledge on membrane demo-site examples and insights in industrial practice.

Literature:

- T. Melin, R. Rautenbach: Membranverfahren: Grundlagen der Modul- und Anlagenauslegung (2., erweiterte Auflage), Springer-Verlag, Berlin 2004.
- Marcel Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, Dordrecht, The Netherlands
- Richard W. Baker, Membrane Technology and Applications, Second Edition, John Wiley & Sons, Ltd., 2004

Course: Membrane Technology (Übung)

Lecturer:
Prof. Mathias Ernst

Language:
EN

Cycle:
WS

Content:

The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane materials and the characterization of membrane material by simple methods and advanced analysis. The functions, advantages and drawbacks of different membrane housings and modules are explained. Students learn how an industrial membrane application is designed in the succession of treatment steps like pre-treatment, water conditioning, membrane integration and post-treatment of water. Besides theory, the students will be provided with knowledge on membrane demo-site examples and insights in industrial practice.

Literature:

- T. Melin, R. Rautenbach: Membranverfahren: Grundlagen der Modul- und Anlagenauslegung (2., erweiterte Auflage), Springer-Verlag, Berlin 2004.
- Marcel Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, Dordrecht, The Netherlands
- Richard W. Baker, Membrane Technology and Applications, Second Edition, John Wiley & Sons, Ltd., 2004

Course: Membrane Technology (Laborpraktikum)

Lecturer:
Prof. Mathias Ernst

Language:
EN

Cycle:
WS

Content:

The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and

manufacturing of different membrane materials and the characterization of membrane material by simple methods and advanced analysis. The functions, advantages and drawbacks of different membrane housings and modules are explained. Students learn how an industrial membrane application is designed in the succession of treatment steps like pre-treatment, water conditioning, membrane integration and post-treatment of water. Besides theory, the students will be provided with knowledge on membrane demo-site examples and insights in industrial practice.

Literature:

- T. Melin, R. Rautenbach: Membranverfahren: Grundlagen der Modul- und Anlagenauslegung (2., erweiterte Auflage), Springer-Verlag, Berlin 2004.
- Marcel Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, Dordrecht, The Netherlands
- Richard W. Baker, Membrane Technology and Applications, Second Edition, John Wiley & Sons, Ltd., 2004

Module: Process Modeling in Water Technology

Courses:

Title	Typ	Hrs/wk
Process Modelling of Wastewater Treatment	Problemorientierte Lehrveranstaltung	2
Process Modeling in Drinking Water Treatment	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Dr. Klaus Johannsen

Admission Requirements:
none

Recommended Previous Knowledge:
Knowledge of the most important processes in drinking water and waste water treatment.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to explain selected processes of drinking water and waste water treatment in detail. They are able to explain basics as well as possibilities and limitations of dynamic modeling.
Capabilities:
Students are able to use the most important features Modelica offers. They are able to transpose selected processes in drinking water and waste water treatment into a mathematical model in Modelica with respect to equilibrium, kinetics and mass balances. They are able to set up and apply models and assess their possibilities and limitations.

Personal Competence:
Social Competence:
Students are able to solve problems and document solutions in a group with members of different technical background. They are able to give appropriate feedback and can work constructively with feedback concerning their work.

Autonomy:
Students are able to define a problem, gain the required knowledge and set up a model.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Environmental Engineering: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Process Modelling of Wastewater Treatment (Problemorientierte Lehrveranstaltung)

Lecturer:
Dr. Joachim Behrendt

Language:
DE/EN

Cycle:
WS

Content:
Mass and energy balances
Tracer modelling
Activated Sludge Model
Wastewater Treatment Plant Modelling (continously and SBR)
Sludge Treatment (ADM, aerobic autothermal)
Biofilm Modelling

Literature:
Henze, Mogens (Seminar on Activated Sludge Modelling, ; Kollekolle Seminar on Activated Sludge Modelling, ;)
Activated sludge modelling : processes in theory and practice ; selected proceedings of the 5th Kollekolle Seminar on Activated Sludge

Modelling, held in Kollekolle, Denmark, 10 - 12 September 2001
ISBN: 1843394146
[London] : IWA Publ., 2002
TUB_HH_Katalog
Henze, Mogens
Activated sludge models ASM1, ASM2, ASM2d and ASM3
ISBN: 1900222248
London : IWA Publ., 2002
TUB_HH_Katalog
Henze, Mogens
Wastewater treatment : biological and chemical processes
ISBN: 3540422285 (Pp.)
Berlin [u.a.] : Springer, 2002
TUB_HH_Katalog
Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;)
Fundamentals of biological wastewater treatment
ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm
Weinheim : WILEY-VCH, 2007
TUB_HH_Katalog

Course: Process Modeling in Drinking Water Treatment (Problemorientierte Lehrveranstaltung)

Lecturer:
Dr. Klaus Johannsen

Language:
DE/EN

Cycle:
WS

Content:
In this course selected drinking water treatment processes (e.g. aeration or activated carbon adsorption) are modeled dynamically using the programming language Modelica, that is increasingly used in industry. In this course OpenModelica is used, an free access frontend of the programming language Modelica.
In the beginning of the course the use of OpenModelica is explainded by means of simple examples. Together required elements and structure of the model are developed. The implementation in OpenModelica and the application of the model is done individually or in groups respectively. Students get feedback and can gain extra points for the exam.

Literature:
OpenModelica: https://openmodelica.org/index.php/download/download-windows
OpenModelica – Modelica Tutorial: https://openmodelica.org/index.php/useresresources/userdocumentation
OpenModelica – Users Guide: https://openmodelica.org/index.php/useresresources/userdocumentation
Peter Fritzson: Principles of Object-Oriented Modeling and Simulation with Modelica 2.1,Wiley-IEEE Press, ISBN 0-471-471631.
MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005.
Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996.
DVGW (Hrsg.): Wasseraufbereitung – Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.

Courses:

Title	Typ	Hrs/wk
Integrated Pollution Control	Vorlesung	2
Health, Safety and Environmental Management	Vorlesung	2
Exercise Health, Safety and Environmental Management	Gruppenübung	1

Module Responsibility:
Prof. Stephan Köster

Admission Requirements:
none

Recommended Previous Knowledge:

- Environmental Technologies
- Environmental Legislation
- Environmental Assessment

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to describe the basics of regulations, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.

Capabilities:
Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.

Personal Competence:
Social Competence:
The students can work together in international groups.

Autonomy:
Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Energy and Environmental Engineering: Vertiefung Environmental Engineering: Compulsory suffrage
Environmental Engineering: Kernqualifikation: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage
Product Development, Materials and Production: Vertiefung Product Development: Compulsory suffrage
Product Development, Materials and Production: Vertiefung Production: Compulsory suffrage
Product Development, Materials and Production: Vertiefung Materials: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory
Water and Environmental Engineering: Vertiefung Cities: Compulsory

Course: Integrated Pollution Control (Vorlesung)

Lecturer:
Prof. Stephan Köster

Language:
EN

Cycle:
WS

Content:
The lecture focusses on:

- The Regulatory Framework
- Pollution & Impacts, Characteristics of Pollutants
- Approaches of Integrated Pollution Control
- Sevilla Process, Best Available Technologies & BREF Documents
- Case Studies: paper industry, cement industry, automotive industry
- Field Trip

Literature:

Course: Health, Safety and Environmental Management (Vorlesung)

Lecturer:
Dr. Constantin Stephan

Language:
EN

Cycle:
WS

Content:
Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace Crisis management

Literature:
C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315)

Course: Exercise Health, Safety and Environmental Management (Übung)

Lecturer:
Dr. Constantin Stephan

Language:
EN

Cycle:
WS

Content:
Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace Crisis management

Literature:
C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

Module: Analytical Methods and Treatment Technologies for Wastewaters

Courses:

Title	Typ	Hrs/wk
Low-Cost Procedures for Water and Wastewater Analysis	Vorlesung	2
Physico-Chemical Water Treatment	Vorlesung	2

Module Responsibility:
Dr. Holger Gulyas

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamental knowledge in chemistry and physics

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students know some non-biological processes for the treatment of water and wastewater as well as the fundamentals of mass transfer which is essential for many treatment processes. They have knowledge about analytical procedures which can be applied even without the availability of a laboratory and which are useful for evaluating the performance of (waste)water treatment processes and the assessment of surface water quality in an economically feasible way.
Capabilities:
The students are able to select suitable processes for the treatment of wastewaters with respect to their characteristics. They can evaluate the efforts and costs for analytical procedures for the characterization of waters/wastewaters and select economically feasible analytical procedures.

Personal Competence:
Social Competence:
The students have the competence to plan and to perform wastewater analyses together with colleagues in small groups and to efficiently distribute the respective tasks within the group.
Autonomy:
The students are capable to make their own decisions with respect to the selection of suitable water/wastewater treatment processes as well as economically feasible analytical procedures for water/wastewater characterization.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Energy and Environmental Engineering: Vertiefung Energy and Environmental Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Low-Cost Procedures for Water and Wastewater Analysis (Vorlesung)

Lecturer:
Dr. Holger Gulyas

Language:
EN

Cycle:
WS

Content:
1 Introduction
2 Costing of wastewater and water analyses
3 Parameters routinely measured in municipal wastewater effluents
4 Surrogate parameters
5 Field methods

6 Basic laboratory instruments and equipment
6.1 Balances
6.2 Volumetric dosing instruments
6.3 Photometer
6.3.1 General
6.3.2 Principle of photometry
6.3.3 Elements of a photometer
6.4 Deionised water supply
6.5 Safety equipment
7 Inorganic parameters
7.1 Inorganic parameters by probes/electrodes
7.1.1 Dissolved oxygen
7.1.1.1 Polarographic measurement of dissolved oxygen
7.1.1.2 Optical probe for measuring dissolved oxygen utilising luminescence quenching of oxygen
7.1.1.3 Titrimetric determination of dissolved oxygen
7.1.2 pH
7.1.3 Alkalinity
7.1.4 Electric conductivity/salinity
7.2 Nitrogen and phosphorus compounds (nutrients)
7.2.1 Colorimetric methods without expensive instruments
7.2.2 Reflectometric methods
7.2.3 Photometric methods
8 Particles in water and wastewater
9 Organic sum parameters
9.1 Overview
9.2 Chemical Oxygen Demand: Why to avoid COD analyses by the dichromate method?
9.3 TOC cuvette tests
9.4 Absorption of UV light (254 nm) as a surrogate parameter for COD
9.5 Volatile Solids as surrogate for COD
9.6 Biological oxygen demand
10 Microbiological parameters determined in a low-cost way
11 Toxicity toward activated sludge

Literature:
Skript auf StudIP

Course: Physico-Chemical Water Treatment (Vorlesung)

Lecturer:
Dr. Holger Gulyas

Language:
EN

Cycle:
WS

Content:
- Stripping
- Evaporation
- Wastewater Incineration
- Wet Air Oxidation
- Ozonation
- Advanced Oxidation Processes

Literature:
Physical-Chemical Treatment of Water and Wastewater, A.P. Sincero, G.A. Sincero, CRC Press, Boca Raton 2003;
Handbook of Separation Techniques for Chemical Engineers, P.A. Schweitzer, ed., McGraw-Hill, New York 1988
Perry´s Chemical Engineers´ Handbook, R.H. Perry, D.W. Green, J.O. Maloney, eds., McGraw-Hill, New York 1984
Chemical Engineering, Vol. 2, J.M. Coulson, J.F. Richardson, Pergamon Press, Oxford 1991
Ozone in Water Treatment, B. Langlais, D.A. Reckhow, D.R. Brink, eds., Lewis Publishers, Chelsea 1991

Module: Project Work/Seminar Cities

Courses:

Title	Typ	Hrs/wk
Project Work/Seminar Cities	Projektseminar	2

Module Responsibility:
Dozenten des SD B

Admission Requirements:
none

Recommended Previous Knowledge:

- Basics of Urban Planning
- Urban Infrastructures (Water, Energy, Heat)
- Environmental Technologies (Solid Waste Disposal, Air Quality Control, Wastewater Treatement, etc.)

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
The students are able to demonstrate their detailed knowledge in the field of Water and Environmental Engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.
The students can develop solving strategies and approaches for fundamental and practical problems in the field of Water and Environmental Engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society.
Scientific work techniques that are used can be described and critically reviewed.

Capabilities:
The students are able to independently select methods or planning approaches for the project work and to justify their choice. They can explain how these methods or approaches relate to solutions in the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.

Personal Competence:
Social Competence:
The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.

Autonomy:
The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 152, Study Time in Lecture: 28

Assignment for the Following Curricula:
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory

Course: Project Work/Seminar Cities (Projektseminar)

Lecturer:
Dozenten des SD B

Language:
DE/EN

Cycle:
WS

Content:
The problem is defined by a university teacher or on proposal by the student. Regularly, discussions with the supervisor take place. The project work ends with a final presentation.

Literature:

- Projektbezogene Bücher und Fachartikel.
- Project based books and scientific articles.

Module: Wasterwater Treatment and Air Pollution Abatement

Courses:

Title	Typ	Hrs/wk
Biological Wastewater Treatment	Vorlesung	2
Air Pollution Abatement	Vorlesung	2

Module Responsibility:
Dr. Ernst-Ulrich Hartge

Admission Requirements:

Recommended Previous Knowledge:
Basic knowledge of biology and chemistry
basic knowledge of solids process engineering and separation technology

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
After successful completion of the module students are able to

- name and explain biological processes for waste watter treatment,
- characterize waste water and sewage sludge
- discuss legal regulations in the area of emissions and air quality
- classify off gas tretament processes and to define their area of application

Capabilities:
Students are able to

- choose and design processs steps for the biological waste water treatment
- combine processes for cleaning of off-gases depending on the pollutants contained in the gases

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 124, Study Time in Lecture: 56

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Energy and Environmental Engineering: Vertiefung Environmental Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Waste and Energy: Compulsory suffrage
International Management and Engineering: Vertiefung II. Energy and Environmental Engineering: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory
Water and Environmental Engineering: Vertiefung Cities: Compulsory

Course: Biological Wastewater Treatment (Vorlesung)

Lecturer:
Dr. Joachim Behrendt

Language:
DE/EN

Cycle:
WS

Content:
Charaterisation of Wastewater
Metobolism of Microorganisms
Kinetic of mirobiotic processes

Calculation of bioreactor for wastewater treatment
Concepts of Wastewater treatment
Design of WWTP
Excursion to a WWTP
Biofilms
Biofim Reactors
Anaerobic Wastewater and sldge treatment
resources oriented sanitation technology
Future challenges of wastewater treatment

Literature:

Gujer, Willi
Siedlungswasserwirtschaft : mit 84 Tabellen
ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv?id=2842122&prov=M&dok_var=1&dok_ext=htm
Berlin [u.a.] : Springer, 2007
TUB_HH_Katalog
Henze, Mogens
Wastewater treatment : biological and chemical processes
ISBN: 3540422285 (Pp.)
Berlin [u.a.] : Springer, 2002
TUB_HH_Katalog
Imhoff, Karl (Imhoff, Klaus R.;)
Taschenbuch der Stadtentwässerung : mit 10 Tafeln
ISBN: 3486263331 ((Gb.))
München [u.a.] : Oldenbourg, 1999
TUB_HH_Katalog
Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;)
Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft
ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334
Donaueschingen-Pfohren : Mall-Beton-Verl., 2000
TUB_HH_Katalog
Mudrack, Klaus (Kunst, Sabine;)
Biologie der Abwasserreinigung : 18 Tabellen
ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903
Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003
TUB_HH_Katalog
Tchobanoglous, George (Metcalf & Eddy, Inc., ;)
Wastewater engineering : treatment and reuse
ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk))
Boston [u.a.] : McGraw-Hill, 2003
TUB_HH_Katalog
Henze, Mogens
Activated sludge models ASM1, ASM2, ASM2d and ASM3
ISBN: 1900222248
London : IWA Publ., 2002
TUB_HH_Katalog
Kunz, Peter
Umwelt-Bioverfahrenstechnik
Vieweg, 1992
Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall, ;)
Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe aus der Abwasserbehandlung, Kleinkläranlagen
ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL: http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf
Weimar : Universitätsverl, 2006
TUB_HH_Katalog
Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall
DWA-Regelwerk
Hennef : DWA, 2004
TUB_HH_Katalog
Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;)
Fundamentals of biological wastewater treatment
ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm
Weinheim : WILEY-VCH, 2007
TUB_HH_Katalog

Course: Air Pollution Abatement (Vorlesung)

Lecturer:

Dr. Ernst-Ulrich Hartge

Language:
EN

Cycle:
WS

Content:
In the lecture methods for the reduction of emissions from industrial plants are treated. At the beginning a short survey of the different forms of air pollutants is given. In the second part physical principals for the removal of particulate and gaseous pollutants form flue gases are treated. Industrial applications of these principles are demonstrated with examples showing the removal of specific compounds, e.g. sulfur or mercury from flue gases of incinerators.

Literature:
Handbook of air pollution prevention and control, Nicholas P. Cheremisinoff. - Amsterdam [u.a.] : Butterworth-Heinemann, 2002
Atmospheric pollution : history, science, and regulation, Mark Zachary Jacobson. - Cambridge [u.a.] : Cambridge Univ. Press, 2002
Air pollution control technology handbook, Karl B. Schnelle. - Boca Raton [u.a.] : CRC Press, c 2002
Air pollution, Jeremy Colls. - 2. ed. - London [u.a.] : Spon, 2002

Module: Resources Oriented Sanitation Systems

Courses:

Title	Typ	Hrs/wk
Rural Development in Different Climates	Vorlesung	2
Resources Oriented Sanitation: High and Low-Tech Options	Vorlesung	2
Resources Oriented Sanitation: High - and Low - Tech Options	Laborpraktikum	1

Module Responsibility:
Prof. Ralf Otterpohl

Admission Requirements:
Bachelor's degree

Recommended Previous Knowledge:
Basic knowledge of the global situation with rising poverty, soil degradation, lack of water resources and sanitation

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students can describe resources oriented wastewater systems mainly based on source control in detail. They can comment on techniques designed for reuse of water, nutrients and soil conditioners.
Students are able to discuss a wide range of proven approaches in Rural Development from and for many regions of the world.

Capabilities:
Students are able to design low-tech/low-cost sanitation, rural water supply, rainwater harvesting systems, measures for the rehabilitation of top soil quality combined with food and water security. Students can consult on the basics of soil building through "Holisitc Planned Grazing" as developed by Allan Savory.

Personal Competence:
Social Competence:
Autonomy:
Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.

ECTS-Credit points:
6 LP

Examination:
Schriftliche Ausarbeitung

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Energy and Environmental Engineering: Vertiefung Energy and Environmental Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Water: Compulsory suffrage
International Management and Engineering: Vertiefung II. Energy and Environmental Engineering: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage
Water and Environmental Engineering: Vertiefung Water: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Environment: Compulsory suffrage
Water and Environmental Engineering: Vertiefung Cities: Compulsory suffrage

Course: Rural Development in Different Climates (Vorlesung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
WS

Content:

- Small Breakout Groups on "Rural Development" and presentation of results
- Living Soil – THE key element of Rural Development
- Permaculture Principles of Rural Development
- Case Studies: Global Ecovillage Network, Complementary Currencies

- Going Further: The TUHH Toolbox for Rural Development
- Rainwater Harvesting, Participatory planning principles
- Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos
- EMAS Technologies, Hand-Pump and wells
- Practical Pump/Well-Building
- Seminar: Participants prepare and give short 5 min presentations “Best Practice cases in Rural Development”
- In Depth: Rural Drinking Water Supply (Dr. Bendinger)
- cont. Rural Drinking Water Supply (Dr. Bendinger)
- cont. Rural Drinking Water Supply (Dr. Bendinger)
- Exam

Literature:

- Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation: http://youtu.be/9hmkgn0nBgk
- Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press

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Course: Resources Oriented Sanitation: High and Low-Tech Options (Vorlesung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
WS

Content:

- Small Breakout Groups on “The horrific global situation in Sanitation ” and presentation of results
- Keynote lecture: Resources Oriented Sanitation around the World
- Participant Workshop: Video contest: Participants groups search, introduce, show and discuss excellent short water videos
- In Depth: Terra Preta Sanitation, an emerging concept based on historic global best practice in the Amazon Region
- Seminar: All participants prepare and give 10 min presentations (choice of topics)
- cont.
- cont.
- cont.
- Rehearsal and final panel discussion
- Exam

Literature:

- J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek)
- Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download)
- Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys

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Course: Resources Oriented Sanitation: High - and Low - Tech Options (Laborpraktikum)

Lecturer:
Dr. Holger Gulyas

Language:
EN

Cycle:
WS

Content:
- Construction of urine-diverting toilets
- Comparison of stored and fresh urine: ammonia concentration
- Comparison of stored and fresh urine: alkalinity

Literature:
Skript
Steven A. Esrey, Jean Gough, Dave Rapaport, Ron Sawyer, Mayling Simpson-Hébert, Jorge Vargas and Uno Winblad: Ecological Sanitation, SIDA, Stockholm 1998, http://www.ecosanres.org/pdf_files/Ecological_Sanitation.pdf

Module: Wastewater Systems and Reuse

Courses:

Title	Typ	Hrs/wk
Wastewater Systems - Collection, Treatment and Reuse	Vorlesung	2
Wastewater Systems - Collection, Treatment and Reuse	Hörsaalübung	1
Sustainable Water Management	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Ralf Otterpohl

Admission Requirements:
Bachelor's degree

Recommended Previous Knowledge:
Knowledge of water and wastewater management and the key processes involved in water and wastewater treatment.

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Students are able to outline key areas of the full range of treatment systems in water and waste water management, as well as their mutual dependence for sustainable water protection. They can describe relevant economic, environmental and social factors.
Capabilities:
Students are able to pre-design and explain the available water and wastewater treatment processes and the scope of their application in municipal and for some industrial treatment plants.

Personal Competence:
Social Competence:
Through partial PBL students have learned to research and to interact with other students on the subjects covered.
Autonomy:
Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.

ECTS-Credit points:
6 LP

Examination:
Klausur

Workload in Hours:
Indipendent Study Time: 110, Study Time in Lecture: 70

Assignment for the Following Curricula:
Environmental Engineering: Kernqualifikation: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory suffrage
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory suffrage

Course: Wastewater Systems - Collection, Treatment and Reuse (Vorlesung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
SS

Content:
•Understanding the global situation with water and wastewater
•Regional planning and decentralised systems
•Overview on innovative approaches
•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
•Mathematical Modelling of Nitrogen Removal
•Exercises with calculations and design

Literature:
Henze, Mogens:
Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
George Tchobanoglous, Franklin L. Burton, H. David Stensel:
Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy
McGraw-Hill, 2004 - 1819 pages

Course: Wastewater Systems - Collection, Treatment and Reuse (Übung)

Lecturer:
Prof. Ralf Otterpohl

Language:
EN

Cycle:
SS

Content:
•Understanding the global situation with water and wastewater
•Regional planning and decentralised systems
•Overview on innovative approaches
•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
•Mathematical Modelling of Nitrogen Removal
•Exercises with calculations and design

Literature:
Henze, Mogens:
Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
George Tchobanoglous, Franklin L. Burton, H. David Stensel:
Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy
McGraw-Hill, 2004 - 1819 pages

Course: Sustainable Water Management (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Mathias Ernst

Language:
EN

Cycle:
WS

Content:
The course provides knowledge on the sustainable treatment and management of the resource water. Used water is an alternative resource and can be recycled in any field of the urban water cycle after adequate treatment. The resulting water quality is the decisive issue. In the course the central quality parameters of drinking- as well as wastewater assessment will be presented and discussed. Moreover the legal frame for water reuse in the EU and examples from all over the world will be communicated. The students receive the task to develop a conceptual design study of an indirect potable reuse facility in given boundary conditions. To fulfill this task, the students will work in small groups representing a consulting firm. Later in the course the firms will present their concepts. In preparation to the team presentation further knowledge on alternative water resources and sustainable management will be provided. International case studies will be presented and discussed. Next to the communication of technical details, planning tools for the implementation of alternative water management will be given also Option for an effective public perception program of later water users.

Literature:

- Milestones in Water Reuse, V. Lazarova, T. Asano, A. Bahri, J. Anderson, IWA Publishing 2013
- Current UN World Water Development Reports
- Water Security for Better Lives, OECD Studie 2013
- PPT's provided during the course

Module: Project Work JEMES

Courses:

Title	Typ	Hrs/wk
Projekt Work JEMES	Projektseminar	2

Module Responsibility:
Dozenten des Studiengangs

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
12 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 332, Study Time in Lecture: 28

Assignment for the Following Curricula:
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Water: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung Energy: Compulsory

Course: Projekt Work JEMES (Projektseminar)

Lecturer:
Dozenten des Studiengangs

Language:
EN

Cycle:
WS/SS

Content:

Literature:

Specialisation _Mobility

Module: Projekt Work JEMES_Mobility

Courses:

Title	Typ	Hrs/wk
Projekt Work JEMES_Mobility	Projektseminar	2

Module Responsibility:
Dozenten des SD B

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
15 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 422, Study Time in Lecture: 28

Assignment for the Following Curricula:
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung _Mobility: Compulsory

Course: Projekt Work JEMES_Mobility (Projektseminar)

Lecturer:
Dozenten des SD B

Language:
EN

Cycle:
WS

Content:

Literature:

Module: Mobility JEMES (see Mobility Plan)

Courses:

Title	Typ	Hrs/wk

Module Responsibility:
Dozenten des SD B

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:
Capabilities:

Personal Competence:
Social Competence:
Autonomy:

ECTS-Credit points:
15 LP

Examination:
Projektarbeit

Workload in Hours:
Indipendent Study Time: 450, Study Time in Lecture: 0

Assignment for the Following Curricula:
Joint European Master in Environmental Studies - Cities and Sustainability: Vertiefung _Mobility: Compulsory

Thesis

Module: Master Thesis

Courses:

Title	Typ	Hrs/wk

Module Responsibility:
Professoren der TUHH

Admission Requirements:

Recommended Previous Knowledge:

Educational Objectives:
After taking part successfully, students have reached the following learning results:

Professional Competence:
Theoretical Knowledge:

- The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues.
- The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject, describing current developments and taking up a critical position on them.
- The students can place a research task in their subject area in its context and describe and critically assess the state of research.

Capabilities:
The students are able:

- To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.
- To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incompletely defined problems in a solution-oriented way.
- To develop new scientific findings in their subject area and subject them to a critical assessment.

Personal Competence:
Social Competence:
Students can

- Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way.
- Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding their own assessments and viewpoints convincingly.

Autonomy:
Students are able:

- To structure a project of their own in work packages and to work them off accordingly.
- To work their way in depth into a largely unknown subject and to access the information required for them to do so.
- To apply the techniques of scientific work comprehensively in research of their own.

ECTS-Credit points:
30 LP

Examination:
lt. FSPO

Workload in Hours:
Indipendent Study Time: 900, Study Time in Lecture: 0

Assignment for the Following Curricula:
Civil Engineering: Abschlussarbeit: Compulsory
Bioprocess Engineering: Abschlussarbeit: Compulsory
Chemical and Bioprocess Engineering: Abschlussarbeit: Compulsory
Computer Science: Abschlussarbeit: Compulsory
Electrical Engineering: Abschlussarbeit: Compulsory
Energy and Environmental Engineering: Abschlussarbeit: Compulsory
Energy Systems: Abschlussarbeit: Compulsory
Environmental Engineering: Abschlussarbeit: Compulsory
Aircraft Systems Engineering: Abschlussarbeit: Compulsory
Global Innovation Management: Abschlussarbeit: Compulsory
Computational Science and Engineering: Abschlussarbeit: Compulsory
Information and Communication Systems: Abschlussarbeit: Compulsory
International Management and Engineering: Abschlussarbeit: Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Abschlussarbeit: Compulsory

Logistics, Infrastructure and Mobility: Abschlussarbeit: Compulsory
Mechatronics: Abschlussarbeit: Compulsory
Biomedical Engineering: Abschlussarbeit: Compulsory
Microelectronics and Microsystems: Abschlussarbeit: Compulsory
Product Development, Materials and Production: Abschlussarbeit: Compulsory
Renewable Energies: Abschlussarbeit: Compulsory
Naval Architecture and Ocean Engineering: Abschlussarbeit: Compulsory
Ship and Offshore Technology: Abschlussarbeit: Compulsory
Theoretical Mechanical Engineering: Abschlussarbeit: Compulsory
Process Engineering: Abschlussarbeit: Compulsory
Water and Environmental Engineering: Abschlussarbeit: Compulsory