TUHH

Technische Universität Hamburg-Harburg

Module Manual

Master of Science

Chemical and Bioprocess Engineering

Winter Term 2014

Table of Contents

Program description

Content:

Core qualification

Module: Applied Thermodynamics: Thermodynamic Properties for Industrial Applications

Courses:

Title	Typ	Hrs/wk
Applied Thermodynamics: Thermodynamic Properties for Industrial Applications	Vorlesung	4
Applied Thermodynamics: Thermodynamic Properties for Industrial Applications	Gruppenübung	2

Module Responsibility:
Dr. Sven Jakobtorweihen

Admission Requirements:

Recommended Previous Knowledge:
Thermodynamics III

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

Professional Competence:
Theoretical Knowledge:
The students are capable to formulate thermodynamic problems and to specify possible solutions. Furthermore, they can describe the current state of research in thermodynamic property predictions.

Capabilities:
The students are capable to apply modern thermodynamic calculation methods to multi-component mixtures and relevant biological systems. They can calculate phase equilibria and partition coefficients by applying equations of state, gE models, and COSMO-RS methods. They can provide a comparison and a critical assessment of these methods with regard to their industrial relevance. The students are capable to use the software COSMOtherm and relevant property tools of ASPEN and to write short programs for the specific calculation of different thermodynamic properties. They can judge and evaluate the results from thermodynamic calculations/predictions for industrial processes.

Personal Competence:
Social Competence:
Students are capable to develop and discuss solutions in small groups; further they can translate these solutions into calculation algorithms.

Autonomy:
Students can rank the field of “Applied Thermodynamics” within the scientific and social context. They are capable to define research projects within the field of thermodynamic data calculation.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

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

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Applied Thermodynamics: Thermodynamic Properties for Industrial Applications (Vorlesung)

Lecturer:
Dr. Sven Jakobtorweihen, Prof. Ralf Dohrn

Language:
EN

Cycle:
WS

Content:

- Phase equilibria in multicomponent systems
- Partioning in biorelevant systems
- Calculation of phase equilibria in colloidal systems: UNIFAC, COSMO-RS (exercises in computer pool)
- Calculation of partitioning coefficients in biological membranes: COSMO-RS (exercises in computer pool)
- Application of equations of state (vapour pressure, phase equilibria, etc.) (exercises in computer pool)
- Intermolecular forces, interaction Potenitials
- Introduction in statistical thermodynamics

Literature:

Course: Applied Thermodynamics: Thermodynamic Properties for Industrial Applications (Übung)

Lecturer:
Dr. Sven Jakobtorweihen

Language:
EN

Cycle:
WS

Content:
exercises in computer pool, see lecture description for more details

Literature:

Module: Separation Technologies for Life Sciences

Courses:

Title	Typ	Hrs/wk
Chromatographic Separation Processes	Vorlesung	2
Unit Operations for Bio-Related Systems	Vorlesung	2
Unit Operations for Bio-Related Systems	Problemorientierte Lehrveranstaltung	2

Module Responsibility:
Prof. Irina Smirnova

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of Chemistry, Fluid Process Engineering, Thermal Separation Processes, Chemical Engineering, Chemical Engineering, Bioprocess Engineering
Basic knowledge in thermodynamics and in unit operations related to thermal separation processes

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

Professional Competence:
Theoretical Knowledge:
On completion of the module, students are able to present an overview of the basic thermal process technology operations that are used, in particular, in the separation and purification of biochemically manufactured products. Students can describe chromatographic separation techniques and classic and new basic operations in thermal process technology and their areas of use. In their choice of separation operation students are able to take the specific properties and limitations of biomolecules into consideration. Using different phase diagrams they can explain the principle behind the basic operation and its suitability for bioseparation problems.

Capabilities:
On completion of the module, students are able to assess the separation processes for bio- and pharmaceutical products that have been dealt with for their suitability for a specific separation problem. They can use simulation software to establish the productivity and economic efficiency of bioseparation processes. In small groups they are able to jointly design a downstream process and to present their findings in plenary and summarize them in a joint report.

Personal Competence:
Social Competence:
Students are able in small heterogeneous groups to jointly devise a solution to a technical problem by using project management methods such as keeping minutes and sharing tasks and information.

Autonomy:
Students are able to prepare for a group assignment by working their way into a given problem on their own. They can procure the necessary information from suitable literature sources and assess its quality themselves. They are also capable of independently preparing the information gained in a way that all participants can understand (by means of reports, minutes, and presentations).

ECTS-Credit points:
6 LP

Examination:
Klausur

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

Assignment for the Following Curricula:
Bioprocess Engineering: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Chromatographic Separation Processes (Vorlesung)

Lecturer:
Dr. Monika Johannsen

Language:
EN

Cycle:
WS

Content:

- Introduction: overview, history of chromatography, LC (HPLC), GC, SFC
- Fundamentals of linear (analytical) chromatography, retention time/factor, separation factor, peak resolution, band broadening, Van-Deemter equation
- Fundamentals of nonlinear chromatography, discontinuous and continuous preparative chromatography (annular, true moving bed - TMB, simulated moving bed - SMB)
- Adsorption equilibrium: experimental determination of adsorption isotherms and modeling
- Equipment for chromatography, production and characterization of chromatographic adsorbents
- Method development, scale up methods, process design, modeling of chromatographic processes, economic aspects
- Applications: e.g. normal phase chromatography, reversed phase chromatography, hydrophobic interaction chromatography, chiral chromatography, bioaffinity chromatography, ion exchange chromatography

Literature:

- Schmidt-Traub, H.: Preparative Chromatography of Fine Chemicals and Pharmaceutical Agents. Weinheim: Wiley-VCH (2005) - eBook
- Carta, G.: Protein chromatography: process development and scale-up. Weinheim: Wiley-VCH (2010)
- Guiochon, G.; Lin, B.: Modeling for Preparative Chromatography. Amsterdam: Elsevier (2003)
- Hagel, L.: Handbook of process chromatography: development, manufacturing, validation and economics. London ;Burlington, MA Academic (2008) - eBook

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Course: Unit Operations for Bio-Related Systems (Vorlesung)

Lecturer:
Prof. Irina Smirnova

Language:
EN

Cycle:
WS

Content:
Contents:

- Introduction: overview about the separation process in biotechnology and pharmacy
- Handling of multicomponent systems
- Adsorption of biologic molecules
- Crystallization of biologic molecules
- Reactive extraction
- Aqueous two-phase systems
- Micellar systems: micellar extraction and micellar chromatographie
- Electrophoresis
- Choice of the separation process for the specific systems

Learning Outcomes:

- Basic knowledge of separation processes for biotechnological and pharmaceutical processes
- Identification of specific features and limitations in bio-related systems
- Proof of economical value of the process

Literature:
"Handbook of Bioseparations", Ed. S. Ahuja
http://www.elsevier.com/books/handbook-of-bioseparations-2/ahuja/978-0-12-045540-9
"Bioseparations Engineering" M. R. Ladish
http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0471244767.html

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Course: Unit Operations for Bio-Related Systems (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Irina Smirnova

Language:
EN

Cycle:

WS

Content:

Contents:

- Introduction: overview about the separation process in biotechnology and pharmacy
- Handling of multicomponent systems
- Adsorption of biologic molecules
- Crystallization of biologic molecules
- Reactive extraction
- Aqueous two-phase systems
- Micellar systems: micellar extraction and micellar chromatographie
- Electrophoresis
- Choice of the separation process for the specific systems

Learning Outcomes:

- Basic knowledge of separation processes for biotechnological and pharmaceutical processes
- Identification of specific features and limitations in bio-related systems
- Proof of economical value of the process

Literature:

"Handbook of Bioseparations", Ed. S. Ahuja
http://www.elsevier.com/books/handbook-of-bioseparations-2/ahuja/978-0-12-045540-9
"Bioseparations Engineering" M. R. Ladish
http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0471244767.html

Module: Biocatalysis

Courses:

Title	Typ	Hrs/wk
Biocatalysis and Enzyme Technology	Vorlesung	2
Technical Biocatalysis	Vorlesung	2

Module Responsibility:
Prof. Andreas Liese

Admission Requirements:
Bachelor VT, BVT or equivalent

Recommended Previous Knowledge:
Knowledge of bioprocess engineering and process engineering at bachelor level

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

Professional Competence:
Theoretical Knowledge:
After successful completion of this course, students will be able to

- reflect a broad knowledge about enzymes and their applications in academia and industry
- have an overview of relevant biotransformations und name the general definitions

Capabilities:
After successful completion of this course, students will be able to

- understand the fundamentals of biocatalysis and enzyme processes and transfer this to new tasks
- know the several enzyme reactors and the important parameters of enzyme processes
- use their gained knowledge about the realisation of processes. Transfer this to new tasks
- analyse and discuss special tasks of processes in plenum and give solutions
- communicate and discuss in English

Personal Competence:
Social Competence:
After completion of this module, participants will be able to debate technical and biocatalytical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork.
Autonomy:
After completion of this module, participants will be able to solve a technical problem independently including a presentation of the results.

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: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Environmental Engineering: Vertiefung Biotechnology: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Biocatalysis and Enzyme Technology (Vorlesung)

Lecturer:
Prof. Andreas Liese

Language:
EN

Cycle:
WS

Content:
1. Introduction: Impact and potential of enzyme-catalysed processes in biotechnology.
2. History of microbial and enzymatic biotransformations.
3. Chirality - definition & measurement
4. Basic biochemical reactions, structure and function of enzymes.

5. Biocatalytic retrosynthesis of asymmetric molecules
6. Enzyme kinetics: mechanisms, calculations, multisubstrate reactions.
7. Reactors for biotransformations.

Literature:

- K. Faber: Biotransformations in Organic Chemistry, Springer, 5th Ed., 2004
- A. Liese, K. Seelbach, C. Wandrey: Industrial Biotransformations, Wiley-VCH, 2006
- R. B. Silverman: The Organic Chemistry of Enzyme-Catalysed Reactions, Academic Press, 2000
- K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology. VCH, 2005.
- R. D. Schmidt: Pocket Guide to Biotechnology and Genetic Engineering, Woley-VCH, 2003

Course: Technical Biocatalysis (Vorlesung)

Lecturer:
Prof. Andreas Liese

Language:
EN

Cycle:
WS

Content:

1. Introduction
2. Production and Down Stream Processing of Biocatalysts
3. Analytics (offline/online)
4. Reaction Engineering & Process Control
   - Definitions
   - Reactors
   - Membrane Processes
   - Immobilization
5. Process Optimization
   - Simplex / DOE / GA
6. Examples of Industrial Processes
   - food / feed
   - fine chemicals
7. Non-Aqueous Solvents as Reaction Media
   - ionic liquids
   - scCO2
   - solvent free

Literature:

- A. Liese, K. Seelbach, C. Wandrey: Industrial Biotransformations, Wiley-VCH, 2006
- H. Chmiel: Bioprozeßtechnik, Elsevier, 2005
- K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, VCH, 2005
- R. D. Schmidt: Pocket Guide to Biotechnology and Genetic Engineering, Woley-VCH, 2003

Module: Process Systems Engineering and Transport Processes

Courses:

Title	Typ	Hrs/wk
Multiphase Flows	Vorlesung	2
Process Systems Engineering	Vorlesung	2
Heat & Mass Transfer in Process Engineering	Vorlesung	2

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:
none

Recommended Previous Knowledge:

- Fundamentals in Fluid Dynamics
- Fundamentals of Heat & Mass Transport
- Particle Technology
- Separation Technology
- Reactor Design and Operation
- Fundamentals of Process Control

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

Professional Competence:
Theoretical Knowledge:
The students are able to decribe the transport processes in single- and multiphase flows. They are able to explain the analogy between heat- and mass transfer as well as the limits of this analogy. The students are able to write down the main transport laws and their application as well as the limits of application.
Students are able to:

- describe how transport coefficients for heat- and mass transfer can be derived experimentally,
- define fundamentals of process synthesis and proces control,
- present and explain the hierarchical method of Douglas regarding process synthesis,
- interpret heat recovery systems,
- explain the pinch point method,
- illustrate the interactions in process control systems.

Capabilities:
Students are able to:

- use transport processes for the design of technical processes.
- utilize methods of process synthesis to develop a whole production process
- conduct a themal analysis of a process regarding the heat and cooling demands
- utilize the pinch point method
- develop ans evaluate a process control system

Personal Competence:
Social Competence:
The students are able to discuss in international teams in english and develop an approach under pressure of time.
Autonomy:
Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice. They are able to organize their own team and to define priorities.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

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

Assignment for the Following Curricula:
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory

Course: Multiphase Flows (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:

EN

Cycle:
WS

Content:

- Interfaces in MPF (boundary layers, surfactants)
- Hydrodynamics & pressure drop in Film Flows
- Hydrodynamics & pressure drop in Gas-Liquid Pipe Flows
- Hydrodynamics & pressure drop in Bubbly Flows
- Mass Transfer in Film Flows
- Mass Transfer in Gas-Liquid Pipe Flows
- Mass Transfer in Bubbly Flows
- Reactive mass Transfer in Multiphase Flows
- Film Flow: Application Trickle Bed Reactors
- Pipe Flow: Application Turbular Reactors
- Bubbly Flow: Application Bubble Column Reactors

Literature:

Brauer, H.: Grundlagen der Einphasen- und Mehrphasenströmungen. Verlag Sauerländer, Aarau, Frankfurt (M), 1971.
Clift, R.; Grace, J.R.; Weber, M.E.: Bubbles, Drops and Particles, Academic Press, New York, 1978.
Fan, L.-S.; Tsuchiya, K.: Bubble Wake Dynamics in Liquids and Liquid-Solid Suspensions, Butterworth-Heinemann Series in Chemical Engineering, Boston, USA, 1990.
Hewitt, G.F.; Delhaye, J.M.; Zuber, N. (Ed.): Multiphase Science and Technology. Hemisphere Publishing Corp, Vol. 1/1982 bis Vol. 6/1992.
Kolev, N.I.: Multiphase flow dynamics. Springer, Vol. 1 and 2, 2002.
Levy, S.: Two-Phase Flow in Complex Systems. Verlag John Wiley & Sons, Inc, 1999.
Crowe, C.T.: Multiphase Flows with Droplets and Particles. CRC Press, Boca Raton, Fla, 1998.

Course: Process Systems Engineering (Vorlesung)

Lecturer:
Prof. Georg Fieg

Language:
EN

Cycle:
WS

Content:
Introduction
Process Synthesis
Synthesis of Heat Recovery Systems
Process Control

Literature:

J. M. Douglas, Conceptual Design of Chemical Processes, McGraw-Hill, 1988
J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2001
T. McAvoy, Interaction Analysis, Instrument Society of Amerika, 1983
B.A. Ogunnaike, W.H. Ray, Process Dynamics, Modeling and Control, Oxford University Press, 1994

Course: Heat & Mass Transfer in Process Engineering (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
EN

Cycle:
WS

Content:

- Introduction - Transport Processes in Chemical Engineering
- Molecular Heat- and Mass Transfer: Applications of Fourier's and Fick's Law
- Convective Heat and Mass Transfer: Applications in Process Engineering
- Unsteady State Transport Processes: Cooling & Drying
- Transport at fluidic Interfaces: Two Film, Penetration, Surface Renewal
- Transport Laws & Balance Equations with turbulence, sinks and sources
- Experimental Determination of Transport Coefficients
- Design and Scale Up of Reactors for Heat- and Mass Transfer
- Reactive Mass Transfer
- Processes with Phase Changes – Evaporization and Condensation
- Radiative Heat Transfer - Fundamentals

- Radiative Heat Transfer - Solar Energy

Literature:

1. Baehr, Stephan: Heat and Mass Transfer, Wiley 2002.
2. Bird, Stewart, Lightfood: Transport Phenomena, Springer, 2000.
3. John H. Lienhard: A Heat Transfer Textbook, Phlogiston Press, Cambridge Massachusetts, 2008.
4. Myers: Analytical Methods in Conduction Heat Transfer, McGraw-Hill, 1971.
5. Incropera, De Witt: Fundamentals of Heat and Mass Transfer, Wiley, 2002.
6. Beek, Muttzall: Transport Phenomena, Wiley, 1983.
7. Crank: The Mathematics of Diffusion, Oxford, 1995.
8. Madhusudana: Thermal Contact Conductance, Springer, 1996.
9. Treybal: Mass-Transfer-Operation, McGraw-Hill, 1987.

Module: Particle Technology for International Master Programs

Courses:

Title	Typ	Hrs/wk
Particle Technology for IMP	Vorlesung	2
Practicle Course Particle Technology for IMP	Laborpraktikum	3

Module Responsibility:
Prof. Stefan Heinrich

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 list and to describe processes and unit-operations of solids process engineering,
- to describe the characterization of particles and explain particle distributions and their bulk properties.

Capabilities:
students are able to

- choose and design apparatuses and processes for solids processing according to the desired solids properties of the product
- assess solids with respect to their behavior in solids processing steps

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:
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory

Course: Particle Technology for IMP (Vorlesung)

Lecturer:
Prof. Stefan Heinrich

Language:
EN

Cycle:
WS

Content:

- Description of particles and particle distributions
- Description of a separation process
- Description of a particle mixture
- Particle size reduction
- Agglomeration, particle size enlargement
- Storage and flow of bulk solids
- Basics of fluid/particle flows
- classifying processes
- Separation of particles from fluids
- Basic fluid mechanics of fluidized beds
- Pneumatic and hydraulic transport

Literature:

- M. Rhodes: Introduction to Particle Technology, John Wiley & Sons, 1998
- M.E. Fayed & L. Otten: Handbook of Powder Science & Technology, 2nd Ed., Chapman & Hall, 1997
- M. Stieß: Mechanische Verfahrenstechnik 1, 2.Auflage, Springer-Verlag, 1995 (German)

- M. Stieß: Mechanische Verfahrenstechnik 2, Springer-Verlag, 1994 (German)

Course: Practicle Course Particle Technology for IMP (Laborpraktikum)

Lecturer:
Prof. Stefan Heinrich

Language:
EN

Cycle:
WS

Content:
Following experiments have to be carried out:

- Sieving
- Bulk properties
- Size reduction
- Mixing
- Gas cyclone
- Blaine-test, filtration
- Sedimentation

Literature:

- M. Rhodes: Introduction to Particle Technology, John Wiley & Sons, 1998
- M.E. Fayed & L. Otten: Handbook of Powder Science & Technology, 2nd Ed., Chapman & Hall, 1997
- M. Stieß: Mechanische Verfahrenstechnik 1, 2.Auflage, Springer-Verlag, 1995 (German)
- M. Stieß: Mechanische Verfahrenstechnik 2, Springer-Verlag, 1994 (German)

Module: Business & Management

Courses:

Title	Typ	Hrs/wk
Labour Law	Vorlesung	2
Business Model Generation & Green Technologies	Seminar	2
Corporate Entrepreneurship & Green Innovation	Seminar	2
E-Commerce	Vorlesung	2
Entrepreneurship & Green Technologies	Vorlesung	2
Intellectual Property	Vorlesung	2
Innovation Management	Vorlesung	2
International Law	Vorlesung	2
Internationalization Strategies	Vorlesung	2
Management and Leadership	Vorlesung	2
Entrepreneurial Management	Vorlesung	2
Marketing	Vorlesung	2
Project Management	Vorlesung	2
Project Management in Industrial Practice	Vorlesung	2
Risk Management	Vorlesung	2
Key Aspects of Patent Law	Seminar	2
Environmental Management and Corporate Responsibilty	Vorlesung	2
Management Consulting	Vorlesung	2
Entrepreneurial Business Creation	Problemorientierte Lehrveranstaltung	2
Managment of Trust and Reputation	Seminar	2
Methods of Systematic Product Development	Seminar	2
Public and Constitutional Law	Vorlesung	2

Module Responsibility:
Prof. Matthias Meyer

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:
6 LP

Examination:

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

Assignment for the Following Curricula:
Civil Engineering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
Energy Systems: Kernqualifikation: Compulsory
Environmental Engineering: Kernqualifikation: Compulsory
Aircraft Systems Engineering: Kernqualifikation: Compulsory
Computational Science and Engineering: Kernqualifikation: Compulsory

Information and Communication Systems: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Microelectronics and Microsystems: Kernqualifikation: Compulsory
Product Development, Materials and Production: Kernqualifikation: Compulsory
Renewable Energies: Kernqualifikation: Compulsory
Naval Architecture and Ocean Engineering: Kernqualifikation: Compulsory
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory
Water and Environmental Engineering: Kernqualifikation: Compulsory

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Course: Labour Law (Vorlesung)

Lecturer:
Dr. Walter Wellinghausen

Language:
DE

Cycle:
SS

Content:

- Contract of employment
- Conditions of work
- Employment protection
- Termination and cancellation of employment contracts
- Legal protection in disputes
- Rules governing compensation
- Accident and social security law
- Co-determination law
- Law governing disputes
- European employment law

Literature:
- Gesetzestexte zum Arbeitsrecht
- Rechtsprechung zum Arbeitsrecht
- Schaub: Arbeitsrechtshandbuch

Course: Business Model Generation & Green Technologies (Seminar)

Lecturer:
Dr. Michael Prange

Language:
EN

Cycle:
WS

Content:

- Overview about Green Technologies
- Introduction to Business Model Generation
- Business model patterns
- Design techniques for business ideas
- Strategy development
- Value proposition architecture
- Business plan and financing
- Component based foundations
- Lean Entrepreneurship

Based on examples and case studies primarily in the field of green technologies, students learn the basics of Business Model Generation and will be able to develop business models and to evaluate start up projects.

Literature:
Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung
Presentation slides, examples and case studies from the lecture

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Course: Corporate Entrepreneurship & Green Innovation (Seminar)

Lecturer:
Dr. Michael Prange

Language:
EN

Cycle:
SS

Content:

- Overview about Green Innovation
- Introduction to Corporate Entrepreneurship
- Entrepreneurial thinking in established companies
- Entrepreneurs and managers
- Strategic innovation processes
- Corporate Venturing
- Product Service Systems
- Open Innovation
- User Innovation

Based on examples and case studies primarily in the field of green innovation, students learn the basics of corporate entrepreneurship and will be able to implement entrepreneurial thinking in established companies and to describe strategic innovation processes.

Literature:
Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung
Presentation slides, examples and case studies from the lecture

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Course: E-Commerce (Vorlesung)

Lecturer:
Prof. Michael Ceyp

Language:
DE

Cycle:
SS

Content:
This lectures starts with an overview about the broad field of e-commerce. Then the relevant e-commerce systems, processes and management tasks are explained and discussed. Afterwards necessary online marketing instruments and their strength and weaknesses are defined to get traffic to an e-commerce shop. This lectures closes with a description of necessary steps for the e-commerce-implementation.

Literature:
Ceyp, M., Scupin, J-P. (2013), Erfolgreiches Social Media Marketing - Konzepte und Maßnahmen, Wiesbaden.
Fritz, W. (2004): Internet-Marketing und Electronic Commerce - Grundlagen-Rahmenbedingungen-Instrumente. 3. Aufl., Wiesbaden.
Heinemann, G. (2014), Der neue Online-Handel - Geschäftsmodell und Kanalexzellenz im E-Commerce, 5. Aufl, Wiesbaden.
Heinemann, G., (2012) Der neue Mobile-Commerce – Erfolgsfaktoren und Best Practices, Wiesbaden.
Kollmann, T. (2013): E-Business, 5. Aufl., Berlin.
Kreutzer, R. (2012), Praxisorientiertes Online-Marketing , Wiesbaden.
Meier, A./ Stormer, H.(2012): eBusiness &eCommerce - Management der digitalen Wertschöpfungskette, 3. Aufl., Berlin / Heidelberg.
Schwarze, J. (Hrsg) (2002): Electronic Commerce - Grundlagen und praktische Umsetzung, Herne /Berlin.
Wirtz, B.W.(2013): Electronic Business, 4. Aufl., Wiesbaden.

Course: Entrepreneurship & Green Technologies (Vorlesung)

Lecturer:
Dr. Michael Prange

Language:
DE/EN

Cycle:
WS/SS

Content:
The lecture "Entrepreneurship & Green Technologies" is offerend as an elective course for all master's programs at TUHH.
Based on examples and case studies primarily in the field of green technologies, students learn the basics of entrepreneurship and will be able to develop business models and to evaluate start-up projects.

Literature:
Präsentationsfolien, Beispiele und Fallstudien aus der Vorlesung
Presentation slides, examples and case studies from the lecture

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Course: Intellectual Property (Vorlesung)

Lecturer:
Dr. Frederik Thiering

Language:
DE

Cycle:
WS

Content:

- Trademark law
- Copyright
- Patent law
- Know-how, supplementary performance protection, et al.
- Enforcement of intellectual property rights
- Licensing of intellectual property rights
- Hypothecation, security assignment and evaluation of intellectual property rights

Literature:
Quellen und Materialen wird im Internet zur Verfügung gestellt

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Course: Innovation Management (Vorlesung)

Lecturer:
Prof. Cornelius Herstatt

Language:
DE

Cycle:
SS

Content:
Innovation is key to corporate growth and sustainibility. In this lecture Prof. Herstatt presents a systematic way from generating ideas to the successful implementation of innovations. **The lecture is presented in German language only**

Literature:

- Goffin, K., Herstatt, C. and Mitchell, R. (2009): Innovationsmanagement: Strategie und effektive Umsetzung von Innovationsprozessen mit dem Pentathlon-Prinzip, München: Finanzbuch Verlag

Weiterführende Literatur

- Innovationsmanagement
  Juergen Hauschildt
- F + E Management
  Specht, G. / Beckmann, Chr.
- Management der frühen Innovationsphasen
  Cornelius Herstatt, Birgit Verworn
  (im TUHH-Intranet auch als E-Book verfügbar)
- Bringing Technology and Innovation Into the Boardroom
- weitere Literaturempfehlungen auf Anfrage

Course: International Law (Vorlesung)

Lecturer:
Dr. Frederik Thiering

Language:
EN

Cycle:
SS

Content:

- What is International Law?
- Bidding on International Tenders
- Drafting the International Project Contract
- International Dispute Resolution
- Mergers and Acquisitions
- Obtaining worldwide protection for Intellectual Property
- International product launch
- International taxation
- Import Restrictions and Antidumping

Literature:
Quellen und Materialen wird im Internet zur Verfügung gestellt

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Course: Internationalization Strategies (Vorlesung)

Lecturer:
Prof. Thomas Wrona

Language:
EN

Cycle:
SS

Content:
- Introduction
- Internationalization of markets
- Measuring internationalization of firms
- Target market strategies
- Market entry strategies
- Timing strategies
- Allocation strategies
- Case Studies

Literature:
Bartlett/Ghoshal (2002): Managing Across Borders, The Transnational Solution, 2nd edition, Boston

- Buckley, P.J./Ghauri, P.N. (1998), The Internationalization of the Firm, 2nd edition
- Czinkota, Ronkainen, Moffett, Marinova, Marinov (2009), International Business, Hoboken
- Dunning, J.H. (1993), The Globalization of Business: The Challenge of the 1990s, London
- Ghoshal, S. (1987), Global Strategy: An Organizing Framework, Strategic Management Journal, p. 425-440
- Praveen Parboteeah, K.,Cullen, J.B. (2011) , Strategic International Management, International 5th Edition
- Rugman, A.M./Collinson, S. (2012): International Business, 6th Edition, Essex 2012

Course: Management and Leadership (Vorlesung)

Lecturer:
Prof. Christian Ringle

Language:
DE

Cycle:
SS

Content:

- definitions and foundations of strategic management
- strategic planning
- strategic analysis and forecast
- development of strategic options
- strategy evaluaton, implementation and strategic control

Literature:
- Bea, F.X.; Haas, J.: Strategisches Management, 5. Auflage, Stuttgart 2009.
- Dess, G. G.; Lumpkin, G. T.; Eisner, A. B.: Strategic management: Creating competitive advantages, Boston 2010
- Hahn, D.; Taylor, B.: Strategische Unternehmensplanung: Strategische Unternehmensführung, 9. Auflage, Heidelberg 2006.
- Hinterhuber, H.H.: Strategische Unternehmensführung Bd. 1: Strategisches Denken, 7. Aufl., Berlin u. a. 2004
- Hinterhuber, H.H.: Strategische Unternehmensführung Bd. 2: Strategisches Handeln, 7. Aufl., Berlin u. a. 2004
- Hungenberg, H.: Strategisches Management in Unternehmen, 6. Auflage, Wiesbaden 2011
- Johnson, G.; Scholes, K.; Whittington, R.: Strategisches Management. Eine Einführung, 9. Auflage, München 2011
- Macharzina, K.: Unternehmensführung: Das internationale Managementwissen, 7. Auflage, Wiesbaden 2010.
- Porter, M.E.: Competitive strategy, New York 1980 (deutsche Ausgabe: Wettbewerbsstrategie, 10. Aufl., Frankfurt am Main 1999)
- Welge, M. K.; Al-Laham, A.: Strategisches Management, 5. Auflage, Wiesbaden 2008.

Course: Entrepreneurial Management (Vorlesung)

Lecturer:
Prof. Christoph Ihl

Language:

EN

Cycle:
WS

Content:
This course introduces the fundamentals of technology entrepreneurship including its economic and cultural underpinnings. It highlights the differences between mere business ideas and scalable and repeatable business opportunities. It is designed to familiarize students with the process and all relevant entrepreneurial tools and concepts that technology entrepreneurs use to create business opportunities and to start companies. It involves taking a technology idea and finding a high-potential commercial opportunity, gathering resources such as talent and capital, figuring out how to sell and market the idea, and managing rapid growth. The course also discusses relevant concepts and tools from entrepreneurial strategy, such as disruptive innovations, technology adoption cycles and intellectual property, as well as from entrepreneurial marketing, such as product positioning and differentiation, distribution, promotion and pricing. Particular emphasis will be put on business model design and customer development proposed in the lean startup approach. Participants will learn a systematic process that technology entrepreneurs use to identify, create and exploit business opportunities. The students will also achieve knowledge and skills in the activities related with the start and the growth of new companies. All in all, the course is supposed to create the entrepreneurial mindset of looking for technology opportunities and business solutions, where others see insurmountable problems. This mindset of turning problems into opportunities can well be generalized from startups to larger companies and other settings.

- Develop a working knowledge and understanding of the entrepreneurial perspective
- Understand the difference between a good idea and scalable business opportunity
- Understand the process of taking a technology idea and finding a high-potential commercial opportunity
- Develop understanding of major elements of business models and how they are interrelated
- Understand the components of business opportunity assessment and business plans
- Develop understanding of major elements of business models and how they are interrelated
- Knowledge about appropriate evaluation criteria for business ideas
- Understanding of the basic building blocks of promising business models
- Knowledge about the key aspects of business models and planning:
  value proposition and target customer analysis
  market and competitive analysis, IP protection
  production, sourcing and partners
  legal form, cooperation contracts, liability issues
  financial planning

Literature:
Byers, T.H.; Dorf, R.C.; Nelson, A.J. (2011). Technology Ventures: From Idea to Enterprise. 3rd ed. McGraw-Hill, 2011.
Hisrich, P.; Peters, M. P.; Shepherd, D. A. (2009). Entrepreneurship, 8th ed., McGraw-Hill, 2009.
Osterwalder, A.; Yves, P. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons, 2010.

Course: Marketing (Vorlesung)

Lecturer:
Prof. Christian Lüthje

Language:
EN

Cycle:
WS

Content:
Contents
Basics of Marketing
The philosophy and fundamental aims of marketing. Contrasting different marketing fields (e.g. business-to-consumer versus business-to-business marketing). The process of marketing planning, implementation and controlling
Strategic Marketing Planning
How to find profit opportunities? How to develop cooperation, internationalization, timing, differentiation and cost leadership strategies?
Market-oriented Design of products and services
How can companies get valuable customer input on product design and development? What is a service? How can companies design innovative services supporting the products?
Pricing
What are the underlying determinants of pricing decision? Which pricing strategies should companies choose over the life cycle of products? What are special forms of pricing on business-to-business markets (e.g. competitive bidding, auctions)?
Marketing Communication
What is the role of communication and advertising in business-to-business markets? Why advertise? How can companies manage communication over advertisement, exhibitions and public relations?
Sales and Distribution
How to build customer relationship? What are the major requirements of industrial selling? What is a distribution channel? How to design and manage a channel strategy on business-to-business markets?

Knowledge

Students will gain an introduction and good overview of

- Specific challenges in the marketing of innovative goods and services
- Key strategic areas in strategic marketing planning (cooperation, internationalization, timing)
- Tools for information gathering about future customer needs and requirements
- Fundamental pricing theories and pricing methods
- Main communication instruments
- Marketing channels and main organizational issues in sales management
- Basic approaches for managing customer relationship

Skills
Based on the acquired knowledge students will be able to:

- Design market timing decisions
- Make decisions for marketing-related cooperation and internationalization activities
- Manage the challenges of market-oriented development of new products and services
- Translate customer needs into concepts, prototypes and marketable offers
- Determine the perceived quality of an existing product or service using advanced elicitation and measurement techniques that fit the given situation
- Analyze the pricing alternatives for products and services
- Make strategic sales decisions for products and services (i.e. selection of sales channels)
- Analyze the value of customers and apply customer relationship management tools

Social Competence
The students will be able to

- have fruitful discussions and exchange arguments
- present results in a clear and concise way
- carry out respectful team work

Self-reliance
The students will be able to

- Acquire knowledge independently in the specific context and to map this knowledge on other new complex problem fields.
- Consider proposed business actions in the field of marketing and reflect on them.

Literature:
Homburg, C., Kuester, S., Krohmer, H. (2009). Marketing Management, McGraw-Hill Education, Berkshire, extracts p. 31-32, p. 38-53, 406-414, 427-431
Bingham, F. G., Gomes, R., Knowles, P. A. (2005). Business Marketing, McGraw-Hill Higher Education, 3rd edition, 2004, p. 106-110
Besanke, D., Dranove, D., Shanley, M., Schaefer, S. (2007), Economics of strategy, Wiley, 3rd edition, 2007, p. 149-155
Hutt, M. D., Speh, T.W. (2010), Business Marketing Management, 10th edition, South Western, Lengage Learning, p. 112-116

Course: Project Management (Vorlesung)

Lecturer:
Prof. Carlos Jahn

Language:
EN

Cycle:
WS

Content:
The lecture “project management” aims at characterizing typical phases of projects. Important contents are: possible tasks, organization, techniques and tools for initiation, definition, planning, management and finalization of projects.

Literature:
Project Management Institute (2008): A guide to the project management body of knowledge (PMBOK® Guide). 4. Aufl. Newtown Square, Pa: Project Management Institute.

Course: Project Management in Industrial Practice (Vorlesung)

Lecturer:
Wilhelm Radomsky

Language:
DE

Cycle:
WS

Content:

- Project management in a company
- Project life cycle / Project environment
- Project structuring / Project planning
- Deployment of methods / Team development
- Contract / Risk / Change management
- Multi-project management / Quality management
- Project controlling / Reporting
- Project organization / Project conclusion

Literature:

• Brown (1998): Erfolgreiches Projektmanagement in 7 Tagen
• Burghardt (2002): Einführung in Projektmanagement
• Cleland / King (1997): Project Management Handbook
• Hemmrich, Harrant (2002): Projektmanagement, In 7 Schritten zum Erfolg
• Kerzner (2003): Projektmanagement
• Litke (2004): Projektmanagement
• Madauss (2005): Handbuch Projektmanagement
• Patzak / Rattay (2004): Projektmanagement
• PMI (2004): A Guide to the Project Management Body of Knowledge
• RKW / GPM: Projektmanagement Fachmann
• Schelle / Ottmann / Pfeiffer (2005): ProjektManager

Course: Risk Management (Vorlesung)

Lecturer:
Dr. Meike Schröder

Language:
DE

Cycle:
WS

Content:

Risks are inherent in every aspect of business, and the ability of managing risks is one important aspect that differentiates successful business leaders from others. There exist various categories of risk, such as credit, country, market, liquidity, operational, supply chain and reputational. Companies are vulnerable to risks. What makes such risks even more complex and challenging to manage is that the risks are often not within the direct control of the business executive. They can exist outside of the company boundary, and yet the impact to the company can be huge. The awareness and knowledge of how to manage risks in companies, will become increasingly important.
Some of the main topics covered in this lecture include:

- Targets and legal aspects of risk management
- Risks and their impact
- Risk types (classification)
- Risk management and human resource
- Steps of the risk management process and their instruments
- Methods of risk assessment
- Implementation of risk management
- Management of specific risks

This lecture is presented in German language only.

Literature:

Brühwiler, B., Romeike, F. (2010), Praxisleitfaden Risikomanagement. ISO 31000 und ONR 49000 sicher anwenden, Berlin: Erich Schmidt.
Cottin, C., Döhler, S. (2013), Risikoanalyse. Modellierung, Beurteilung und Management von Risiken mit Praxisbeispielen, 2. überarbeitete und erweiterte Aufl., Wiesbaden: Springer.
Eller, R., Heinrich, M., Perrot, R., Reif, M. (2010), Kompaktwissen Risikomanagement. Nachschlagen, verstehen und erfolgreich umsetzen, Wiesbaden: Gabler.
Fiege, S. (2006), Risikomanagement- und Überwachungssystem nach KonTraG. Prozess, Instrumente, Träger, Wiesbaden: Deutscher Universitäts-Verlag.
Frame, D. (2003), Managing Risk in organizations. A guide for managers, San Francisco: Wiley.
Götze, U., Henselmann, K., Mikus, B. (2001), Risikomanagement, Heidelberg: Physica-Verlag.
Müller, K. (2010), Handbuch Unternehmenssicherheit. Umfassendes Sicherheits-, Kontinuitäts- und Risikomanagement mit System, 2., neu bearbeitete Auflage, Wiesbaden: Springer.
Rosenkranz, F., Missler-Behr, M. (2005), Unternehmensrisiken erkennen und managen. Einführung in die quantitative Planung, Berlin u.a.: Springer.
Wengert, H., Schittenhelm F. A. (2013), Coporate Risk Mangement, Berlin: Springer.

Course: Key Aspects of Patent Law (Seminar)

Lecturer:
Prof. Christian Rohnke

Language:
DE

Cycle:
SS

Content:
Mayor Issues in Patent Law:
The seminar covers five mayor issues in german patent law, namely patentatbility, prosecution, ownership and employee inventions, infringement and licensing and other commercila uses.
The lecturer will give an introduction to each issue which will be followed by in-depth inquiry by the participants through group work, presentation of results and moderated discussion.

Literature:
wird noch bekannt gegeben

Course: Environmental Management and Corporate Responsibilty (Vorlesung)

Lecturer:
Prof. Heike Flämig

Language:
DE

Cycle:
SS

Content:

- Imparting knowledge on EMAS and ISO 14.001 as important methodological approaches for the integration of environmental and sustainability management in business companies
- Explaination of theoretical concepts of corporate sustainability management
- Imparting pracitical knowledge from different stakeholder views: consulting company, trading enterprise, NGO, financial market

Literature:
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Course: Management Consulting (Vorlesung)

Lecturer:
Gerald Schwetje

Language:
DE

Cycle:
SS

Content:
The Management Consulting lecture teaches students knowledge that is complementary to their technical and business administration studies. They learn the basics of consulting and agent-principal theory and are given an overview of the consulting market. They are also shown how management consulting works and which methodical building blocks (processes) are needed to deal with a client's concerns and to undertake a consulting process. By means of practical examples students gain an insight into the extensive range of management consultancy services and of functional consulting.

Literature:
Bamberger, Ingolf (Hrsg.): Strategische Unternehmensberatung: Konzeptionen – Prozesse – Methoden, Gabler Verlag, Wiesbaden 2008
Bansbach, Schübel, Brötzel & Partner (Hrsg.): Consulting: Analyse – Konzepte – Gestaltung, Stollfuß Verlag, Bonn 2008
Fink, Dietmar (Hrsg.): Strategische Unternehmensberatung, Vahlens Handbücher, München, Verlag Vahlen, 2009
Heuermann, R./Herrmann, F.: Unternehmensberatung: Anatomie und Perspektiven einer Dienstleistungselite, Fakten und Meinungen für Kunden, Berater und Beobachter der Branche, Verlag Vahlen, München 2003
Kubr, Milan: Management consulting: A guide to the profession, 3. Auflage, Geneva, International Labour Office, 1992
Küting, Karlheinz (Hrsg.): Saarbrücker Handbuch der Betriebswirtschaftlichen Beratung; 4. Aufl., NWB Verlag, Herne 2008
Nagel, Kurt: 200 Strategien, Prinzipien und Systeme für den persönlichen und unternehmerischen Erfolg, 4. Aufl., Landsberg/Lech, mi-Verlag, 1991
Niedereichholz, Christel: Unternehmensberatung: Beratungsmarketing und Auftragsakquisition, Band 1, 2. Aufl., Oldenburg Verlag, 1996
Niedereichholz; Christel: Unternehmensberatung: Auftragsdurchführung und Qualitätssicherung, Band 2, Oldenburg Verlag, 1997
Quiring, Andreas: Rechtshandbuch für Unternehmensberater: Eine praxisorientierte Darstellung der typischen Risiken und der zweckmäßigen Strategien zum Risikomanagement mit Checklisten und Musterverträgen, Vahlen Verlag, München 2005
Schwetje, Gerald: Ihr Weg zur effizienten Unternehmensberatung: Beratungserfolg durch eine qualifizierte Beratungsmethode, NWB Verlag, Herne 2013
Schwetje, Gerald: Wer seine Nachfolge nicht regelt, vermindert seinen Unternehmenswert, in: NWB, Betriebswirtschaftliche Beratung,

03/2011 und: Sparkassen Firmenberatung aktuell, 05/2011
Schwetje, Gerald: Strategie-Assessment mit Hilfe von Arbeitshilfen der NWB-Datenbank – Pragmatischer Beratungsansatz speziell für KMU: NWB, Betriebswirtschaftliche Beratung, 10/2011
Schwetje, Gerald: Strategie-Werkzeugkasten für kleine Unternehmen, Fachbeiträge, Excel-Berechnungsprogramme, Checklisten/Muster und Mandanten-Merkblatt: NWB, Downloadprodukte, 11/2011
Schwetje, Gerald: Die Unternehmensberatung als komplementäres Leistungsangebot der Steuerberatung - Zusätzliches Honorar bei bestehenden Klienten: NWB, Betriebswirtschaftliche Beratung, 02/2012
Schwetje, Gerald: Die Mandanten-Berater-Beziehung: Erfolgsfaktor Beziehungsmanagement, in: NWB Betriebswirtschaftliche Beratung, 08/2012
Schwetje, Gerald: Die Mandanten-Berater-Beziehung: Erfolgsfaktor Vertrauen, in: NWB Betriebswirtschaftliche Beratung, 09/2012
Wohlgemuth, Andre C.: Unternehmensberatung (Management Consulting): Dokumentation zur Vorlesung „Unternehmensberatung“, vdf Hochschulverlag, Zürich 2010

Course: Entrepreneurial Business Creation (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. Christoph Ihl

Language:
EN

Cycle:
WS

Content:
This course is supposed to provide intense hands-on experiences with the entrepreneurial process, tools and concepts discussed in the lecture “Entrepreneurship Management” and additional online material. At the beginning of the class, students form teams to search for and create a scalable and repeatable business opportunity. Rather than writing a comprehensive business plan or designing the perfect product, both of which are highly difficult and risky investments in the uncertain front end of any business idea, we follow a lean startup approach. Student teams will have to think about all the parts of building a business and apply the tools of business model design and customer & agile development in order optimize the search for and creation of a business opportunity. Students will start by mapping the assumptions regarding each of the part in their business model and then devote significant time on testing these hypotheses with customers and partners outside in the field (customer development). Based on the gathered information, students should realize which of their assumptions were wrong, and figure out ways how to fix it (learning events called “pivots”). The goal is to proceed in an iterative and incremental way (agile development) to build prototypes and (minimum viable) products. Throughout the course, student teams will present their lessons-learned (pivots) and how their business models have evolved based on their most important pivots. The course provides intense hands-on experience with the objective to develop the entrepreneurial mindset. This mindset of turning problems into opportunities can well be generalized from startups to innovative challenges in established companies and other innovative settings.

- assess and validate entrepreneurial opportunities, either for new venture creation or in the context of established corporations
- create and verify a business models to exploit entrepreneurial opportunities
- create and verify plans for gathering required resources such as talent and capital (startup) or employees and budgets (established firms)
- prepare comprehensive business plans
- identify and define business opportunities
- assess and validate entrepreneurial opportunities
- create and verify a business model of how to sell and market an entrepreneurial opportunity
- formulate and test business model assumptions and hypotheses
- conduct customer and expert interviews regarding business opportunities
- prepare business opportunity assessment
- create and verify a plan for gathering resources such as talent and capital
- pitch a business opportunity to your classmates and the teaching team
- team work
- communication and presentation
- give and take critical comments
- engaging in fruitful discussions
- autonomous work and time management
- project management
- analytical skills

Literature:
Blank, Steve (2013). Why the lean start-up changes everything. Harvard Business Review 91.5 (2013): 63-72.
Blank, Steven Gary, and Bob Dorf. The startup owner's manual: the step-by-step guide for building a great company. K&S Ranch, Incorporated, 2012.
Ries, Eric (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Random House LLC, 2011.

Course: Managment of Trust and Reputation (Seminar)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
SS

Content:
The seminar offers a comparison and analysis of relevant theoretical concepts and practical issues in the corporate management of trust and reputation. Selected case studies will be used to discuss opportunities, problems, and limitations using trust and reputation to coordinate and control economic behavior.

Literature:
Allgäuer, Jörg E. (2009): Vertrauensmanagement: Kontrolle ist gut, Vertrauen ist besser. Ein Plädoyer für Vertrauensmanagement als zentrale Aufgabe integrierter Unternehmenskommunikation von Dienstleistungsunternehmen. München: brain script Behr.
Beckert, Jens; Metzner, André; Roehl, Heiko (1998): Vertrauenserosion als organisatorische Gefahr und wie ihr zu begegnen ist. In: Organisationsentwicklung 17 (4), S. 57-66.
Eberl, Peter (2003): Vertrauen und Management. Studien zu einer theoretischen Fundierung des Vertrauenskonstruktes in der Managementlehre. Stuttgart: Schäffer-Poeschel.
Eberl, Peter (2012): Vertrauen und Kontrolle in Organisationen. Das problematische Verhältnis der Betriebswirtschaftslehre zum Vertrauen. In: Möller, Heidi (Hg.): Vertrauen in Organisationen. Riskante Vorleistung oder hoffnungsvolle Erwartung? Wiesbaden: Springer VS, S. 93-110.
Eisenegger, Mark (2005): Reputation in der Mediengesellschaft. Konstitution Issues Monitoring Issues Management. Wiesbaden: VS Verlag für Sozialwissenschaften.
Florian, Michael (2013): Paradoxien des Vertrauensmanagements. Risiken und Chancen einer widerspenstigen immateriellen Ressource. In: Personalführung 46, Heft 2/2013, S. 40-47.
Grüninger, Stephan (2001): Vertrauensmanagement - Kooperation, Moral und Governance. Marburg: Metropolis.
Grüninger, Stephan; John, Dieter (2004): Corporate Governance und Vertrauensmanagement. In: Josef Wieland (Hg.): Handbuch Wertemanagement. Erfolgsstrategien einer modernen Corporate Governance. Hamburg: Murmann, S. 149-177.
Meifert, Matthias (2008): Ist Vertrauenskultur machbar? Vorbedingungen und Überforderungen betrieblicher Personalpolitik. In: Rainer Benthin und Ulrich Brinkmann (Hg.): Unternehmenskultur und Mitbestimmung. Betriebliche Integration zwischen Konsens und Konflikt. Frankfurt/Main, New York: Campus, S. 309-327.
Neujahr, Elke; Merten, Klaus (2012): Reputationsmanagement. Zur Kommunikation von Wertschätzung. In: PR-Magazin 06/2012, S. 60-67.
Osterloh, Margit; Weibel, Antoinette (2006): Investition Vertrauen. Prozesse der Vertrauensentwicklung in Organisationen. Wiesbaden: Gabler.
Osterloh, Margit; Weibel, Antoinette (2006): Vertrauen und Kontrolle. In: Robert J. Zaugg und Norbert Thom (Hg.): Handbuch Kompetenzmanagement. Durch Kompetenz nachhaltig Werte schaffen. Festschrift für Prof. Dr. Dr. h.c. mult. Norbert Thom zum 60. Geburtstag. Bern [u.a.]: Haupt, S. 53-63.
Osterloh, Margit; Weibel, Antoinette (2007): Vertrauensmanagement in Unternehmen: Grundlagen und Fallbeispiele. In: Manfred Piwinger und Ansgar Zerfaß (Hg.): Handbuch Unternehmenskommunikation. Wiesbaden: Gabler, S. 189-203.
Schmidt, Matthias; Beschorner, Thomas (2005): Werte- und Reputationsmanagement. München und Mering: Hampp.
Seifert, Matthias (2003): Vertrauensmanagement in Unternehmen. Eine empirische Studie über Vertrauen zwischen Angestellten und ihren Führungskräften. 2. Aufl. München und Mering: Hampp.
Sprenger, Reinhard K. (2002): Vertrauen führt. Worauf es im Unternehmen wirklich ankommt, Frankfurt/Main, New York.
Thiessen, Ansgar (2011): Organisationskommunikation in Krisen. Reputationsmanagement durch strategische, integrierte und situative Krisenkommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften.
Walgenbach, Peter (2000): Das Konzept der Vertrauensorganisation. Eine theoriegeleitete Betrachtung. In: Die Betriebswirtschaft 60 (6), S. 707-720.
Walgenbach, Peter (2006): Wieso ist Vertrauen in ökonomischen Transaktionsbeziehungen so wichtig, und wie lässt es sich generieren? In: Hans H. Bauer, Marcus M. Neumann und Anja Schüle (Hg.): Konsumentenvertrauen. Konzepte und Anwendungen für ein nachhaltiges Kundenbindungsmanagement. München: Vahlen, S. 17-26.
Weibel, Antoinette (2004): Kooperation in strategischen Wissensnetzwerken. Vertrauen und Kontrolle zur Lösung des sozialen Dilemmas. Wiesbaden: Dt. Univ.-Verl.
Weinreich. Uwe (2003): Vertrauensmanagement. In: Deutscher Manager-Verband e.V. (Hg.): Die Zukunft des Managements. Perspektiven für die Unternehmensführung. Zürich: Vdf, Hochsch.-Verl. an der ETH, S. 193-201.

Course: Methods of Systematic Product Development (Seminar)

Lecturer:
Solveigh Hieber

Language:
DE/EN

Cycle:
SS

Content:
This seminar is about the basics of TRIZ and some additional creativity techniques.
Content:

- Introduction in Methods of Systematic Product Development
- Framework for the use of TRIZ and creativity techniques
- Historical background and origin of TRIZ
- TRIZ basic methods:
    - Innovation Check List

    - Ideal Final Result
    - Functional Analysis and Object Analysis
    - Contradiction Matrix and Inventive Principles
    - Physical Contradictions and Separation Principles
    - Method of Smart Little People
    - Trends of Technical Evolution
- Basics for Moderators
- The TRIZ Community today
- Additional, common Creativity Techniques

Literature:

Altschuller, S. (1984): Erfinden – Wege zur Lösung technischer Probleme. Limitierter Nachdruck 1998. VEB Verlag Technik
Koltze, K. & Souchkov, V. (2010): Systematische Innovation: TRIZ-Anwendung in der Produkt- und Prozessentwicklung. Carl Hanser Verlag
Orloff, M. A. (2006): Grundlagen der klassischen TRIZ. 3. Auflage. Springer Verlag

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Course: Public and Constitutional Law (Vorlesung)

Lecturer:

Klaus Tempke

Language:

DE

Cycle:

SS

Content:

Different areas of public law; proceedings, jurisdiction of administrative courts with stages of appeal,
members of the courts;
Court levels, organization and legal capacity;
Introduction to and structure of fundamental rights;
Human dignity: the guiding principle of the constitution;
General right of privacy and freedom of action.

Literature:

Courses:

Title	Typ	Hrs/wk
Bioreactor Design and Operation	Vorlesung	2
Bioreactor Design and Operation	Laborpraktikum	1
Biosystems Engineering	Vorlesung	2
Biosystems Engineering	Problemorientierte Lehrveranstaltung	1

Module Responsibility:
Prof. An-Ping Zeng

Admission Requirements:
Bachelor VT, BVT or equivalent

Recommended Previous Knowledge:
Knowledge of bioprocess engineering and process engineering at bachelor level

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

Professional Competence:
Theoretical Knowledge:
After completion of this module, participants will be able to:

- differentiate between different kinds of bioreactors and describe their key features
- identify and characterize the peripheral and control systems of bioreactors
- depict integrated biosystems (bioprocesses including up- and downstream processing)
- name different sterilization methods and evaluate those in terms of different applications
- recall and define the advanced methods of modern systems-biological approaches
- connect the multiple "omics"-methods and evaluate their application for biological questions
- recall the fundamentals of modeling and simulation of biological networks and biotechnological processes and to discuss their methods
- assess and apply methods and theories of genomics, transcriptomics, proteomics and metabolomics in order to quantify and optimize biological processes at molecular and process levels.

Capabilities:
After completion of this module, participants will be able to:

- describe different process control strategies for bioreactors and chose them after analysis of characteristics of a given bioprocess
- plan and construct a bioreactor system including peripherals from lab to pilot plant scale
- adapt a present bioreactor system to a new process and optimize it
- develop concepts for integration of bioreactors into bioproduction processes
- combine the different modeling methods into an overall modeling approach, to apply these methods to specific problems and to evaluate the achieved results critically
- connect all process components of biotechnological processes for a holistic system view.

Personal Competence:
Social Competence:
After completion of this module, participants will be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork.
Autonomy:
After completion of this module, participants will be able to solve a technical problem in teams of approx. 8-12 persons independently including a presentation of the results.

ECTS-Credit points:
6 LP

Examination:
Klausur

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

Assignment for the Following Curricula:
Bioprocess Engineering: Kernqualifikation: Compulsory

Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Environmental Engineering: Vertiefung Biotechnology: Compulsory suffrage
International Management and Engineering: Vertiefung II. Process Engineering and Biotechnology: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Bioreactor Design and Operation (Vorlesung)

Lecturer:
Prof. An-Ping Zeng

Language:
EN

Cycle:
SS

Content:

Design of bioreactors and peripheries:

- reactor types and geometry
- materials and surface treatment
- agitation system design
- insertion of stirrer
- sealings
- fittings and valves
- peripherals
- materials
- standardization
- demonstration in laboratory and pilot plant

Sterile operation:

- theory of sterilisation processes
- different sterilisation methods
- sterilisation of reactor and probes
- industrial sterile test, automated sterilisation
- introduction of biological material
- autoclaves
- continuous sterilisation of fluids
- deep bed filters, tangential flow filters
- demonstration and practice in pilot plant

Instrumentation and control:

- temperature control and heat exchange
- dissolved oxygen control and mass transfer
- aeration and mixing
- used gassing units and gassing strategies
- control of agitation and power input
- pH and reactor volume, foaming, membrane gassing

Bioreactor selection and scale-up:

- selection criteria
- scale-up and scale-down
- reactors for mammalian cell culture

Integrated biosystem:

- interactions and integration of microorganisms, bioreactor and downstream processing
- Miniplant technologies

Team work with presentation:

- Operation mode of selected bioprocesses (e.g. fundamentals of batch, fed-batch and continuous cultivation)

Literature:

- Storhas, Winfried, Bioreaktoren und periphere Einrichtungen, Braunschweig: Vieweg, 1994
- Chmiel, Horst, Bioprozeßtechnik; Springer 2011
- Krahe, Martin, Biochemical Engineering, Ullmann‘s Encyclopedia of Industrial Chemistry
- Pauline M. Doran, Bioprocess Engineering Principles, Second Edition, Academic Press, 2013
- Other lecture materials to be distributed

Course: Bioreactor Design and Operation (Laborpraktikum)

Lecturer:
Prof. An-Ping Zeng

Language:
EN

Cycle:
SS

Content:

Design of bioreactors and peripheries (Exercise/Practical):

- reactor types and geometry
- materials and surface treatment
- agitation system design
- insertion of stirrer
- sealings
- fittings and valves
- peripherals
- materials
- standardization
- demonstration in laboratory and pilot plant

Sterile operation:

- theory of sterilisation processes
- different sterilisation methods
- sterilisation of reactor and probes
- industrial sterile test, automated sterilisation
- introduction of biological material
- autoclaves
- continuous sterilisation of fluids
- deep bed filters, tangential flow filters
- demonstration and practice in pilot plant

Instrumentation and control:

- temperature control and heat exchange
- dissolved oxygen control and mass transfer
- aeration and mixing
- used gassing units and gassing strategies
- control of agitation and power input
- pH and reactor volume, foaming, membrane gassing

Bioreactor selection and scale-up:

- selection criteria
- scale-up and scale-down
- reactors for mammalian cell culture

Integrated biosystem:

- interactions and integration of microorganisms, bioreactor and downstream processing
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Team work with presentation:

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Literature:

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- Chmiel, Horst, Bioprozeßtechnik; Springer 2011
- Krahe, Martin, Biochemical Engineering, Ullmann‘s Encyclopedia of Industrial Chemistry
- Pauline M. Doran, Bioprocess Engineering Principles, Second Edition, Academic Press, 2013
- Other lecture materials to be distributed

Course: Biosystems Engineering (Vorlesung)

Lecturer:
Prof. An-Ping Zeng

Language:
EN

Cycle:
SS

Content:
Introduction to Biosystems Engineering

Experimental basis and methods for biosystems analysis

- Introduction to genomics, transcriptomics and proteomics
- More detailed treatment of metabolomics
- Determination of in-vivo kinetics
- Techniques for rapid sampling
- Quenching and extraction
- Analytical methods for determination of metabolite concentrations

Analysis, modelling and simulation of biological networks

- Metabolic flux analysis
- Introduction
- Isotope labelling
- Elementary flux modes
- Mechanistic and structural network models
- Regulatory networks
- Systems analysis
- Structural network analysis
- Linear and non-linear dynamic systems
- Sensitivity analysis (metabolic control analysis)

Modelling and simulation for bioprocess engineering

- Modelling of bioreactors
- Dynamic behaviour of bioprocesses

Selected projects for biosystems engineering

- Miniaturisation of bioreaction systems
- Miniplant technology for the integration of biosynthesis and downstream processin
- Technical and economic overall assessment of bioproduction processes

Literature:
E. Klipp et al. Systems Biology in Practice, Wiley-VCH, 2006
R. Dohrn: Miniplant-Technik, Wiley-VCH, 2006
G.N. Stephanopoulos et. al.: Metabolic Engineering, Academic Press, 1998
I.J. Dunn et. al.: Biological Reaction Engineering, Wiley-VCH, 2003
Lecture materials to be distributed

Course: Biosystems Engineering (Problemorientierte Lehrveranstaltung)

Lecturer:
Prof. An-Ping Zeng

Language:
EN

Cycle:
SS

Content:
Introduction to Biosystems Engineering (Exercise)

Experimental basis and methods for biosystems analysis

- Introduction to genomics, transcriptomics and proteomics
- More detailed treatment of metabolomics
- Determination of in-vivo kinetics
- Techniques for rapid sampling
- Quenching and extraction
- Analytical methods for determination of metabolite concentrations

Analysis, modelling and simulation of biological networks

- Metabolic flux analysis
- Introduction
- Isotope labelling
- Elementary flux modes
- Mechanistic and structural network models
- Regulatory networks
- Systems analysis
- Structural network analysis
- Linear and non-linear dynamic systems
- Sensitivity analysis (metabolic control analysis)

Modelling and simulation for bioprocess engineering

- Modelling of bioreactors
- Dynamic behaviour of bioprocesses

Selected projects for biosystems engineering

- Miniaturisation of bioreaction systems
- Miniplant technology for the integration of biosynthesis and downstream processin
- Technical and economic overall assessment of bioproduction processes

Literature:

E. Klipp et al. Systems Biology in Practice, Wiley-VCH, 2006
R. Dohrn: Miniplant-Technik, Wiley-VCH, 2006
G.N. Stephanopoulos et. al.: Metabolic Engineering, Academic Press, 1998
I.J. Dunn et. al.: Biological Reaction Engineering, Wiley-VCH, 2003
Lecture materials to be distributed

Module: Heterogeneous Catalysis

Courses:

Title	Typ	Hrs/wk
Analysis and Design of Heterogeneous Catalytic Reactors	Vorlesung	2
Modern Methods in Heterogeneous Catalysis	Vorlesung	2
Modern Methods in Heterogeneous Catalysis	Laborpraktikum	2

Module Responsibility:
Prof. Raimund Horn

Admission Requirements:
Not applicable.

Recommended Previous Knowledge:
Content of the bachelor-modules "process technology", as well as particle technology, fluidmechanics in process-technology and transport processes.

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

Professional Competence:
Theoretical Knowledge:
The students are able to apply their knowledge to explain industrial catalytic processes as well as indicate different synthesis routes of established catalyst systems. They are capable to outline dis-/advantages of supported and full-catalysts with respect to their application. Students are able to identify anayltical tools for specific catalytic applications.
Capabilities:
After successfull completition of the module, students are able to use their knowledge to identify suitable analytical tools for specific catalytic applications and to explain their choice. Moreover the students are able to choose and formulate suitable reactor systems for the current synthesis process. Students can apply their knowldege discretely to develop and conduct experiments. They are able to appraise achieved results into a more general context and draw conclusions out of them.

Personal Competence:
Social Competence:
The students are able to plan, prepare, conduct and document experiments according to scientific guidelines in small groups.
Autonomy:
The students are able to obtain further information for experimental planning and assess their relevance autonomously.

ECTS-Credit points:
6 LP

Examination:
Klausur

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

Assignment for the Following Curricula:
Bioprocess Engineering: Vertiefung A - General Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Analysis and Design of Heterogeneous Catalytic Reactors (Vorlesung)

Lecturer:
Prof. Raimund Horn

Language:
EN

Cycle:
SS

Content:
1. Material- and Energybalance of the two-dimensionsal zweidimensionalen pseudo-homogeneous reactor model
2. Numerical solution of ordinary differential equations (Euler, Runge-Kutta, solvers for stiff problems, step controlled solvers)
3. Reactor design with one-dimensional models (ethane cracker, catalyst deactivation, tubular reactor with deactivating catalyst, moving bed reactor with regenerating catalyst, riser reactor, fluidized bed reactor)
4. Partial differential equations (classification, numerical solution Lösung, finite difference method, method of lines)
5. Examples of reactor design (isothermal tubular reactor with axial dispersion, dehydrogenation of ethyl benzene, wrong-way behaviour)
6. Boundary value problems (numerical solution, shooting method, concentration- and temperature profiles in a catalyst pellet, multiphase reactors, trickle bed reactor)

Literature:

1. Lecture notes R. Horn
2. Lecture notes F. Keil
3. G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
4. R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000

Course: Modern Methods in Heterogeneous Catalysis (Vorlesung)

Lecturer:
Prof. Raimund Horn

Language:
EN

Cycle:
SS

Content:
Heterogeneous Catalysis and Chemical Reaction Engineering are inextricably linked. About 90% of all chemical intermediates and consumer products (fuels, plastics, fertilizers etc.) are produced with the aid of catalysts. Most of them, in particular large scale products, are produced by heterogeneous catalysis viz. gaseous or liquid reactants react on solid catalysts. In multiphase reactors gases, liquids and a solid catalyst are present.
Heterogeneous catalysis plays also a key role in any future energy scenario (fuel cells, electrocatalytic splitting of water) and in environmental engineering (automotive catalysis, photocatalyic abatement of water pollutants).
Heterogeneous catalysis is an interdisciplinary science requiring knowledge of different scientific disciplines such as

- Materials Science (synthesis and characterization of solid catalysts)
- Physics (structure and electronic properties of solids, defects)
- Physical Chemistry (thermodynamics, reaction mechanisms, chemical kinetics, adsorption, desorption, spectroscopy, surface chemistry, theory)
- Reaction Engineering (catalytic reactors, mass- and heat transport in catalytic reactors, multi-scale modeling, application of heterogeneous catalysis)

The class „Modern Methods in Heterogeneous Catalysis“ will deal with the above listed aspects of heterogeneous catalysis beyond the material presented in the normal curriculum of chemical reaction engineering classes. In the corresponding laboratory will have the opportunity to apply their aquired theoretical knowledge by synthesizing a solid catalyst, characterizing it with a variety of modern instrumental methods (e.g. BET, chemisorption, pore analysis, XRD, Raman-Spectroscopy, Electron Microscopy) and measuring its kinetics. Class and laboratory „Modern Methods in Heterogeneous Catalysis“ in combination with the lecture „Analysis and Design of Heterogeneous Catalytic Reactors“ will give interested students the opportunity to specialize in this vibrant, multifaceted and application oriented field of research.

Literature:

- J.M. Thomas, W.J. Thomas: Principles and Practice of Heterogeneous Catalysis, VCH
- I. Chorkendorff, J. W. Niemantsverdriet, Concepts of Modern Catalysis and Kinetics, WILEY-VCH
- B.C. Gates: Catalytic Chemistry, John Wiley
- R.A. van Santen, P.W.N.M. van Leeuwen, J.A. Moulijn, B.A. Averill (Eds.): Catalysis: an integrated approach, Elsevier
- D.P. Woodruff, T.A. Delchar: Modern Techniques of Surface Science, Cambridge Univ. Press
- J.W. Niemantsverdriet: Spectrocopy in Catalysis, VCH
- F. Delannay (Ed.): Characterization of heterogeneous catalysts, Marcel Dekker
- C.H. Bartholomew, R.J. Farrauto: Fundamentals of Industrial Catalytic Processes (2nd Ed.),Wiley

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Course: Modern Methods in Heterogeneous Catalysis (Laborpraktikum)

Lecturer:
Prof. Raimund Horn

Language:
EN

Cycle:
SS

Content:
Heterogeneous Catalysis and Chemical Reaction Engineering are inextricably linked. About 90% of all chemical intermediates and consumer products (fuels, plastics, fertilizers etc.) are produced with the aid of catalysts. Most of them, in particular large scale products, are produced by heterogeneous catalysis viz. gaseous or liquid reactants react on solid catalysts. In multiphase reactors gases, liquids and a solid catalyst are present.
Heterogeneous catalysis plays also a key role in any future energy scenario (fuel cells, electrocatalytic splitting of water) and in environmental engineering (automotive catalysis, photocatalyic abatement of water pollutants).
Heterogeneous catalysis is an interdisciplinary science requiring knowledge of different scientific disciplines such as

- Materials Science (synthesis and characterization of solid catalysts)
- Physics (structure and electronic properties of solids, defects)
- Physical Chemistry (thermodynamics, reaction mechanisms, chemical kinetics, adsorption, desorption, spectroscopy, surface chemistry, theory)
- Reaction Engineering (catalytic reactors, mass- and heat transport in catalytic reactors, multi-scale modeling, application of heterogeneous catalysis)

The class „Modern Methods in Heterogeneous Catalysis“ will deal with the above listed aspects of heterogeneous catalysis beyond the material presented in the normal curriculum of chemical reaction engineering classes. In the corresponding laboratory will have the opportunity to apply their aquired theoretical knowledge by synthesizing a solid catalyst, characterizing it with a variety of modern instrumental methods (e.g. BET, chemisorption, pore analysis, XRD, Raman-Spectroscopy, Electron Microscopy) and measuring its kinetics. Class and laboratory „Modern Methods in Heterogeneous Catalysis“ in combination with the lecture „Analysis and Design of Heterogeneous Catalytic Reactors“ will give interested students the opportunity to specialize in this vibrant, multifaceted and application oriented field of research.

Literature:

- J.M. Thomas, W.J. Thomas: Principles and Practice of Heterogeneous Catalysis, VCH
- I. Chorkendorff, J. W. Niemantsverdriet, Concepts of Modern Catalysis and Kinetics, WILEY-VCH
- B.C. Gates: Catalytic Chemistry, John Wiley
- R.A. van Santen, P.W.N.M. van Leeuwen, J.A. Moulijn, B.A. Averill (Eds.): Catalysis: an integrated approach, Elsevier
- D.P. Woodruff, T.A. Delchar: Modern Techniques of Surface Science, Cambridge Univ. Press
- J.W. Niemantsverdriet: Spectrocopy in Catalysis, VCH
- F. Delannay (Ed.): Characterization of heterogeneous catalysts, Marcel Dekker
- C.H. Bartholomew, R.J. Farrauto: Fundamentals of Industrial Catalytic Processes (2nd Ed.),Wiley

Module: Technical Microbiology

Courses:

Title	Typ	Hrs/wk
Applied Molecular Biology	Vorlesung	2
Technical Microbiology	Vorlesung	2
Technical Microbiology	Hörsaalübung	1

Module Responsibility:
Dr. Skander Elleuche

Admission Requirements:
none

Recommended Previous Knowledge:
Bachelor with basic knowledge in microbiology and genetics

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

Professional Competence:
Theoretical Knowledge:
After successfully finishing this module, students are able

- to give an overview of genetic processes in the cell
- to explain the application of industrial relevant biocatalysts
- to explain and prove genetic differences between pro- and eukaryotes

Capabilities:
After successfully finishing this module, students are able

- to explain and use advanced molecularbiological methods
- to recognize problems in interdisciplinary fields

Personal Competence:
Social Competence:
Students are able to

- write protocols and PBL-summaries in teams
- to lead and advise members within a PBL-unit in a group
- develop and distribute work assignments for given problems

Autonomy:
Students are able to

- search information for a given problem by themselves
- prepare summaries of their search results for the team
- make themselves familiar with new topics

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: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Environmental Engineering: Kernqualifikation: Compulsory suffrage
International Management and Engineering: Vertiefung II. Process Engineering and Biotechnology: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Applied Molecular Biology (Vorlesung)

Lecturer:

Dr. Skander Elleuche

Language:
EN

Cycle:
SS

Content:
Lecture and PBL
- Methods in genetics / molecular cloning
- Industrial relevance of microbes and their biocatalysts
- Biotransformation at extreme conditions
- Genomics
- Protein engineering techniques
- Synthetic biology

Literature:
Relevante Literatur wird im Kurs zur Verfügung gestellt.
Grundwissen in Molekularbiologie, Genetik, Mikrobiologie und Biotechnologie erforderlich.
Lehrbuch: Brock - Mikrobiologie / Microbiology (Madigan et al.)

Course: Technical Microbiology (Vorlesung)

Lecturer:
Dr. Kerstin Sahm, Prof. Garabed Antranikian

Language:
EN

Cycle:
SS

Content:

- History of microbiology and biotechnology
- Enzymes
- Molecular biology
- Fermentation
- Downstream Processing
- Industrial microbiological processes
- Technical enzyme application
- Biological Waste Water treatment

Literature:
Microbiology, 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (eds.), formerly „Brock“, Pearson
Industrielle Mikrobiologie, 2012, Sahm, H., Antranikian, G., Stahmann, K.-P., Takors, R. (eds.) Springer Berlin, Heidelberg, New York, Tokyo.
Angewandte Mikrobiologie, 2005, Antranikian, G. (ed.), Springer, Berlin, Heidelberg, New York, Tokyo.

Course: Technical Microbiology (Übung)

Lecturer:
Dr. Kerstin Sahm

Language:
EN

Cycle:
SS

Content:

- History of microbiology and biotechnology
- Enzymes
- Molecular biology
- Fermentation
- Downstream Processing
- Industrial microbiological processes
- Technical enzyme application
- Biological Waste Water treatment

Literature:
Microbiology, 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (eds.), formerly „Brock“, Pearson
Industrielle Mikrobiologie, 2012, Sahm, H., Antranikian, G., Stahmann, K.-P., Takors, R. (eds.) Springer Berlin, Heidelberg, New York, Tokyo.
Angewandte Mikrobiologie, 2005, Antranikian, G. (ed.), Springer, Berlin, Heidelberg, New York, Tokyo.

Courses:

Title	Typ	Hrs/wk
Sociology of Work	Seminar	2
Blue Engineering – Aspects of social and ecological responsibility II	Seminar	1
German as a Foreign Language for International Master Programs	Seminar	4
European Culture: Architectural and Cultural History Course A	Seminar	2
European Culture: Architectural and Cultural History Course B	Seminar	2
European Culture: History II.	Seminar	2
European Culture: Art	Seminar	2
Engineering Education Research and Applications	Seminar	2
Human Factors in Aviation and Maritime Systems	Vorlesung	2
Foreign Language Course	Seminar	2
Management and Communication	Seminar	2
Humanities and Engineering: Intercultural Communication	Seminar	2
Humanities and Engineering: Politics	Seminar	2
Theory of Communication	Seminar	2
Creative Processes in Technology, Music and the Arts	Seminar	2
Power plays in organizations: Micro-political competence and gender competence for professional practice	Seminar	2
Socio-economic and ecological Responsability in Engineering Profession	Seminar	2
Sociology and Social Critism	Seminar	2
World Literature: Meaning and Interpretation in the Interculture Dialogue	Seminar	2
Economic Sociology	Seminar	2
Academic Writing for Engineers	Seminar	2

Module Responsibility:
Dagmar Richter

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:
6 LP

Examination:

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

Assignment for the Following Curricula:
Civil Engineering: Kernqualifikation: Compulsory
Bioprocess Engineering: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Computer Science: Kernqualifikation: Compulsory
Electrical Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Kernqualifikation: Compulsory
Energy Systems: Kernqualifikation: Compulsory
Environmental Engineering: Kernqualifikation: Compulsory
Aircraft Systems Engineering: Kernqualifikation: Compulsory
Global Innovation Management: Kernqualifikation: Compulsory suffrage
Computational Science and Engineering: Kernqualifikation: Compulsory
Information and Communication Systems: Kernqualifikation: Compulsory

International Management and Engineering: Kernqualifikation: Compulsory
Logistics, Infrastructure and Mobility: Kernqualifikation: Compulsory
Mechatronics: Kernqualifikation: Compulsory
Microelectronics and Microsystems: Kernqualifikation: Compulsory
Product Development, Materials and Production: Kernqualifikation: Compulsory
Renewable Energies: Kernqualifikation: Compulsory
Naval Architecture and Ocean Engineering: Kernqualifikation: Compulsory
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory
Process Engineering: Kernqualifikation: Compulsory
Water and Environmental Engineering: Kernqualifikation: Compulsory

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Course: Sociology of Work (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
WS

Content:
Work is a central sociological category that mediates between individual and society. Currently, it is subject to radical and diverse processes of change. In the seminar course, we will present and discuss recent findings in the field of work research. Topics include, among others, subjectivation and precarisation of labor as well as reproductive and care work.

Literature:
Fuchs, Tatjana (2006): Kurzfassung Was ist gute Arbeit? Anforderungen aus der Sicht von Erwerbstätigen In: INIFES (Hg.): Forschungsbericht an die Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. Stadtbergen, 13-38
Hochschild, Arlie Russell, 2003. Love and Gold. In: femina politica, Zeitschrift für feministische Politik-Wissenschaft, 12.Jg. Heft 1/2003. S.77-9
Kratzer, Nick u.a. (2011): Leistungspolitik und Work-Life-Balance. Eine Trendanalyse des Projekts Lanceo. Institut für Sozialwissenschaftliche Forschung e. V. ISF München
Lehndorff, Steffen (2003): Marktsteuerung von Dienstleistungsarbeit. In: Dörre, Klaus; Röttger, Bernd (Hg.): Das neue Marktregime. Konturen eines nachfordistischen Produktionsmodells. Hamburg: VSAVerl., S. 153 171
Marrs, Kira (2010): Herrschaft und Kontrolle in der Arbeit. In: Böhle, Fritz/ Voß, Günter/ Wachtler, Günther (Hg.): Handbuch Arbeitssoziologie. Wiesbaden, 331-358
Bourdieu, Pierre (1998): Prekariat ist überall. In: Ders.: Gegenfeuer. Konstanz, 96-102

Course: Blue Engineering – Aspects of social and ecological responsibility II (Seminar)

Lecturer:
Robinson Peric

Language:
DE

Cycle:
WS

Content:
The seminar broaches the issue of both the connections and disparities between ecological and social responsibility in the context of engineering sciences. The underlying vision consists in a socially and ecologically sustainable development of technology, following a holistic approach in solving problems of mankind and nature. In this venue, the seminar provokes a creative immersion with questions regarding sustainable development and tries to evoke answers both on a small scale, as well as from a broader view.

Literature:
Literatur wird zu Beginn des Seminars bekanntgegeben.
References will be announced on the seminar's first appointment.

Course: German as a Foreign Language for International Master Programs (Seminar)

Lecturer:
Dagmar Richter

Language:
DE

Cycle:
WS/SS

Content:

Master's German course in cooperation with IBH e.V. – Master's German courses at different levels
In the international studies program these are obligatory for non-native speakers of German and for students without a DSH certificate or equivalent TEST-DAF result. Grading after an aptitude test. All other students must sign up for a total of 4 ECTS from the catalog of non-technical supplementary courses.

Literature:

- Will be announced in lectures -

Course: European Culture: Architectural and Cultural History Course A (Seminar)

Lecturer:
Dr. Marlis Bussacker

Language:
DE

Cycle:
WS

Content:

Literature:

- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: European Culture: Architectural and Cultural History Course B (Seminar)

Lecturer:
Dr. Imke Hofmeister

Language:
DE

Cycle:
WS

Content:

Literature:

- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: European Culture: History II. (Seminar)

Lecturer:
Prof. Margarete Jarchow, Dr. Martin Doerry

Language:
DE

Cycle:
WS

Content:

No event has left such deep traces on the political consciousness of the Federal Republic of Germany as the murder of millions of European Jews. With five autobiographical texts by survivors and victims of the holocaust the former historical events at that time are reconstructed. Their impact on current standards of political thought and action will be analyzed. The concentration of the individual stories facilitates the understanding of the historical context.
All titles are also available in English translation. Selected reviews as well as documentary footage are presented.

Literature:

Der Publizist Sebastian Haffner erzählt vom Entstehen des Nationalsozialismus und von seiner wachsenden Distanz zum NS-Regime („Geschichte eines Deutschen. Die Erinnerungen 1914 – 1933").
Der Historiker Saul Friedländer berichtet vom Überleben mit falscher Identität in einem französischen Internat („Wenn die Erinnerung kommt").
Der Kritiker Marcel Reich-Ranicki schreibt über seine Flucht aus dem Warschauer Ghetto und seine Liebe zur deutschen Kultur („Mein Leben").
Die Literaturwissenschaftlerin Ruth Klüger hat das KZ Auschwitz-Birkenau überlebt und wird bis heute von der eigenen Erinnerung an das Vernichtungslager verfolgt („weiter leben").
Die Ärztin Lilli Jahn schließlich wurde in Auschwitz von den Nazis umgebracht, ihr Schicksal ist in einem Briefwechsel mit ihren fünf Kindern dokumentiert (Martin Doerry: „Mein verwundetes Herz. Das Leben der Lilli Jahn. 1900 – 1944").

Course: European Culture: Art (Seminar)

Lecturer:
Dr. Gabriele Himmelmann

Language:
DE

Cycle:
WS/SS

Content:
The seminar focuses on works of painting, sculpture, arts and crafts, and design in a specific epoch of art and cultural history. By means of examples students acquire in-depth knowledge about works of art, their origins, their production conditions, their production techniques, and the societal framework conditions in their stylistic epoch. Ability to discuss and to communicate is trained by analyzing the works of art that are dealt with and eyes are opened for one's own and other cultures. The course includes excursions to museums and art museums to gain access to the customary ways in which museums present their exhibits.

Literature:
- Geschichte der Kunst in 12 Bänden, Beck'sche Reihe, München 2011
- Geschichte der bildenden Kunst in Deutschland, 8 Bände, München: Prestel 2006-
- Kunst-Epochen, Reclam-Universalbibliothek, Stuttgart 2002-
- Hans Belting / Heinrich Dilly / Wolfgang Kemp / Willibald Sauerländer / Martin Warnke, Kunstgeschichte – Eine Einführung, 7. Aufl. Berlin 2008
- Jutta Held / Norbert Schneider, Grundzüge der Kunstwissenschaft, Köln 2007
- Michael J. Gelb, How to think like Leonardo da Vinci, New York 1998
- E.H. Gombrich, The Story of Art, Phaidon Press Limited, London 1995
- Wilfried Koch, Baustilkunde, Bertelsmann Lexikon Verlag, Gütersloh 1993
- Jacques Tullier, Geschichte der Kunst, Architektur, Skulptur, Malerei, Paris 2002
- Silvio Vietta, Europäische Kulturgeschichte – eine Einführung, München 2005

Course: Engineering Education Research and Applications (Seminar)

Lecturer:
Prof. Christian Hans Gerhard Kautz

Language:
DE

Cycle:
WS/SS

Content:

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Learning scenarios, active learning methods
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Methods, results and implications of engineering education research
Conceptual understanding and misconceptions in introductory engineering courses
Research on learning behaviour, motivation, and beliefs
Preparation of Tutorials for selected lecture courses
Problem-Based Learning
Learning styles in engineering education
Assessment

Literature:
ausgewählte Artikel aus Fachzeitschriften werden an die Seminarteilnehmer verteilt, weiterführende Literatur wird zum jeweiligen Thema angegeben

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Course: Human Factors in Aviation and Maritime Systems (Vorlesung)

Lecturer:
Dr. Peter Maschke

Language:
DE

Cycle:
WS/SS

Content:
Title: Human Factor in Aviation and Maritime Systems
The human operator is both the strong and weak element within the aviation and maritime system. On the one hand, the operator increases the reliability of the technical system by a factor of ten. On the other hand, the operator him/herself induces a high error rate which is the

most critical risk in these man-machine systems: The main cause for more than 70% of accidents in aviation and maritime systems is due to human error. In this context the human operator (pilot, air traffic controller, astronaut or nautical officer) always interacts with machines or in a team of other operators.
To improve safety and efficiency, focus should be put both on designing a human oriented machine and on the operator: What are the important job requirements, how to find people who fulfil these requirements, and what can be reached by technical and non-technical training. For these options it has to be taken into account that human behavior is limited due to physiological and psychological aspects, e.g. human perception is biased due to subjectivity, and human decision making is not rational. The diversity of team situations is complicating these aspects.

Literature:

Badke-Schaub, Hofinger & Lauche (2008). Human Factors - Psychologie sicheren Handelns in Risikobranchen. Heidelberg: Springer.
Bauch, A. (2001). Ergonomie in der Flugzeugkabine - Passagierprozesse und manuelle Arbeitsablaufe. DGLR BERICHT (S. 49-56), ISSN 3932182154. Link: http://www.mp.haw-hamburg.de/pers/Scholz/dglr/bericht0101/Bauch.pdf
Goeters, K.-M. (Ed.) (2004). Aviation Psychology: Practice and Research. Aldershot: Ashgate.
Johnston,N., Fuller R., McDonald, N. (Eds.) (1994). Aviation Psychology: Training and Selection. Aldershot Hampshire: Avebury Aviation.
Sackett, P.R. & Lievens, F. (2008). Personnel Selection. Annual Review of Psychology, 59,
419-450.
Schuler, H. (2006). Lehrbuch der Personalpsychologie (2. Auflage). Göttingen: Hogrefe.
Schuler, H. (2007). Lehrbuch der Organisationpsychologie (4. Auflage). Huber: Bern.

Course: Foreign Language Course (Seminar)

Lecturer:
Dagmar Richter

Language:

Cycle:
WS/SS

Content:
In the Field of the Nontechnical Complementary Courses students are able to chose foreign language courses. Therefore the Hamburger Volkshochschule offers a special language programm on TUHH campus for TUHH Students. It includes courses in english, chinese, french, japanese, portuguese, russia, swedish, spanisch and german as a foreign language. All lectures impart common language knowledge, english courses although english for technical purposes.

Literature:
Kursspezifische Literatur / selected bibliography depending on special lecture programm.

Course: Management and Communication (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
SS

Content:
The seminar will present basic elements of personality-promoting work organisation, motivation theories, different management concepts, communication theories and approaches to conflict and knowledge management. These subjects are applied to specific practical examples. Participants are given the opportunity to reflect on their own communicative and social behaviour.

Literature:

Große Boes, Stefanie; Kaseric, Tanja (2010): Trainer-Kit. Die wichtigsten Trainings-Theorien, ihre Anwendung im Seminar und Übungen für den Praxistransfer. 4. Aufl. Bonn: managerSeminare Verlags GmbH
Klutmann, Beate (2004): Führung: Theorie und Praxis. Hamburg: Windmühle
Laufer, Hartmut (2011): Grundlagen erfolgreicher Mitarbeiterführung. Führungspersönlichkeit, Führungsmethoden, Führungsinstrumente. 11. Auflage. Offenbach: GABAL
Neuberger, Oswald (2002): Führen und führen lassen. 6. überarb. und erw. Aufl. Stuttgart: Lucius und Lucius
Schulz von Thun, Friedemann; Ruppel, Johannes; Stratmann, Roswitha (2002): Miteinander reden: Kommunikationspsychologie für Führungskräfte. 4. Aufl. Reinbek bei Hamburg

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Course: Humanities and Engineering: Intercultural Communication (Seminar)

Lecturer:
Prof. Margarete Jarchow, Dr. Matthias Mayer

Language:

EN

Cycle:
WS/SS

Content:

As young professionals with technical background you may often tend to focus on communicating numbers and statistics in your presentations. However, facts are only one aspect of convincing others. Often, your personality, personal experience, cultural background and emotions are more important. You have to convince as a person in order to get your content across.
In this workshop you will learn how to increase and express your cultural competence. You will apply cultural knowledge and images in order to positively influence communicative situations. You will learn how to add character and interest to your talks, papers and publications by referring to your own and European Cultural background. You will find out the basics of communicating professionally and convincingly by showing personality and by referring to your own cultural knowledge. You will get hands-on experience both in preparing and in conducting such communicative situations. This course is not focussing on delivering new knowledge about European culture but helps you using existing knowledge or such that you can gain e.g. in other Humanities courses.
Content

- How to enrich the personal character of your presentations **by referring to European and your own culture**.
- How to properly arrange **content and structure.**
- How to use **PowerPoint for visualization** (you will use computers in an NIT room).
- How to be well-prepared and convincing **when delivering** your thoughts to your audience**.**

Literature:
Literaturhinweise werden zu Beginn des Seminars bekanntgegeben.
Literature will be announced at the beginning of the seminar.

Course: Humanities and Engineering: Politics (Seminar)

Lecturer:
Dr. Stephan Albrecht, Anne Katrin Finger, Gunnar Jeremias

Language:
EN

Cycle:
WS/SS

Content:
Scientists and engineers neither just strive for truths and scientific laws, nor are they working in a space far from politics. Science and engineering have contributed to what we now call the Anthropocene, the first time in the history of mankind when essential cycles of the earth system, e.g. carbon cycle, climate system, are heavily influenced or even shattered. Furthermore, Peak oil is indicating the end of cheap fossil energy thus triggering the search for alternatives such as biomass.
Systems of knowledge, science and technology in the OECD countries have since roughly 30 years increasingly become divided. On the one hand new technologies such as modern biotechnology, IT or nanotechnology are developing rapidly, bringing about many innovations for industry, agriculture, and consumers. On the other hand scientific studies from earth, environmental, climate change, agricultural and social sciences deliver increasingly robust evidence on more or less severe impacts on society, environment, global equity, and economy resulting from innovations during the last 50 years. Technological innovation thus is no longer an uncontested concept. And many protest movements demonstrate that the introduction of new or the enlargement of existing technologies (e.g. airports, railway stations, highways, high-voltage power lines surveillance) isn't at all a matter of course.
It is important to bear in mind the fact that all processes of technological innovation are made by humans, individually and collectively. Industrial, social, and political organizations as actors from the local to global level of communication, deliberation, and decision making interact in diverse arenas, struggling to promote their respective corporate and/or political agenda. So innovations are as well a problem of technology as a problem of politics. Innovation and technology policies aren't the same in all countries. We can observe conceptual and practical variations.
Since the 1992 Earth Summit in Rio de Janeiro Agenda 21 constitutes a normative umbrella, indicating Sustainable Development (SD) as core cluster of earth politics on all levels from local to global. Meanwhile other documents such as the Millennium Development Goals (MDG) have complemented the SD agenda. SD can be interpreted as operationalization of the Universal Declaration of Human Rights, adopted in 1948 by the General Assembly of the United Nations and since amended many times.
Engineers and scientists as professionals can't avoid to become confronted with many non-technical and non-disciplinary items, challenges, and dilemmas. So they have to choose between alternative options for action, as individuals and as members of organizations or employees. Therefore the seminar will address core elements of the complex interrelations between science, society and politics. Reflections on experiences of participants – e.g. from other countries as Germany – during the seminar are very welcome.
The goals of the seminar include:

- Raising awareness and increasing knowledge about the political implications of scientific work and institutions;
- Improving the understanding of different concepts and designs of innovation and technology policies;
- Increasing knowledge about the status and perspectives of sustainable development as framework concept for technological and scientific progress;
- Understanding core elements of recent arguments, conflicts, and crises on technological innovations, e.g. geo-engineering or bio-economy;

- Improving the understanding of scientists' responsibility for impacts of their professional activities;
- Embedding individual professional responsibility in social and political contexts.

The seminar will deal with current problems from areas such as innovation policy, energy, food systems, and raw materials. Issues will include the future of energy, food security and electronics. Historical issues will also be addressed.
The seminar will start with a profound overarching introduction. Issues will be introduced by a short presentation and a Q & A session, followed by group work on selected problems. All participants will have to prepare a presentation during the weekend seminar. The seminar will use inter alia interactive tools of teaching such as focus groups, simulations and presentations by students. Regular and active participation is required at all stages.

Literature:
Literatur wird zu Beginn des Seminars abgesprochen.

Course: Theory of Communication (Seminar)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
SS

Content:
The seminar focuses on sociological theories of communication and selected problems of practical application in the area of crisis communication. The issue of crisis communication will be analyzed on the basis of case studies.

Literature:
Habermas, Jürgen (1981): Theorie des kommunikativen Handelns. 2 Bände. Frankfurt/Main: Suhrkamp.
Luhmann, Niklas (1984): Soziale Systeme. Grundriß einer allgemeinen Theorie. Frankfurt/Main: Suhrkamp.
Malsch, Thomas (2005): Kommunikationsanschlüsse. Zur soziologischen Differenz von realer und künstlicher Sozialität. Wiesbaden: VS Verlag für Sozialwissenschaften.
Malsch, Thomas; Schmitt, Marco (Hg.) (2014): Neue Impulse für die soziologische Kommunikationstheorie. Empirische Widerstände und theoretische Verknüpfungen. Springer Fachmedien: Wiesbaden.
Meckel, Miriam; Schmid, Beat F. (Hg.) (2008): Unternehmenskommunikation. Kommunikationsmanagement aus Sicht der Unternehmensführung. 2., überarbeitete und erweiterte
Auflage. Gabler GWV Fachverlage: Wiesbaden.
Merten, Klaus (1999): Einführung in die Kommunikationswissenschaft. Bd 1/1: Grundlagen der Kommunikationswissenschaft. Münster: Lit Verlag.
Nolting, Tobias; Thießen, Ansgar (Hg.) (2008): Krisenmanagement in der Mediengesellschaft. Potenziale und Perspektiven der Krisenkommunikation. Wiesbaden: VS Verlag für Sozialwissenschaften.
Schützeichel, Rainer (2004): Soziologische Kommunikationstheorien. Konstanz: UVK Verlagsgesellschaft.
Thießen, Ansgar (2011): Organisationskommunikation in Krisen. Reputationsmanagement durch situative, integrierte und strategische Krisenkommunikation. VS Verlag für Sozialwissenschaften/Springer Fachmedien: Wiesbaden.
Thießen, Ansgar (Hg.) (2013): Handbuch Krisenmanagement. Springer Fachmedien: Wiesbaden.

Course: Creative Processes in Technology, Music and the Arts (Seminar)

Lecturer:
Prof. Hans-Joachim Braun

Language:
EN

Cycle:
WS

Content:
Creativity, which involves the generation of useful ideas and products, is an elusive term. "Inspirationalists" ,who point out spontaneous insights and "aha effects", have increasingly come under pressure from "structuralists", who emphasize hard work and expertise in creative processes, divesting creative people from supernatural gifts. In this light , a musical composition can be regarded as a piece of "cognitive engineering".In this seminar we will deal with the different concepts of creativity in their historical and cultural context. The main focus will be on investigating creative processes in invention, engineering design, architecture, the fine arts (for example Picasso`s Guernica), and in musical composition and improvisation. .Do creative processes follow a similar logic or are there vital domain-dependent differences? Two what extent have recent, particularly psychometric, studies been able to obtain empirically relevant and satisfying answers to the issue of creativity?

Literature:
H.-J. Braun, Engineering Design and Musical Composition: An Exploratory Inquiry; ICON vol.8, 2002, 1-24.
J. Kaufman &R.J. Steinberg; The Cambridge Handbook of Creativity, Cambridge U.P. 2010.
R.K. Sawyer, Explaining Creativity. The Science of Human Innovation, Oxford U.P. 2012,
R.W. Weisberg, Creativity: Understanding Innovation in Problem Solving, Science, Invention and the Arts, New York, John Wiley, 2006.

Course: Power plays in organizations: Micro-political competence and gender competence for professional practice (Seminar)

Lecturer:
Doris Cornils

Language:
DE

Cycle:
WS

Content:
folgt

Literature:
Cornils, D.; Mucha, A.; Rastetter, D. (2014): Mikropolitisches Kompetenzmodell: Erkennen, verstehen und bewerten mikropolitischer Kompetenz. In: OSC, Organisationberatung – Supervision – Coaching, 1/2014, S. 3-19
Cornils, Doris (2012): Mikropolitik und Aufstiegskompetenz von Frauen, in: CEWS-Journal, Center of Excellence Women and Science, 14.6.2012, Nr. 84, S. 23-34

Course: Socio-economic and ecological Responsability in Engineering Profession (Seminar)

Lecturer:
Dr. Wolfgang Neef

Language:
DE

Cycle:
WS

Content:

- technical science,economics and society
- sociologic and economic models of engineering in future
- engineering and technology without growth- and profit-compulsion

Literature:
Reader für die Lehrveranstaltung zu den Themen "Technik und Gesellschaft" und "Studium und Berufseinstieg"
Reader zu the topics "Technology and Society" and "Studying and Starting in Profession"

Course: Sociology and Social Critism (Seminar)

Lecturer:
Prof. Gabriele Winker

Language:
DE

Cycle:
WS

Content:
The seminar course focuses on the question of the significance and extent of social inequality. It will provide an overview of central sociological terms of analysis and findings of inequality studies.

Literature:
- Burzan, Nicole. Soziale Ungleichheit. Eine Einführung in die zentralen Theorien. 3. überarb. Aufl. Wiesbaden: VS Verlag für Sozialwissenschaften, 2007
- Hradil, Stefan: Soziale Ungleichheit in Deutschland. 8. Aufl., Nachdruck, Wiesbaden: VS Verlag für Sozialwissenschaften, 2005
- Kreckel, Reinhard: Politische Soziologie der sozialen Ungleichheit, 3., überarbeitete und erweiterte Auflage, Frankfurt/New York: Campus, 2004
- Winker, Gabriele; Nina Degele: Intersektionalität. Zur Analyse sozialer Ungleichheiten. Bielefeld: transcript Verlag, 2009

Course: World Literature: Meaning and Interpretation in the Interculture Dialogue (Seminar)

Lecturer:
Bertrand Schütz

Language:
DE

Cycle:
WS/SS

Content:
The seminar 'literature and culture' investigates the scope and possible meaning of what is commonly called European and especially German culture.
The practice of hermeneutics as basic discipline of the humanities comprises the approach to literary texts and their broader cultural context as well.
Subject matters are chosen according to their relevance for contemporary issues, particularly with regard to an intercultural dialogue.
Culture is thereby to be understood as the creative response to a given situation and the capacity to integrate inputs and influences, therefore as an ongoing process of permanent readjustment and learning, and by no means as a fixed identity in terms of an “essence”.

Literature:
Außer den unten angegebenen Referenzwerken wird je nach Thematik des Semesters eine spezifische Bibliographie erstellt.
Ernst Cassirer
Philosophie der symbolischen Formen
Hamburg 2010
Hans-Jörg Rheinberg
Experiment - Differenz - Schrift
Zur Geschichte epistemischer Dinge
Marburg 1992
Werner Heisenberg
Ordnung der Wirklichkeit
München 1989
Thomas S. Kuhn
The structure of scientific revolutions
The University of Chicago Press 1962

Course: Economic Sociology (Seminar)

Lecturer:
Dr. Michael Florian

Language:
DE

Cycle:
WS

Content:
Economic sociology means the application of sociological theories, methods, and perspectives in the analysis of economic issues. The seminar is concerned with new developments in economic sociology. Using case studies, the course will offer insights into the strengths and weaknesses of different sociological approaches.

Literature:
Baecker, Dirk: Wirtschaftssoziologie. Transcript: Bielefeld, 2006.
Bourdieu, Pierre et al.: Der Einzige und sein Eigenheim. Erweiterte Neuausgabe. Hamburg: VSA, 2002.
Beckert, Jens: Was ist soziologisch an der Wirtschaftssoziologie? Ungewißheit und die Einbettung wirtschaftlichen Handelns. In: Zeitschrift für Soziologie 25, 1996, S. 125–146.
Beckert, Jens: Grenzen des Marktes. Die sozialen Grundlagen wirtschaftlicher Effizienz. Campus: Frankfurt/New York, 1997
Beckert, Jens; Diaz-Bone, Rainer; Ganßmann, Heiner (Hg.) (2007): Märkte als soziale Strukturen. Frankfurt am Main/New York: Campus-Verlag.
Beckert, Jens; Deutschmann, Christoph (Hg.) (2010): Wirtschaftssoziologie. Sonderheft 49 der Kölner Zeitschrift für Soziologie und Sozialpsychologie: Wiesbaden: VS Verlag für Sozialwissenschaften.
Fligstein, Neil (2011): Die Architektur der Märkte. Wiesbaden: VS Verlag für Sozialwissenschaften.
Florian, Michael; Hillebrandt, Frank (Hg.): Pierre Bourdieu: Neue Perspektiven für die Soziologie der Wirtschaft. VS Verlag für Sozialwissenschaften: Wiesbaden, 2006.
Granovetter, Mark: Ökonomisches Handeln und soziale Struktur: Das Problem der Einbettung. In: Hans-Peter Müller und Steffen Sigmund (Hrsg.): Zeitgenössische amerikanische Soziologie. Leske + Budrich, Opladen 2000, S. 175-207.
Heinemann, Klaus (Hg.): Soziologie wirtschaftlichen Handelns. Sonderheft 28 der Kölner Zeitschrift für Soziologie und Sozialpsychologie. Opladen: Westdeutscher Verlag, 1987
Hirsch-Kreinsen, Hartmut: Wirtschafts- und Industriesoziologie. Grundlagen, Fragestellungen, Themenbereiche. Weinheim/München: Juventa, 2005.
Smelser, Neil J.; Swedberg, Richard (HG.): The Handbook of Economic Sociology. 2nd edition. Princeton/Oxford: Princeton University Press and New York: Russell Sage Foundation: New York, 2005.

Course: Academic Writing for Engineers (Seminar)

Lecturer:
Dr. Janina Lenger

Language:

DE

Cycle:

WS/SS

Content:

Writing is not a talent but a craft. It can only be improved if it is explicitly practiced. Students will acquire the necessary tools and knowledge to successfully write scientific texts in this seminar. Main components are brief inputs, practical exercises and knowledge sharing.
Contents are:
- the basics of writing theory
- components of scientific writing
- methods and exercises for problem solving within the writing process
- dealing with supervisors
- time management

Literature:

M. Cargill, P. O'Connor, Writing Scientific Research Articles, Wiley-Blackwell, Chichester, UK, 2009.
O. Kruse, Keine Angst vor dem leeren Blatt, Campus Verlag, Frankfurt/New York, 2000.
J. Wolfsberger, Frei Geschrieben, Mut Freiheit und Strategie für wissenschaftliche Abschlussarbeiten, UTB, Stuttgart, 2010.
W. Schneider, Deutsch für junge Profis, Rowohlt Taschenbuch Verlag, Reinbek bei Hamburg, 2011.
H.-J. Ortheil, Schreiben dicht am Leben, Dudenverlag, Mannheim – Zürich, 2012.

Module: Process Design Project

Courses:

Title	Typ	Hrs/wk
Process Design Project	Projektierungskurs	6

Module Responsibility:
Dozenten des SD V

Admission Requirements:
none

Recommended Previous Knowledge:

- Particle Technology and Solid Process Engineering
- Transport Processes
- Process- and Plant Design II
- Fluid Mechanics for Process Engineering
- Chemical Reaction Engineering
- Bioprocess- and Biosystems-Engineering

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

Professional Competence:
Theoretical Knowledge:
After the students passed the project course successfully they know:

- how a team is working together so solve a complex task in process engineering
- what kind of tools are necessary to design a process
- what kind of drawbacks and difficulties are coming up by designing a process

Capabilities:
After passing the Module successfully the students are able to:

- utilize tools for process design for a specific given process engineering task,
- choose and connect apparatusses for a complete process,
- collecting all relevant data for an economical and ecological evaluation,
- optimization of calculation sequence with respect to flowsheet simulation.

Personal Competence:
Social Competence:
The students are able to discuss in international teams in english and develop an approach under pressure of time.
Autonomy:
Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice. They are able to organize their own team and to define priorities.

ECTS-Credit points:
6 LP

Examination:
Projektarbeit

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

Assignment for the Following Curricula:
Bioprocess Engineering: Kernqualifikation: Compulsory
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory
Energy and Environmental Engineering: Vertiefung Energy and Environmental Engineering: Compulsory suffrage
Process Engineering: Kernqualifikation: Compulsory

Course: Process Design Project (Projektierungskurs)

Lecturer:
NN

Language:
DE

Cycle:
WS

Content:
In the Process Design Project the students have to design in teams an energy or process engineering plant by calculating and designing single plant components. The calculation of costs as well as the process safety is another important aspect of this course. Furthermore the

approval procedures have to be taken into account.

Literature:

Module: Research project IMP Chemical and Bioprocess Engineering

Courses:

Title	Typ	Hrs/wk
Research Project IMP Chemical and Bioprocess Engineering	Problemorientierte Lehrveranstaltung	6

Module Responsibility:
Dozenten des SD V

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:
6 LP

Examination:
Projektarbeit

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

Assignment for the Following Curricula:
Chemical and Bioprocess Engineering: Kernqualifikation: Compulsory

Course: Research Project IMP Chemical and Bioprocess Engineering (Problemorientierte Lehrveranstaltung)

Lecturer:
Dozenten des SD V

Language:
DE/EN

Cycle:
WS

Content:

Literature:

Specialisation General Process Engineering

In the direction General Process Engineering, the students can construct their program emphasis freely.
For students with correspondingly good German language levels the modules in German language from the Masters Biotechnology and Process Engineering are available as well.

Module: Renewable Energies in Supply Systems

Courses:

Title	Typ	Hrs/wk
Electricity Generation from Renewable Sources of Energy	Seminar	2
Heat Provision from Renewable Sources of Energy	Seminar	2

Module Responsibility:
Prof. Martin Kaltschmitt

Admission Requirements:
none

Recommended Previous Knowledge:
none

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

Professional Competence:
Theoretical Knowledge:
The students can describe current issue and problems in the field of renewable energies. Furthermore, they can explain aspects in relation to the provision of heat or electricity through different renewable technologies, and explain and assess them in a technical, economical and environmental way.

Capabilities:
Students are able to solve scientific problems in the context of heat and electricity supply using renewable energy systems by:

- using module-comprehensive knowledge for different applications,
- evaluating alternative input parameter regarding the solution of the task in the case of incomplete information (technical, economical and ecological parameter),
- a systematic documentation of the work results in form of a written version, the presentation itself and the defense of contents.

Personal Competence:
Social Competence:
Students can

- respectfully work together as a team with around 2-3 members,
- participate in subject-specific and interdisciplinary discussions in the area of dimensioning and analysis of potentials of heat and electricty supply using renewable energie, and can develop cooperated solutions,
- defend their own work results in front of fellow students and
- assess the performance of fellow students in comparison to their own performance. Furthermore, they can accept professional constructive criticism.

Autonomy:
Students can independently tap knowledge regarding to the given task. 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:
5 LP

Examination:
Schriftliche Ausarbeitung

Workload in Hours:
Indipendent Study Time: 94, 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
Renewable Energies: Vertiefung Bio energies: Compulsory
Renewable Energies: Vertiefung Wind energy: Compulsory

Course: Electricity Generation from Renewable Sources of Energy (Seminar)

Lecturer:

Prof. Martin Kaltschmitt

Language:
DE/EN

Cycle:
WS

Content:

- Preliminary discussion with the seminar rules
- Distribution of the topics related to the subject of the seminar to individual students / groups of students (depending on the number of participating students)
- Delivery of a five-page summary of the seminar topic and distribution to the participants by the student / group of students
- Presentation of the processed topic (30 min) with PPT presentation and subsequent discussion (20 minutes)
- Attendance is mandatory for all seminars

Literature:

- Eigenständiges Literaturstudium in der Bibliothek und aus anderen Quellen.

Course: Heat Provision from Renewable Sources of Energy (Seminar)

Lecturer:
Prof. Martin Kaltschmitt

Language:
DE/EN

Cycle:
SS

Content:

- Preliminary discussion with the seminar rules
- Distribution of the topics related to the subject of the seminar to individual students / groups of students (depending on the number of participating students)
- Delivery of a five-page summary of the seminar topic and distribution to the participants by the student / group of students
- Presentation of the processed topic (30 min) with PPT presentation and subsequent discussion (20 minutes)
- Attendance is mandatory for all seminars

Literature:
Eigenständiges Literaturstudium in der Bibliothek und aus anderen Quellen.

Module: High Pressure Chemical Engineering

Courses:

Title	Typ	Hrs/wk
Industrial Processes Under High Pressure	Vorlesung	2
Advanced Separation Processes	Vorlesung	2

Module Responsibility:
Dr. Monika Johannsen

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of Chemistry, Chemical Engineering, Fluid Process Engineering, Thermal Separation Processes, Thermodynamics, Heterogeneous Equilibria

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

Professional Competence:
Theoretical Knowledge:
After a successful completion of this module, students can:

- explain the influence of pressure on the properties of compounds, phase equilibria, and production processes,
- describe the thermodynamic fundamentals of separation processes with supercritical fluids,
- exemplify models for the description of solid extraction and countercurrent extraction,
- discuss parameters for optimization of processes with supercritical fluids.

Capabilities:
After successful completion of this module, students are able to:

- compare separation processes with supercritical fluids and conventional solvents,
- assess the application potential of high-pressure processes at a given separation task,
- include high pressure methods in a given multistep industrial application,
- estimate economics of high-pressure processes in terms of investment and operating costs,
- perform an experiment with a high pressure apparatus under guidance,
- evaluate experimental results,
- prepare an experimental protocol.

Personal Competence:
Social Competence:
After successful completion of this module, students are able to:

- present a scientific topic from an original publication in teams of 2 and defend the contents together.

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
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
International Management and Engineering: Vertiefung II. Process Engineering and Biotechnology: Compulsory suffrage
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Industrial Processes Under High Pressure (Vorlesung)

Lecturer:
Dr. Carsten Zetzl

Language:
EN

Cycle:
SS

Content:
Part I : Physical Chemistry and Thermodynamics
1. Introduction: Overview, achieving high pressure, range of parameters.
2. Influence of pressure on properties of fluids: P,v,T-behaviour, enthalpy, internal energy, entropy, heat capacity, viscosity, thermal conductivity, diffusion coefficients, interfacial tension.
3. Influence of pressure on heterogeneous equilibria: Phenomenology of phase equilibria
4. Overview on calculation methods for (high pressure) phase equilibria).
Influence of pressure on transport processes, heat and mass transfer.
Part II : High Pressure Processes
5. Separation processes at elevated pressures: Absorption, adsorption (pressure swing adsorption), distillation (distillation of air), condensation (liquefaction of gases)
6. Supercritical fluids as solvents: Gas extraction, cleaning, solvents in reacting systems, dyeing, impregnation, particle formation (formulation)
7. Reactions at elevated pressures. Influence of elevated pressure on biochemical systems: Resistance against pressure
Part III : Industrial production
8. Reaction : Haber-Bosch-process, methanol-synthesis, polymerizations; Hydrations, pyrolysis, hydrocracking; Wet air oxidation, supercritical water oxidation (SCWO)
9. Separation : Linde Process, De-Caffeination, Petrol and Bio-Refinery
10. Industrial High Pressure Applications in Biofuel and Biodiesel Production
11. Sterilization and Enzyme Catalysis
12. Solids handling in high pressure processes, feeding and removal of solids, transport within the reactor.
13. Supercritical fluids for materials processing.
14. Cost Engineering
Learning Outcomes:
After a successful completion of this module, the student should be able to
- understand of the influences of pressure on properties of compounds, phase equilibria, and production processes.
- Apply high pressure approches in the complex process design tasks
- Estimate Efficiency of high pressure alternatives with respect to investment and operational costs

Performance Record:
1. Presence (28 h)
2. Oral presentation of original scientific article (15 min) with written summary
3. Written examination and Case study
(2+3 : 32 h Workload)
Workload:
60 hours total

Literature:
Literatur:
Script: High Pressure Chemical Engineering.
G. Brunner: Gas Extraction. An Introduction to Fundamentals of Supercritical Fluids and the Application to Separation Processes. Steinkopff, Darmstadt, Springer, New York, 1994.

Course: Advanced Separation Processes (Vorlesung)

Lecturer:
Dr. Monika Johannsen

Language:
EN

Cycle:
SS

Content:

- Introduction/Overview on Properties of Supercritical Fluids (SCF)and their Application in Gas Extraction Processes
- Solubility of Compounds in Supercritical Fluids and Phase Equilibrium with SCF
- Extraction from Solid Substrates: Fundamentals, Hydrodynamics and Mass Transfer
- Extraction from Solid Substrates: Applications and Processes (including Supercritical Water)
- Countercurrent Multistage Extraction: Fundamentals and Methods, Hydrodynamics and Mass Transfer
- Countercurrent Multistage Extraction: Applications and Processes
- Solvent Cycle, Methods for Precipitation
- Supercritical Fluid Chromatography (SFC): Fundamentals and Application
- Simulated Moving Bed Chromatography (SMB)
- Membrane Separation of Gases at High Pressures
- Separation by Reactions in Supercritical Fluids (Enzymes)

Literature:

G. Brunner: Gas Extraction. An Introduction to Fundamentals of Supercritical Fluids and the Application to Separation Processes. Steinkopff, Darmstadt, Springer, New York, 1994.

Module: Cell and Tissue Engineering

Courses:

Title	Typ	Hrs/wk
Fundamentals of Cell and Tissue Engineering	Vorlesung	3
Bioprocess Engineering for Medical Applications	Vorlesung	3

Module Responsibility:
Dr. Ralf Pörtner

Admission Requirements:
Bachelor VT, BVT

Recommended Previous Knowledge:
Knowledge of bioprocess engineering and process engineering at bachelor level

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

Professional Competence:
Theoretical Knowledge:
After successful completion of the module the students
- know the basic principles of cell and tissue culture
- know the relevant metabolic and physiological properties of animal and human cells
- are able to explain and describe the basic underlying principles of bioreactors for cell and tissue cultures, in contrast to microbial fermentations
- are able to explain the essential steps (unit operations) in downstream
- are able to explain, analyze and describe the kinetic relationships and significant litigation strategies for cell culture reactors

Capabilities:
The students are able
- to analyze and perform mathematical modeling to cellular metabolism at a higher level
- are able to to develop process control strategies for cell culture systems

Personal Competence:
Social Competence:

Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

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

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 Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Theoretical Mechanical Engineering: Vertiefung Bio- and Medical Technology: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Fundamentals of Cell and Tissue Engineering (Vorlesung)

Lecturer:
Dr. Ralf Pörtner, Prof. An-Ping Zeng

Language:
EN

Cycle:
SS

Content:
Overview of cell culture technology and tissue engineering (cell culture product manufacturing, complexity of protein therapeutics, examples of tissue engineering) (Pörtner, Zeng) Fundamentals of cell biology for process engineering (cells: source, composition and structure. interactions with environment, growth and death – cell cycle, protein glycolysation) (Pörtner) Cell physiology for process engineering (Overview of central metabolism, genomics etc.) (Zeng) Medium design (impact of media on the overall cell culture process, basic components of culture medium, serum and protein-free media) (Pörtner) Stochiometry and kinetics of cell growth and product formation (growth of mammalian cells, quantitative description of cell growth & product formation, kinetics of growth)

Literature:

Butler, M (2004) Animal Cell Culture Technology – The basics, 2nd ed. Oxford University Press
Ozturk SS, Hu WS (eds) (2006) Cell Culture Technology For Pharmaceutical and Cell-Based Therapies. Taylor & Francis Group, New York
Eibl, R.; D. Eibl; R. Pörtner; G. Catapano and P. Czermak: Cell and Tissue Reaction Engineering, Springer (2008). ISBN 978-3-540-68175-5
Pörtner R (ed) (2013) Animal Cell Biotechnology – Methods and Protocols. Humana Press

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Course: Bioprocess Engineering for Medical Applications (Vorlesung)

Lecturer:
Dr. Ralf Pörtner

Language:
EN

Cycle:
SS

Content:
Requirements for cell culture processess, shear effects, microcarrier technology Reactor systems for mammalian cell culture (production systems) (design, layout, scale-up: suspension reactors (stirrer, aeration, cell retention), fixed bed, fluidized bed (carrier), hollow fiber reactors (membranes), dialysis reactors, Reactor systems for Tissue Engineering, Prozess strategies (batch, fed-batch, continuous, perfusion, mathematical modelling), control (oxygen, substrate etc.) • Downstream

Literature:

Butler, M (2004) Animal Cell Culture Technology – The basics, 2nd ed. Oxford University Press
Ozturk SS, Hu WS (eds) (2006) Cell Culture Technology For Pharmaceutical and Cell-Based Therapies. Taylor & Francis Group, New York
Eibl, R.; D. Eibl; R. Pörtner; G. Catapano and P. Czermak: Cell and Tissue Reaction Engineering, Springer (2008). ISBN 978-3-540-68175-5
Pörtner R (ed) (2013) Animal Cell Biotechnology – Methods and Protocols. Humana Press

Courses:

Title	Typ	Hrs/wk
Numerical Treatment of Ordinary Partial Differential Equations	Vorlesung	2
Numerical Treatment of Ordinary Partial Differential Equations	Gruppenübung	2

Module Responsibility:
Prof. Sabine Le Borne

Admission Requirements:

- Mathematik I, II, III for Engineering Students (german or english)

or

- Analysis & Linear Algebra I + II for Technomathematicians
- Analysis III for Technomathematicians

Recommended Previous Knowledge:

- Lecture material of prerequisite lectures
- basic MATLAB knowledge

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

Professional Competence:
Theoretical Knowledge:
Students are able to

- list numerical methods for the solution of ordinary differential equations and explain their core ideas,
- repeat convergence statements for the treated numerical methods (including the prerequisites tied to the underlying problem),
- explain aspects regarding the practical execution of a method.

Capabilities:
Students are able to

- implement (MATLAB), apply and compare numerical methods for the solution of ordinary differential equations,
- to justify the convergence behaviour of numerical methods with respect to the posed problem and selected algorithm,
- for a given problem, develop a suitable solution approach, if necessary by the composition of several algorithms, to execute this approach and to critically evaluate the results.

Personal Competence:
Social Competence:
Students are able to

- work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.

Autonomy:
Students are capable

- to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
- to assess their individual progess and, if necessary, to ask questions and seek help.

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
Chemical and Bioprocess Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Electrical Engineering: Vertiefung Control and Power Systems: Compulsory suffrage
Computational Science and Engineering: Vertiefung Scientific Computing: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Technomathematics: Vertiefung Mathematics: Compulsory suffrage
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory

Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Numerical Treatment of Ordinary Partial Differential Equations (Vorlesung)

Lecturer:
Prof. Sabine Le Borne, Dr. Christian Seifert

Language:
DE/EN

Cycle:
SS

Content:
Numerical methods for Initial Value Problems

- single step methods
- multistep methods
- stiff problems
- differential algebraic equations (DAE) of index 1

Numerical methods for Boundary Value Problems

- initial value methods
- multiple shooting method
- difference methods
- variational methods

Literature:

- E. Hairer, S. Noersett, G. Wanner: Solving Ordinary Differential Equations I: Nonstiff Problems
- E. Hairer, G. Wanner: Solving Ordinary Differential Equations II: Stiff and Differential-Algebraic Problems

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Course: Numerical Treatment of Ordinary Partial Differential Equations (Übung)

Lecturer:
Prof. Sabine Le Borne, Dr. Christian Seifert

Language:
DE/EN

Cycle:
SS

Content:
Numerical methods for Initial Value Problems

- single step methods
- multistep methods
- stiff problems
- differential algebraic equations (DAE) of index 1

Numerical methods for Boundary Value Problems

- initial value methods
- multiple shooting method
- difference methods
- variational methods

Literature:

- E. Hairer, S. Noersett, G. Wanner: Solving Ordinary Differential Equations I: Nonstiff Problems
- E. Hairer, G. Wanner: Solving Ordinary Differential Equations II: Stiff and Differential-Algebraic Problems

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)

Courses:

Title	Typ	Hrs/wk
Computational Fluid Dynamics - Exercises in OpenFoam	Gruppenübung	1
Computational Fluid Dynamics in Process Engineering	Vorlesung	2
Statistical Thermodynamics and Molecular Modelling	Vorlesung	2

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:

- Mathematics I-IV
- Fundamentals in Fluid Mechanics

Recommended Previous Knowledge:

- Mathematics
- Basic knowledge in Fluid Mechanics
- Basic knowledge in chemical thermodynamics

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

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

- explain the the basic principles of statistical thermodynamics (ensembles, simple systems)
- describe the main approaches in classical Molecular Modeling (Monte Carlo, Molecular Dynamics) in various ensembles
- discuss examples of computer programs in detail,
- evaluate the application of numerical simulations,
- list the possible start and boundary conditions for a numerical simulation.

Capabilities:
The students are able to:

- set up computer programs for solving simple problems by Monte Carlo or molecular dynamics,
- solve problems by molecular modeling,
- set up a numerical grid,
- perform a simple numerical simulation with OpenFoam,
- evaluate the result of a numerical simulation.

Personal Competence:
Social Competence:
The students are able to

- develop joint solutions in mixed teams and present them in front of the other students,
- to collaborate in a team and to reflect their own contribution toward it.

Autonomy:
The students are able to:

- evaluate their learning progress and to define the following steps of learning on that basis,
- evaluate possible consequences for their profession.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

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
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
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Computational Fluid Dynamics - Exercises in OpenFoam (Übung)

Lecturer:
Prof. Michael Schlüter

Language:
EN

Cycle:
SS

Content:

- generation of numerical grids with a common grid generator
- selection of models and boundary conditions
- basic numerical simulation with OpenFoam within the TUHH CIP-Pool

Literature:
OpenFoam Tutorials (StudIP)

Course: Computational Fluid Dynamics in Process Engineering (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
EN

Cycle:
SS

Content:

- Introduction into partial differential equations
- Basic equations
- Boundary conditions and grids
- Numerical methods
- Finite difference method
- Finite volume method
- Time discretisation and stability
- Population balance
- Multiphase Systems
- Modeling of Turbulent Flows
- Exercises: Stability Analysis
- Exercises: Example on CFD - analytically/numerically

Literature:
Paschedag A.R.: CFD in der Verfahrenstechnik: Allgemeine Grundlagen und mehrphasige Anwendungen, Wiley-VCH, 2004 ISBN 3-527-30994-2.
Ferziger, J.H.; Peric, M.: Numerische Strömungsmechanik. Springer-Verlag, Berlin, 2008, ISBN: 3540675868.
Ferziger, J.H.; Peric, M.: Computational Methods for Fluid Dynamics. Springer, 2002, ISBN 3-540-42074-6

Course: Statistical Thermodynamics and Molecular Modelling (Vorlesung)

Lecturer:
Dr. Sven Jakobtorweihen

Language:
EN

Cycle:
SS

Content:

- **Some lectures will be carried out as computer exercises**
- Introduction to Statistical Mechanics
- The ensemble concept

- The classical limit
- Intermolecular potentials, force fields
- Monte Carlo simulations (acceptance rules) (Übungen im Rechnerpool) (exercises in computer pool)
- Molecular Dynamics Simulations (integration of equations of motion, calculating transport properties) (exercises in computer pool)
- Molecular simulation of Phase equilibria (Gibbs Ensemble)
- Methods for the calculation of free energies

Literature:

Daan Frenkel, Berend Smit: Understanding Molecular Simulation, Academic Press
M. P. Allen, D. J. Tildesley: Computer Simulations of Liquids, Oxford Univ. Press
A.R. Leach: Molecular Modelling – Principles and Applications, Prentice Hall, N.Y.
D. A. McQuarrie: Statistical Mechanics, University Science Books
T. L. Hill: Statistical Mechanics , Dover Publications

Module: Processes at Interfaces

Courses:

Title	Typ	Hrs/wk
Interfaces and Colloids	Vorlesung	2
Phase Transitions	Vorlesung	2

Module Responsibility:
Prof. Rudolf Eggers

Admission Requirements:
none

Recommended Previous Knowledge:
Heat and Mass Transfer, Separation Techniques, Thermodynamics

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

Professional Competence:
Theoretical Knowledge:
After finishing the module students are able to describe in detail the thermodynamic laws at phase boundaries. They have knowledge on experimental methods for interfacial tensions and wetting angles.

Capabilities:
Students have the capability of designing evaporators and condensors related to fixed process parameters

Personal Competence:
Social Competence:
-Students are working in small groups and elaborate special problems in order to demonstrate the results in a presentation.
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Schriftliche Ausarbeitung

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 Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Interfaces and Colloids (Vorlesung)

Lecturer:
Dr. Philip Jaeger, Dr. Philip Jaeger

Language:
DE/EN

Cycle:
WS

Content:
1.Fundamentals, definitions 1.1 Thermodynamics of interfaces 1.2 Surfactants 1.3 Interfacial tension (Principles, Methods, Examples) 1.4 Wetting, adhesion 2.Dispersions 2.1 Droplet formation 2.2 Stabilization 2.3 Physical Properties 2.4 Rheology 2.5 Microemulsions 3. Transport Phenomena 3.1 Mass transport across phase boundaries 3.2 Interfacial convection – Marangoni flow 3.3 Influence of surfactants on interfacial area and transport resistance (bubbles, droplets, falling films) 4. Applications 4.1 Food Emulsification 4.2 Crude oil recovery (EOR) 4.3 Coating 4.4 Separation technology (Spray towers, packed columns) 4.5 Nucleation (Polymer foams, evaporation) 4.6 Recent developments (Surfactant aided extraction)

Literature:
A.W. Adamson: Physical Chemistry of Surfaces, 5th ed., J. Wiley & Sons New York, 1990. P. Becher : Emulsions – Theory and Practice, 1965. P. Becher : Encyclopedia of Emulsion Technology, Vol. 1, Dekker New York, 1983. S.S. Dukhin, G. Kretzschmar, R. Miller: Dynamics of Adsorption at Liquid Interfaces, Elsevier Amsterdam, 1995. D.J. McClements: Food Emulsions – Principle, Practices and Techniques, 2nd ed., CRC Press Boca Raton, 2005. D. Myers: Surfaces, Interfaces and Colloids, VCH-Verlagsgesellschaft Weinheim, 1991. P. Sherman: Emulsion Science, 1968. J. Lyklema: Fundamentals of Interface and Colloid Science, Vol. III, Academic Press London, 2000. A.I. Rusanov: Phasengleichgewichte und Grenzflächenerscheinungen, Akademie Verlag, Berlin 1978. P. C. Hiemenz, R. Rajagopalan:

Principles of Colloid and Surface Chemistry, 3rd ed. Marcel Dekker, New York 1997. P. Grassmann: Physikalische Grundlagen der Verfahrenstechnik, Verlag Salle und Sauerländer, 1983. M.J. Schwuger: Lehrbuch der Grenzflächenchemie, Thieme Verlag, 1996.

Course: Phase Transitions (Vorlesung)

Lecturer:
Prof. Rudolf Eggers

Language:
DE/EN

Cycle:
WS

Content:
Drop formation, film development, condensation of non moving and vapour, condensation of moving vapour, partial condensation, bubble forming (nucleation), free convection boiling, nucleation boiling, film boiling, boiling crisis, apparatus for condensation and evaporation

Literature:
F. Incropea, D. de Witt: Heat and Mass Transfer, Wiley and Sons, 2002
V. Gnielinski, A. Mersmann, F. Thurner: Verdampfung, Vieweg Verlag 1993
K. Stephan: Wärmeübergang beim Kondensieren und beim Sieden, Springer Verlag 1988
N. Kolev: Transiente Zweiphasenströmung Springer Verlag 1986
VDI Wärmeatlas, 2013, 11. Auflage, VDI Verlag

Module: Industrial Process Automation

Courses:

Title	Typ	Hrs/wk
Industrial Process Automation	Vorlesung	2
Industrial Process Automation	Gruppenübung	2

Module Responsibility:
Prof. Alexander Schlaefer

Admission Requirements:

Recommended Previous Knowledge:
principles of mathematics

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

Professional Competence:
Theoretical Knowledge:
The students can evaluated and assess disctrete event systems. They can evaluate properties of processes and explain methods for process analysis. The students can compare methods for process modelling and select an appropriate method for actual problems. They can discuss scheduling methods in the context of actual problems and give a detailed explanation of advantages and disadvantages of different programming methods.

Capabilities:
The students are able to develop and modeling processes anymore they can evaluate them. This involves taking into account optimal scheduling, understanding algorithmic complexity and implementation using PLCs.

Personal Competence:
Social Competence:
The students work in teams to solve problems.

Autonomy:
The students can reflect their knowledge and document the results of their work.

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 Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Electrical Engineering: Vertiefung Control and Power Systems: Compulsory suffrage
International Management and Engineering: Vertiefung II. Mechatronics: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Theoretical Mechanical Engineering: Vertiefung Computer Science: Compulsory suffrage
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Industrial Process Automation (Vorlesung)

Lecturer:
Prof. Alexander Schlaefer

Language:
EN

Cycle:
WS

Content:
- foundations of problem solving and system modeling, discrete event systems
- properties of processes, modeling using automat and Petri-nets
- design considerations for processes (mutex, deadlock avoidance, liveness)
- optimal scheduling for processes
- optimal decisions when planning manufacturing systems, decisions under uncertainty
- software design and software architectures for automation, PLCs

Literature:

J. Lunze: „Automatisierungstechnik“, Oldenbourg Verlag, 2012
Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010
Hrúz, Zhou: Modeling and Control of Discrete-event Dynamic Systems; Springer 2007
Li, Zhou: Deadlock Resolution in Automated Manufacturing Systems, Springer 2009
Pinedo: Planning and Scheduling in Manufacturing and Services, Springer 2009

Course: Industrial Process Automation (Übung)

Lecturer:

Prof. Alexander Schlaefer

Language:

EN

Cycle:

WS

Content:

- foundations of problem solving and system modeling, discrete event systems
- properties of processes, modeling using automat and Petri-nets
- design considerations for processes (mutex, deadlock avoidance, liveness)
- optimal scheduling for processes
- optimal decisions when planning manufacturing systems, decisions under uncertainty
- software design and software architectures for automation, PLCs

Literature:

J. Lunze: „Automatisierungstechnik“, Oldenbourg Verlag, 2012
Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010
Hrúz, Zhou: Modeling and Control of Discrete-event Dynamic Systems; Springer 2007
Li, Zhou: Deadlock Resolution in Automated Manufacturing Systems, Springer 2009
Pinedo: Planning and Scheduling in Manufacturing and Services, Springer 2009

Module: Algebraic Statistics for Computational Biology

Courses:

Title	Typ	Hrs/wk
Algebraic Statistics for Computational Biology	Gruppenübung	2
Algebraic Statistics for Computational Biology	Vorlesung	2

Module Responsibility:
Prof. Karl-Heinz Zimmermann

Admission Requirements:
None.

Recommended Previous Knowledge:
Mathematical Calculus, Linear Algebra, and Higher Abstract Algebra.

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

Professional Competence:
Theoretical Knowledge:
The students know the alignment of sequences, the hidden Markov model, and phylogenetic tree models including the respective algorithms. Moreover, they know the EM algorithm, general algebraic statistical models and developping invariants for them, Gröbner bases in polynomial rings, elimination theory for systems of polynomial equations, and the use of computer algebra systems to solve problems in the context of this class.
Capabilities:
The students are able to formalize, compute, and analyze alignments of sequences, hidden Markov models, and phylogenetic tree models. Moreover, they can compute Gröbner bases in polynomial rings, use elimination theory to tackle systems of polynomial equations, and provide invariants for algebraic statistical models.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly.
Autonomy:
Students are able to acquire new knowledge from newer literature and to associate this knowledge with other fields.

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
Chemical and Bioprocess Engineering: Vertiefung Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Computer Science: Kernqualifikation: Compulsory suffrage
Computational Science and Engineering: Kernqualifikation: Compulsory suffrage
International Management and Engineering: Vertiefung II. Information Technology: Compulsory suffrage

Course: Algebraic Statistics for Computational Biology (Übung)

Lecturer:
Prof. Karl-Heinz Zimmermann

Language:
DE/EN

Cycle:
WS

Content:

Literature:

Course: Algebraic Statistics for Computational Biology (Vorlesung)

Lecturer:
Prof. Karl-Heinz Zimmermann

Language:
DE/EN

Cycle:

WS

Content:

Literature:

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: 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: 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: Applied Bioinformatics

Courses:

Title	Typ	Hrs/wk
Applied Bioinformatics	Vorlesung	3
Applied Bioinformatics	Gruppenübung	3

Module Responsibility:
Prof. An-Ping Zeng

Admission Requirements:
Bachelor VT, BVT or equivalent

Recommended Previous Knowledge:
Basic knowledge of bioprocess engineering and information technology

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

Professional Competence:
Theoretical Knowledge:
After passing the module students are able to describe different methods to analyze sequence and structure of biomolecules. Especially they can explain different algorithms to align sequences in detail. Students can elucidate the relationship of protein sequence and structure and can explain the limitations of structural models.
Furthermore students are able to explain concepts of the design of bioactive compounds and to designate characteristics of quantitative structure-activity relationships (QSAR), molecular pattern recognition and molecular docking.
Capabilities:
Students are able to analyze sequences of proteins independently and to choose and usage respective databases for the particular question. They can also critically evaluate models of protein structures and interpret structural and sequential similarities on the basis of the theory of evolution.
Students are able to use software (e.g. PyMOL) for molecular visualization and modeling of biomolecules. Due to the generality of the acquired software skills and the independent usage of the software, students can become acquainted with unknown programs in future. They can accomplish in silico interaction studies and interpret and discuss the quality of their results and data.

Personal Competence:
Social Competence:
After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork.

Autonomy:
Students are able to solve typical questions and problems in the field of bioinformatics independently.

ECTS-Credit points:
6 LP

Examination:
Klausur

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

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 Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Computer Science: Vertiefung Intelligence Engineering: Compulsory suffrage

Course: Applied Bioinformatics (Vorlesung)

Lecturer:
Prof. An-Ping Zeng, Prof. Matthias Rarey, Prof. Andrew Torda

Language:
EN

Cycle:
WS

Content:
The lecture is split in two parts. The first part starts with an introduction into sequence analysis (protein and nucleotides) and deals with the question why and how biological sequences are compared and searched in databases. Furthermore computer-based prediction and analysis of protein structures and functions are presented and the reliability of these methods is discussed. Finally, evolutionary basics of the relation of proteins, and what can be learned from additional experimental data, is discussed.

In the second half of the lecture basic concepts of modeling and the usage of respective software is taught. In this part some techniques like the visualization and analysis of protein-ligand-complexes, the usage of biochemical data sources, computer-compatible depiction of molecules and molecular pattern recognition, principles of quantitative structure–activity relationships (QSAR) and molecular relationships and also molecular docking are approached.
During the exercises the content of the lecture is applied and studied in more detail with current software.

Literature:
"Understanding Bioinformatics" Zvelebil, M.J. & Baum, J.O.

Course: Applied Bioinformatics (Übung)

Lecturer:
Prof. An-Ping Zeng

Language:
EN

Cycle:
WS

Content:
The lecture is split in two parts. The first part starts with an introduction into sequence analysis (protein and nucleotides) and deals with the question why and how biological sequences are compared and searched in databases. Furthermore computer-based prediction and analysis of protein structures and functions are presented and the reliability of these methods is discussed. Finally, evolutionary basics of the relation of proteins, and what can be learned from additional experimental data, is discussed.
In the second half of the lecture basic concepts of modeling and the usage of respective software is taught. In this part some techniques like the visualization and analysis of protein-ligand-complexes, the usage of biochemical data sources, computer-compatible depiction of molecules and molecular pattern recognition, principles of quantitative structure–activity relationships (QSAR) and molecular relationships and also molecular docking are approached.
During the exercises the content of the lecture is applied and studied in more detail with current software.

Literature:
"Understanding Bioinformatics" Zvelebil, M.J. & Baum, J.O.

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: Industrial Biotransformations

Courses:

Title	Typ	Hrs/wk
Trends in Biotechnology	Seminar	2
Trends in Industrial Biocatalysis	Seminar	2

Module Responsibility:
Prof. Andreas Liese

Admission Requirements:
Bachelor VT, BVT or equivalent

Recommended Previous Knowledge:
Knowledge of bioprocess engineering and process engineering at bachelor level

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

Professional Competence:
Theoretical Knowledge:
After successful completion of the module

- the students can outline the current status of research on the specific topics discussed
- the students can explain the basic underlying principles of the respective industrial biotransformations

Capabilities:
After successful completion of the module students are able to

- analyze and evaluate current research approaches
- plan industrial biotransformations basically

Personal Competence:
Social Competence:
Students are able to work together as a team with several students to solve given tasks and discuss their results in the plenary and to defend them.
Autonomy:
The students are able independently to present the results of their subtasks in a presentation

ECTS-Credit points:
6 LP

Examination:
Referat

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 Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Biotechnology: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Trends in Biotechnology (Seminar)

Lecturer:
Prof. Rudolf Müller

Language:
EN

Cycle:
WS

Content:
At the beginning of the semester a recent review article from the journal Trends in Biotechnologie is distributed to the students. The contents of this article shall be presented, evaluated and discussed with the fellow students.

Literature:
Artikel aus der Zeitschrift Trends in Biotechnology, die an die Studenten zu Beginn des Semesters verteilt werden.

Course: Trends in Industrial Biocatalysis (Seminar)

Lecturer:
Prof. Andreas Liese

Language:
EN

Cycle:
WS

Content:

- Presentation and evaluation of 20-minute student lectures discussing a case study of an industrial biotransformation
- The contents of this article shall be presented, evaluated and discussed with the fellow students.

Literature:

- A. Liese, K. Seelbach, C. Wandrey: Industrial Biotransformations, Wiley-VCH, 2006
- selected scientific papers, that will be distributed during the course of the lecture

Module: Process Engineering for Materials

Courses:

Title	Typ	Hrs/wk
Ceramics Technology	Vorlesung	2
Manufacturing with Polymers and Composites	Vorlesung	2

Module Responsibility:
Prof. Stefan Heinrich

Admission Requirements:
none

Recommended Previous Knowledge:
Basic knowledge in physics, chemistry, mechanics, mathematics

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

Professional Competence:
Theoretical Knowledge:
After successful participation in the module students will be able to explain the different types of materials and composites and their production processes. They know the most important properties and fields of applications.

Capabilities:
Students are able to choose the right material for a certain technical application. They are able to estimate the effort for production as well as the potential for optimization and adaption of materials for certain conditions. They are able to transform a verbal formulated message into an abstract formal procedure.

Personal Competence:
Social Competence:
The students are able to discuss given problems in small groups and to develop a common approach.
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
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Ceramics Technology (Vorlesung)

Lecturer:
Dr. Rolf Janßen

Language:
DE/EN

Cycle:
WS

Content:
Introduction to ceramic processing with emphasis on advanced structural ceramics. The course focus predominatly on powder-based processing, e.g. “powder-metauurgical techniques and sintering (soild state and liquid phase). Also, some aspects of glass and cement science as well as new developments in powderless forming techniques of ceramics and ceramic composites will be addressed Examples will be discussed in order to give engineering students an understanding of technology development and specific applications of ceramic components.

Content: / Inhalt:
1. Introduction
2. Raw materials
3. Powder fabrication
4. Powder processing
5. Shape-forming processes
6. Densification, sintering
7. Glass and Cement technology
8. Ceramic-metal joining techniques

Literature:

W.D. Kingery, „Introduction to Ceramics“, John Wiley & Sons, New York, 1975
ASM Engineering Materials Handbook Vol.4 „Ceramics and Glasses“, 1991
D.W. Richerson, „Modern Ceramic Engineering“, Marcel Decker, New York, 1992

Skript zur Vorlesung

Course: Manufacturing with Polymers and Composites (Vorlesung)

Lecturer:

Prof. Bodo Fiedler

Language:

EN

Cycle:

SS

Content:

Manufacturing of Polymers: General Properties; Calendering; Extrusion; Injection Moulding; Thermoforming, Foaming; Joining
Manufacturing of Composites: Hand Lay-Up; Pre-Preg; GMT, BMC; SMC, RIM; Pultrusion; Filament Winding

Literature:

Osswald, Menges: Materials Science of Polymers for Engineers, Hanser Verlag
Crawford: Plastics engineering, Pergamon Press
Michaeli: Einführung in die Kunststoffverarbeitung, Hanser Verlag
Åström: Manufacturing of Polymer Composites, Chapman and Hall

Specialisation Bioprocess Engineering

In this study programm direction the emphasis is on the area of Bioprocess and Biotechnology Engineering.
For students with correspondingly good German language levels the modules in German language from the Master Biotechnology are available as well.

Module: Cell and Tissue Engineering

Courses:

Title	Typ	Hrs/wk
Fundamentals of Cell and Tissue Engineering	Vorlesung	3
Bioprocess Engineering for Medical Applications	Vorlesung	3

Module Responsibility:
Dr. Ralf Pörtner

Admission Requirements:
Bachelor VT, BVT

Recommended Previous Knowledge:
Knowledge of bioprocess engineering and process engineering at bachelor level

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

Professional Competence:
Theoretical Knowledge:
After successful completion of the module the students
- know the basic principles of cell and tissue culture
- know the relevant metabolic and physiological properties of animal and human cells
- are able to explain and describe the basic underlying principles of bioreactors for cell and tissue cultures, in contrast to microbial fermentations
- are able to explain the essential steps (unit operations) in downstream
- are able to explain, analyze and describe the kinetic relationships and significant litigation strategies for cell culture reactors

Capabilities:
The students are able
- to analyze and perform mathematical modeling to cellular metabolism at a higher level
- are able to to develop process control strategies for cell culture systems

Personal Competence:
Social Competence:

Autonomy:

ECTS-Credit points:
6 LP

Examination:
Klausur

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

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 Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Theoretical Mechanical Engineering: Vertiefung Bio- and Medical Technology: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Fundamentals of Cell and Tissue Engineering (Vorlesung)

Lecturer:
Dr. Ralf Pörtner, Prof. An-Ping Zeng

Language:
EN

Cycle:
SS

Content:

Overview of cell culture technology and tissue engineering (cell culture product manufacturing, complexity of protein therapeutics, examples of tissue engineering) (Pörtner, Zeng) Fundamentals of cell biology for process engineering (cells: source, composition and structure. interactions with environment, growth and death – cell cycle, protein glycolysation) (Pörtner) Cell physiology for process engineering (Overview of central metabolism, genomics etc.) (Zeng) Medium design (impact of media on the overall cell culture process, basic components of culture medium, serum and protein-free media) (Pörtner) Stochiometry and kinetics of cell growth and product formation (growth of mammalian cells, quantitative description of cell growth & product formation, kinetics of growth)

Literature:

Butler, M (2004) Animal Cell Culture Technology – The basics, 2nd ed. Oxford University Press
Ozturk SS, Hu WS (eds) (2006) Cell Culture Technology For Pharmaceutical and Cell-Based Therapies. Taylor & Francis Group, New York
Eibl, R.; D. Eibl; R. Pörtner; G. Catapano and P. Czermak: Cell and Tissue Reaction Engineering, Springer (2008). ISBN 978-3-540-68175-5
Pörtner R (ed) (2013) Animal Cell Biotechnology – Methods and Protocols. Humana Press

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Course: Bioprocess Engineering for Medical Applications (Vorlesung)

Lecturer:

Dr. Ralf Pörtner

Language:

EN

Cycle:

SS

Content:

Requirements for cell culture processess, shear effects, microcarrier technology Reactor systems for mammalian cell culture (production systems) (design, layout, scale-up: suspension reactors (stirrer, aeration, cell retention), fixed bed, fluidized bed (carrier), hollow fiber reactors (membranes), dialysis reactors, Reactor systems for Tissue Engineering, Prozess strategies (batch, fed-batch, continuous, perfusion, mathematical modelling), control (oxygen, substrate etc.) • Downstream

Literature:

Butler, M (2004) Animal Cell Culture Technology – The basics, 2nd ed. Oxford University Press
Ozturk SS, Hu WS (eds) (2006) Cell Culture Technology For Pharmaceutical and Cell-Based Therapies. Taylor & Francis Group, New York
Eibl, R.; D. Eibl; R. Pörtner; G. Catapano and P. Czermak: Cell and Tissue Reaction Engineering, Springer (2008). ISBN 978-3-540-68175-5
Pörtner R (ed) (2013) Animal Cell Biotechnology – Methods and Protocols. Humana Press

Module: Algebraic Statistics for Computational Biology

Courses:

Title	Typ	Hrs/wk
Algebraic Statistics for Computational Biology	Gruppenübung	2
Algebraic Statistics for Computational Biology	Vorlesung	2

Module Responsibility:
Prof. Karl-Heinz Zimmermann

Admission Requirements:
None.

Recommended Previous Knowledge:
Mathematical Calculus, Linear Algebra, and Higher Abstract Algebra.

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

Professional Competence:
Theoretical Knowledge:
The students know the alignment of sequences, the hidden Markov model, and phylogenetic tree models including the respective algorithms. Moreover, they know the EM algorithm, general algebraic statistical models and developping invariants for them, Gröbner bases in polynomial rings, elimination theory for systems of polynomial equations, and the use of computer algebra systems to solve problems in the context of this class.
Capabilities:
The students are able to formalize, compute, and analyze alignments of sequences, hidden Markov models, and phylogenetic tree models. Moreover, they can compute Gröbner bases in polynomial rings, use elimination theory to tackle systems of polynomial equations, and provide invariants for algebraic statistical models.

Personal Competence:
Social Competence:
Students are able to solve specific problems alone or in a group and to present the results accordingly.
Autonomy:
Students are able to acquire new knowledge from newer literature and to associate this knowledge with other fields.

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
Chemical and Bioprocess Engineering: Vertiefung Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Computer Science: Kernqualifikation: Compulsory suffrage
Computational Science and Engineering: Kernqualifikation: Compulsory suffrage
International Management and Engineering: Vertiefung II. Information Technology: Compulsory suffrage

Course: Algebraic Statistics for Computational Biology (Übung)

Lecturer:
Prof. Karl-Heinz Zimmermann

Language:
DE/EN

Cycle:
WS

Content:

Literature:

Course: Algebraic Statistics for Computational Biology (Vorlesung)

Lecturer:
Prof. Karl-Heinz Zimmermann

Language:
DE/EN

Cycle:

WS

Content:

Literature:

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: Applied Bioinformatics

Courses:

Title	Typ	Hrs/wk
Applied Bioinformatics	Vorlesung	3
Applied Bioinformatics	Gruppenübung	3

Module Responsibility:
Prof. An-Ping Zeng

Admission Requirements:
Bachelor VT, BVT or equivalent

Recommended Previous Knowledge:
Basic knowledge of bioprocess engineering and information technology

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

Professional Competence:
Theoretical Knowledge:
After passing the module students are able to describe different methods to analyze sequence and structure of biomolecules. Especially they can explain different algorithms to align sequences in detail. Students can elucidate the relationship of protein sequence and structure and can explain the limitations of structural models.
Furthermore students are able to explain concepts of the design of bioactive compounds and to designate characteristics of quantitative structure-activity relationships (QSAR), molecular pattern recognition and molecular docking.
Capabilities:
Students are able to analyze sequences of proteins independently and to choose and usage respective databases for the particular question. They can also critically evaluate models of protein structures and interpret structural and sequential similarities on the basis of the theory of evolution.
Students are able to use software (e.g. PyMOL) for molecular visualization and modeling of biomolecules. Due to the generality of the acquired software skills and the independent usage of the software, students can become acquainted with unknown programs in future. They can accomplish in silico interaction studies and interpret and discuss the quality of their results and data.

Personal Competence:
Social Competence:
After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork.

Autonomy:
Students are able to solve typical questions and problems in the field of bioinformatics independently.

ECTS-Credit points:
6 LP

Examination:
Klausur

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

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 Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Computer Science: Vertiefung Intelligence Engineering: Compulsory suffrage

Course: Applied Bioinformatics (Vorlesung)

Lecturer:
Prof. An-Ping Zeng, Prof. Matthias Rarey, Prof. Andrew Torda

Language:
EN

Cycle:
WS

Content:
The lecture is split in two parts. The first part starts with an introduction into sequence analysis (protein and nucleotides) and deals with the question why and how biological sequences are compared and searched in databases. Furthermore computer-based prediction and analysis of protein structures and functions are presented and the reliability of these methods is discussed. Finally, evolutionary basics of the relation of proteins, and what can be learned from additional experimental data, is discussed.

In the second half of the lecture basic concepts of modeling and the usage of respective software is taught. In this part some techniques like the visualization and analysis of protein-ligand-complexes, the usage of biochemical data sources, computer-compatible depiction of molecules and molecular pattern recognition, principles of quantitative structure–activity relationships (QSAR) and molecular relationships and also molecular docking are approached.
During the exercises the content of the lecture is applied and studied in more detail with current software.

Literature:
"Understanding Bioinformatics" Zvelebil, M.J. & Baum, J.O.

Course: Applied Bioinformatics (Übung)

Lecturer:
Prof. An-Ping Zeng

Language:
EN

Cycle:
WS

Content:
The lecture is split in two parts. The first part starts with an introduction into sequence analysis (protein and nucleotides) and deals with the question why and how biological sequences are compared and searched in databases. Furthermore computer-based prediction and analysis of protein structures and functions are presented and the reliability of these methods is discussed. Finally, evolutionary basics of the relation of proteins, and what can be learned from additional experimental data, is discussed.
In the second half of the lecture basic concepts of modeling and the usage of respective software is taught. In this part some techniques like the visualization and analysis of protein-ligand-complexes, the usage of biochemical data sources, computer-compatible depiction of molecules and molecular pattern recognition, principles of quantitative structure–activity relationships (QSAR) and molecular relationships and also molecular docking are approached.
During the exercises the content of the lecture is applied and studied in more detail with current software.

Literature:
"Understanding Bioinformatics" Zvelebil, M.J. & Baum, J.O.

Module: Industrial Biotransformations

Courses:

Title	Typ	Hrs/wk
Trends in Biotechnology	Seminar	2
Trends in Industrial Biocatalysis	Seminar	2

Module Responsibility:
Prof. Andreas Liese

Admission Requirements:
Bachelor VT, BVT or equivalent

Recommended Previous Knowledge:
Knowledge of bioprocess engineering and process engineering at bachelor level

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

Professional Competence:
Theoretical Knowledge:
After successful completion of the module

- the students can outline the current status of research on the specific topics discussed
- the students can explain the basic underlying principles of the respective industrial biotransformations

Capabilities:
After successful completion of the module students are able to

- analyze and evaluate current research approaches
- plan industrial biotransformations basically

Personal Competence:
Social Competence:
Students are able to work together as a team with several students to solve given tasks and discuss their results in the plenary and to defend them.
Autonomy:
The students are able independently to present the results of their subtasks in a presentation

ECTS-Credit points:
6 LP

Examination:
Referat

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 Bioprocess Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Environmental Engineering: Vertiefung Biotechnology: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Trends in Biotechnology (Seminar)

Lecturer:
Prof. Rudolf Müller

Language:
EN

Cycle:
WS

Content:
At the beginning of the semester a recent review article from the journal Trends in Biotechnologie is distributed to the students. The contents of this article shall be presented, evaluated and discussed with the fellow students.

Literature:
Artikel aus der Zeitschrift Trends in Biotechnology, die an die Studenten zu Beginn des Semesters verteilt werden.

Course: Trends in Industrial Biocatalysis (Seminar)

Lecturer:
Prof. Andreas Liese

Language:
EN

Cycle:
WS

Content:

- Presentation and evaluation of 20-minute student lectures discussing a case study of an industrial biotransformation
- The contents of this article shall be presented, evaluated and discussed with the fellow students.

Literature:

- A. Liese, K. Seelbach, C. Wandrey: Industrial Biotransformations, Wiley-VCH, 2006
- selected scientific papers, that will be distributed during the course of the lecture

Specialisation Chemical Process Engineering

Here the qualification in process/chemical engineering should be obtained.
For students with correspondingly good German language levels the modules in German language from the Master Process Engineering are available as well.

Module: High Pressure Chemical Engineering

Courses:

Title	Typ	Hrs/wk
Industrial Processes Under High Pressure	Vorlesung	2
Advanced Separation Processes	Vorlesung	2

Module Responsibility:
Dr. Monika Johannsen

Admission Requirements:
none

Recommended Previous Knowledge:
Fundamentals of Chemistry, Chemical Engineering, Fluid Process Engineering, Thermal Separation Processes, Thermodynamics, Heterogeneous Equilibria

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

Professional Competence:
Theoretical Knowledge:
After a successful completion of this module, students can:

- explain the influence of pressure on the properties of compounds, phase equilibria, and production processes,
- describe the thermodynamic fundamentals of separation processes with supercritical fluids,
- exemplify models for the description of solid extraction and countercurrent extraction,
- discuss parameters for optimization of processes with supercritical fluids.

Capabilities:
After successful completion of this module, students are able to:

- compare separation processes with supercritical fluids and conventional solvents,
- assess the application potential of high-pressure processes at a given separation task,
- include high pressure methods in a given multistep industrial application,
- estimate economics of high-pressure processes in terms of investment and operating costs,
- perform an experiment with a high pressure apparatus under guidance,
- evaluate experimental results,
- prepare an experimental protocol.

Personal Competence:
Social Competence:
After successful completion of this module, students are able to:

- present a scientific topic from an original publication in teams of 2 and defend the contents together.

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
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
International Management and Engineering: Vertiefung II. Process Engineering and Biotechnology: Compulsory suffrage
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Industrial Processes Under High Pressure (Vorlesung)

Lecturer:
Dr. Carsten Zetzl

Language:
EN

Cycle:
SS

Content:
Part I : Physical Chemistry and Thermodynamics
1. Introduction: Overview, achieving high pressure, range of parameters.
2. Influence of pressure on properties of fluids: P,v,T-behaviour, enthalpy, internal energy, entropy, heat capacity, viscosity, thermal conductivity, diffusion coefficients, interfacial tension.
3. Influence of pressure on heterogeneous equilibria: Phenomenology of phase equilibria
4. Overview on calculation methods for (high pressure) phase equilibria).
Influence of pressure on transport processes, heat and mass transfer.
Part II : High Pressure Processes
5. Separation processes at elevated pressures: Absorption, adsorption (pressure swing adsorption), distillation (distillation of air), condensation (liquefaction of gases)
6. Supercritical fluids as solvents: Gas extraction, cleaning, solvents in reacting systems, dyeing, impregnation, particle formation (formulation)
7. Reactions at elevated pressures. Influence of elevated pressure on biochemical systems: Resistance against pressure
Part III : Industrial production
8. Reaction : Haber-Bosch-process, methanol-synthesis, polymerizations; Hydrations, pyrolysis, hydrocracking; Wet air oxidation, supercritical water oxidation (SCWO)
9. Separation : Linde Process, De-Caffeination, Petrol and Bio-Refinery
10. Industrial High Pressure Applications in Biofuel and Biodiesel Production
11. Sterilization and Enzyme Catalysis
12. Solids handling in high pressure processes, feeding and removal of solids, transport within the reactor.
13. Supercritical fluids for materials processing.
14. Cost Engineering
Learning Outcomes:
After a successful completion of this module, the student should be able to
- understand of the influences of pressure on properties of compounds, phase equilibria, and production processes.
- Apply high pressure approches in the complex process design tasks
- Estimate Efficiency of high pressure alternatives with respect to investment and operational costs

Performance Record:
1. Presence (28 h)
2. Oral presentation of original scientific article (15 min) with written summary
3. Written examination and Case study
(2+3 : 32 h Workload)
Workload:
60 hours total

Literature:
Literatur:
Script: High Pressure Chemical Engineering.
G. Brunner: Gas Extraction. An Introduction to Fundamentals of Supercritical Fluids and the Application to Separation Processes. Steinkopff, Darmstadt, Springer, New York, 1994.

Course: Advanced Separation Processes (Vorlesung)

Lecturer:
Dr. Monika Johannsen

Language:
EN

Cycle:
SS

Content:

- Introduction/Overview on Properties of Supercritical Fluids (SCF)and their Application in Gas Extraction Processes
- Solubility of Compounds in Supercritical Fluids and Phase Equilibrium with SCF

- Extraction from Solid Substrates: Fundamentals, Hydrodynamics and Mass Transfer
- Extraction from Solid Substrates: Applications and Processes (including Supercritical Water)
- Countercurrent Multistage Extraction: Fundamentals and Methods, Hydrodynamics and Mass Transfer
- Countercurrent Multistage Extraction: Applications and Processes
- Solvent Cycle, Methods for Precipitation
- Supercritical Fluid Chromatography (SFC): Fundamentals and Application
- Simulated Moving Bed Chromatography (SMB)
- Membrane Separation of Gases at High Pressures
- Separation by Reactions in Supercritical Fluids (Enzymes)

Literature:

G. Brunner: Gas Extraction. An Introduction to Fundamentals of Supercritical Fluids and the Application to Separation Processes. Steinkopff, Darmstadt, Springer, New York, 1994.

Courses:

Title	Typ	Hrs/wk
Numerical Treatment of Ordinary Partial Differential Equations	Vorlesung	2
Numerical Treatment of Ordinary Partial Differential Equations	Gruppenübung	2

Module Responsibility:
Prof. Sabine Le Borne

Admission Requirements:

- Mathematik I, II, III for Engineering Students (german or english)

or

- Analysis & Linear Algebra I + II for Technomathematicians
- Analysis III for Technomathematicians

Recommended Previous Knowledge:

- Lecture material of prerequisite lectures
- basic MATLAB knowledge

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

Professional Competence:
Theoretical Knowledge:
Students are able to

- list numerical methods for the solution of ordinary differential equations and explain their core ideas,
- repeat convergence statements for the treated numerical methods (including the prerequisites tied to the underlying problem),
- explain aspects regarding the practical execution of a method.

Capabilities:
Students are able to

- implement (MATLAB), apply and compare numerical methods for the solution of ordinary differential equations,
- to justify the convergence behaviour of numerical methods with respect to the posed problem and selected algorithm,
- for a given problem, develop a suitable solution approach, if necessary by the composition of several algorithms, to execute this approach and to critically evaluate the results.

Personal Competence:
Social Competence:
Students are able to

- work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.

Autonomy:
Students are capable

- to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
- to assess their individual progess and, if necessary, to ask questions and seek help.

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
Chemical and Bioprocess Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Electrical Engineering: Vertiefung Control and Power Systems: Compulsory suffrage
Computational Science and Engineering: Vertiefung Scientific Computing: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Technomathematics: Vertiefung Mathematics: Compulsory suffrage
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory

Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Numerical Treatment of Ordinary Partial Differential Equations (Vorlesung)

Lecturer:
Prof. Sabine Le Borne, Dr. Christian Seifert

Language:
DE/EN

Cycle:
SS

Content:
Numerical methods for Initial Value Problems

- single step methods
- multistep methods
- stiff problems
- differential algebraic equations (DAE) of index 1

Numerical methods for Boundary Value Problems

- initial value methods
- multiple shooting method
- difference methods
- variational methods

Literature:

- E. Hairer, S. Noersett, G. Wanner: Solving Ordinary Differential Equations I: Nonstiff Problems
- E. Hairer, G. Wanner: Solving Ordinary Differential Equations II: Stiff and Differential-Algebraic Problems

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Course: Numerical Treatment of Ordinary Partial Differential Equations (Übung)

Lecturer:
Prof. Sabine Le Borne, Dr. Christian Seifert

Language:
DE/EN

Cycle:
SS

Content:
Numerical methods for Initial Value Problems

- single step methods
- multistep methods
- stiff problems
- differential algebraic equations (DAE) of index 1

Numerical methods for Boundary Value Problems

- initial value methods
- multiple shooting method
- difference methods
- variational methods

Literature:

- E. Hairer, S. Noersett, G. Wanner: Solving Ordinary Differential Equations I: Nonstiff Problems
- E. Hairer, G. Wanner: Solving Ordinary Differential Equations II: Stiff and Differential-Algebraic Problems

Courses:

Title	Typ	Hrs/wk
Computational Fluid Dynamics - Exercises in OpenFoam	Gruppenübung	1
Computational Fluid Dynamics in Process Engineering	Vorlesung	2
Statistical Thermodynamics and Molecular Modelling	Vorlesung	2

Module Responsibility:
Prof. Michael Schlüter

Admission Requirements:

- Mathematics I-IV
- Fundamentals in Fluid Mechanics

Recommended Previous Knowledge:

- Mathematics
- Basic knowledge in Fluid Mechanics
- Basic knowledge in chemical thermodynamics

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

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

- explain the the basic principles of statistical thermodynamics (ensembles, simple systems)
- describe the main approaches in classical Molecular Modeling (Monte Carlo, Molecular Dynamics) in various ensembles
- discuss examples of computer programs in detail,
- evaluate the application of numerical simulations,
- list the possible start and boundary conditions for a numerical simulation.

Capabilities:
The students are able to:

- set up computer programs for solving simple problems by Monte Carlo or molecular dynamics,
- solve problems by molecular modeling,
- set up a numerical grid,
- perform a simple numerical simulation with OpenFoam,
- evaluate the result of a numerical simulation.

Personal Competence:
Social Competence:
The students are able to

- develop joint solutions in mixed teams and present them in front of the other students,
- to collaborate in a team and to reflect their own contribution toward it.

Autonomy:
The students are able to:

- evaluate their learning progress and to define the following steps of learning on that basis,
- evaluate possible consequences for their profession.

ECTS-Credit points:
6 LP

Examination:
Mündliche Prüfung

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
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
Theoretical Mechanical Engineering: Kernqualifikation: Compulsory
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

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Course: Computational Fluid Dynamics - Exercises in OpenFoam (Übung)

Lecturer:
Prof. Michael Schlüter

Language:
EN

Cycle:
SS

Content:

- generation of numerical grids with a common grid generator
- selection of models and boundary conditions
- basic numerical simulation with OpenFoam within the TUHH CIP-Pool

Literature:
OpenFoam Tutorials (StudIP)

Course: Computational Fluid Dynamics in Process Engineering (Vorlesung)

Lecturer:
Prof. Michael Schlüter

Language:
EN

Cycle:
SS

Content:

- Introduction into partial differential equations
- Basic equations
- Boundary conditions and grids
- Numerical methods
- Finite difference method
- Finite volume method
- Time discretisation and stability
- Population balance
- Multiphase Systems
- Modeling of Turbulent Flows
- Exercises: Stability Analysis
- Exercises: Example on CFD - analytically/numerically

Literature:
Paschedag A.R.: CFD in der Verfahrenstechnik: Allgemeine Grundlagen und mehrphasige Anwendungen, Wiley-VCH, 2004 ISBN 3-527-30994-2.
Ferziger, J.H.; Peric, M.: Numerische Strömungsmechanik. Springer-Verlag, Berlin, 2008, ISBN: 3540675868.
Ferziger, J.H.; Peric, M.: Computational Methods for Fluid Dynamics. Springer, 2002, ISBN 3-540-42074-6

Course: Statistical Thermodynamics and Molecular Modelling (Vorlesung)

Lecturer:
Dr. Sven Jakobtorweihen

Language:
EN

Cycle:
SS

Content:

- **Some lectures will be carried out as computer exercises**
- Introduction to Statistical Mechanics
- The ensemble concept

- The classical limit
- Intermolecular potentials, force fields
- Monte Carlo simulations (acceptance rules) (Übungen im Rechnerpool) (exercises in computer pool)
- Molecular Dynamics Simulations (integration of equations of motion, calculating transport properties) (exercises in computer pool)
- Molecular simulation of Phase equilibria (Gibbs Ensemble)
- Methods for the calculation of free energies

Literature:

Daan Frenkel, Berend Smit: Understanding Molecular Simulation, Academic Press
M. P. Allen, D. J. Tildesley: Computer Simulations of Liquids, Oxford Univ. Press
A.R. Leach: Molecular Modelling – Principles and Applications, Prentice Hall, N.Y.
D. A. McQuarrie: Statistical Mechanics, University Science Books
T. L. Hill: Statistical Mechanics , Dover Publications

Module: Processes at Interfaces

Courses:

Title	Typ	Hrs/wk
Interfaces and Colloids	Vorlesung	2
Phase Transitions	Vorlesung	2

Module Responsibility:
Prof. Rudolf Eggers

Admission Requirements:
none

Recommended Previous Knowledge:
Heat and Mass Transfer, Separation Techniques, Thermodynamics

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

Professional Competence:
Theoretical Knowledge:
After finishing the module students are able to describe in detail the thermodynamic laws at phase boundaries. They have knowledge on experimental methods for interfacial tensions and wetting angles.

Capabilities:
Students have the capability of designing evaporators and condensors related to fixed process parameters

Personal Competence:
Social Competence:
-Students are working in small groups and elaborate special problems in order to demonstrate the results in a presentation.
Autonomy:
-

ECTS-Credit points:
6 LP

Examination:
Schriftliche Ausarbeitung

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 Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Environmental Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Interfaces and Colloids (Vorlesung)

Lecturer:
Dr. Philip Jaeger, Dr. Philip Jaeger

Language:
DE/EN

Cycle:
WS

Content:
1.Fundamentals, definitions 1.1 Thermodynamics of interfaces 1.2 Surfactants 1.3 Interfacial tension (Principles, Methods, Examples) 1.4 Wetting, adhesion 2.Dispersions 2.1 Droplet formation 2.2 Stabilization 2.3 Physical Properties 2.4 Rheology 2.5 Microemulsions 3. Transport Phenomena 3.1 Mass transport across phase boundaries 3.2 Interfacial convection – Marangoni flow 3.3 Influence of surfactants on interfacial area and transport resistance (bubbles, droplets, falling films) 4. Applications 4.1 Food Emulsification 4.2 Crude oil recovery (EOR) 4.3 Coating 4.4 Separation technology (Spray towers, packed columns) 4.5 Nucleation (Polymer foams, evaporation) 4.6 Recent developments (Surfactant aided extraction)

Literature:
A.W. Adamson: Physical Chemistry of Surfaces, 5th ed., J. Wiley & Sons New York, 1990. P. Becher : Emulsions – Theory and Practice, 1965. P. Becher : Encyclopedia of Emulsion Technology, Vol. 1, Dekker New York, 1983. S.S. Dukhin, G. Kretzschmar, R. Miller: Dynamics of Adsorption at Liquid Interfaces, Elsevier Amsterdam, 1995. D.J. McClements: Food Emulsions – Principle, Practices and Techniques, 2nd ed., CRC Press Boca Raton, 2005. D. Myers: Surfaces, Interfaces and Colloids, VCH-Verlagsgesellschaft Weinheim, 1991. P. Sherman: Emulsion Science, 1968. J. Lyklema: Fundamentals of Interface and Colloid Science, Vol. III, Academic Press London, 2000. A.I. Rusanov: Phasengleichgewichte und Grenzflächenerscheinungen, Akademie Verlag, Berlin 1978. P. C. Hiemenz, R. Rajagopalan:

Principles of Colloid and Surface Chemistry, 3rd ed. Marcel Dekker, New York 1997. P. Grassmann: Physikalische Grundlagen der Verfahrenstechnik, Verlag Salle und Sauerländer, 1983. M.J. Schwuger: Lehrbuch der Grenzflächenchemie, Thieme Verlag, 1996.

Course: Phase Transitions (Vorlesung)

Lecturer:
Prof. Rudolf Eggers

Language:
DE/EN

Cycle:
WS

Content:
Drop formation, film development, condensation of non moving and vapour, condensation of moving vapour, partial condensation, bubble forming (nucleation), free convection boiling, nucleation boiling, film boiling, boiling crisis, apparatus for condensation and evaporation

Literature:
F. Incropea, D. de Witt: Heat and Mass Transfer, Wiley and Sons, 2002
V. Gnielinski, A. Mersmann, F. Thurner: Verdampfung, Vieweg Verlag 1993
K. Stephan: Wärmeübergang beim Kondensieren und beim Sieden, Springer Verlag 1988
N. Kolev: Transiente Zweiphasenströmung Springer Verlag 1986
VDI Wärmeatlas, 2013, 11. Auflage, VDI Verlag

Module: Industrial Process Automation

Courses:

Title	Typ	Hrs/wk
Industrial Process Automation	Vorlesung	2
Industrial Process Automation	Gruppenübung	2

Module Responsibility:
Prof. Alexander Schlaefer

Admission Requirements:

Recommended Previous Knowledge:
principles of mathematics

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

Professional Competence:
Theoretical Knowledge:
The students can evaluated and assess disctrete event systems. They can evaluate properties of processes and explain methods for process analysis. The students can compare methods for process modelling and select an appropriate method for actual problems. They can discuss scheduling methods in the context of actual problems and give a detailed explanation of advantages and disadvantages of different programming methods.

Capabilities:
The students are able to develop and modeling processes anymore they can evaluate them. This involves taking into account optimal scheduling, understanding algorithmic complexity and implementation using PLCs.

Personal Competence:
Social Competence:
The students work in teams to solve problems.

Autonomy:
The students can reflect their knowledge and document the results of their work.

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 Chemical Process Engineering: Compulsory suffrage
Chemical and Bioprocess Engineering: Vertiefung General Process Engineering: Compulsory suffrage
Electrical Engineering: Vertiefung Control and Power Systems: Compulsory suffrage
International Management and Engineering: Vertiefung II. Mechatronics: Compulsory suffrage
Mechatronics: Vertiefung Intelligent Systems and Robotics: Compulsory suffrage
Theoretical Mechanical Engineering: Vertiefung Computer Science: Compulsory suffrage
Process Engineering: Vertiefung Chemical Process Engineering: Compulsory suffrage
Process Engineering: Vertiefung Process Engineering : Compulsory suffrage

Course: Industrial Process Automation (Vorlesung)

Lecturer:
Prof. Alexander Schlaefer

Language:
EN

Cycle:
WS

Content:
- foundations of problem solving and system modeling, discrete event systems
- properties of processes, modeling using automat and Petri-nets
- design considerations for processes (mutex, deadlock avoidance, liveness)
- optimal scheduling for processes
- optimal decisions when planning manufacturing systems, decisions under uncertainty
- software design and software architectures for automation, PLCs

Literature:

J. Lunze: „Automatisierungstechnik“, Oldenbourg Verlag, 2012
Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010
Hrúz, Zhou: Modeling and Control of Discrete-event Dynamic Systems; Springer 2007
Li, Zhou: Deadlock Resolution in Automated Manufacturing Systems, Springer 2009
Pinedo: Planning and Scheduling in Manufacturing and Services, Springer 2009

Course: Industrial Process Automation (Übung)

Lecturer:

Prof. Alexander Schlaefer

Language:

EN

Cycle:

WS

Content:

- foundations of problem solving and system modeling, discrete event systems
- properties of processes, modeling using automat and Petri-nets
- design considerations for processes (mutex, deadlock avoidance, liveness)
- optimal scheduling for processes
- optimal decisions when planning manufacturing systems, decisions under uncertainty
- software design and software architectures for automation, PLCs

Literature:

J. Lunze: „Automatisierungstechnik“, Oldenbourg Verlag, 2012
Reisig: Petrinetze: Modellierungstechnik, Analysemethoden, Fallstudien; Vieweg+Teubner 2010
Hrúz, Zhou: Modeling and Control of Discrete-event Dynamic Systems; Springer 2007
Li, Zhou: Deadlock Resolution in Automated Manufacturing Systems, Springer 2009
Pinedo: Planning and Scheduling in Manufacturing and Services, Springer 2009

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.

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- 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

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