Module Catalog

M.Sc. Technology of Biogenic Resources
TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)
Technische Universität München

www.tum.de
www.cs.tum.de/

Module Catalog: General Information and Notes to the Reader

What is the module catalog?
One of the central components of the Bologna Process consists in the modularization of university curricula, that is, the transition of universities away from earlier seminar/lecture systems to a modular system in which thematically-related courses are bundled together into blocks, or modules.
This module catalog contains descriptions of all modules offered in the course of study.
Serving the goal of transparency in higher education, it provides students, potential students and other internal and external parties with information on the content of individual modules, the goals of academic qualification targeted in each module, as well as their qualitative and quantitative requirements.

Notes to the reader:

Updated Information
An updated module catalog reflecting the current status of module contents and requirements is published every semester. The date on which the module catalog was generated in TUMonline is printed in the footer.

Non-binding Information
Module descriptions serve to increase transparency and improve student orientation with respect to course offerings. They are not legally-binding. Individual modifications of described contents may occur in praxis.
Legally-binding information on all questions concerning the study program and examinations can be found in the subject-specific academic and examination regulations (FPSO) of individual programs, as well as in the general academic and examination regulations of TUM (APSO).

Elective modules
Please note that generally not all elective modules offered within the study program are listed in the module catalog.

Index of module handbook descriptions (SPO tree)

Alphabetical index can be found on page 169

Compulsory Courses | Pflichtmodule

Module Description

CS0101: Renewables Utilization | Renewables Utilization

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment takes a written examination (90 minutes), with students to unterstand and to apply structure, transformation and use of different renewable resources. Students are required to answer questions using individual formulations and outline structures and reactions. In addition, sample calculations are to be worked out.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic lectures in chemistry; Basics on renewables utilization

Content:
Various types of ingredients of renewable raw materials: sugars, polysaccharides, fats and oils, amino acids, proteins, terpenes, aromatics. The following topics will be dealt with in more detail: structure, composition, occurrence, properties, analysis and type of added value or use in various examples.

Intended Learning Outcomes:
After completion of the modules, students understand the chemical composition of renewable resources as well as their production and application. Using this knowledge students are able to explain the respective advantages and disadvantages as well as analyze the underlying physical, chemical and biotechnological principles of their conversion into valuable products.

Teaching and Learning Methods:
Lecture and accompanying tutorial including individual work on specific examples.

Media:
Presentation, script, examples and solutions

Reading List:

Responsible for Module:
Broder Rühmann

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die stoffliche Nutzung / Renewables Utilization (Exercise) (Übung, 2 SWS)
Rühmann B

Einführung in die stoffliche Nutzung / Renewables Utilization (Lecture) (Vorlesung, 2 SWS)
Sieber V
For further information in this module, please click campus.tum.de or here.

Module Description

CS0132: Energy process engineering | Energy process engineering [EVT]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment takes the form of a written examination (90 minutes). Students demonstrate their ability to solve basic calculations and apply methods of process technology to different issues. In addition, some questions on energy and process technology plants are to bei answered in a written form.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics

Content:
Within the modul the thermal and chemical components of power plants and process engineering plants such as combustion concepts, fuel treatment, exhaust gas purification, production of fuels from biomass and electricity generation concepts are explained. The basics of the design and calculation of steam generators, reactors and synthesis algae and the treatment of gases from gasification processes and their use e.g. in a fuel cell are explained.

Intended Learning Outcomes:
At the end of the module students can understand complex processes for energy and/or fuel production and are able to detect and explain the required needs (e.g. pressure, temperature) and process technologies.

Teaching and Learning Methods:
The module consists of lectures and tutorials. The contents will bei taught in lectures and presentations.

Media:
Lecture, blackbboard, presentation

Reading List:
Kaltschmitt, M.; Hartmann, H.; Hofbauer, H.: Energie aus Biomasse, 2. Auflage, Springer, ISBN 978-3-540-85094-6, 2009
Spliethoff, H., Power generation from Solid Fuels, Springer, ISBN 978-3-642-02855-7, 2010
Karl, J.: Dezentrale Energiesysteme, Oldenbourg, ISBN 3-486-27505-4, 2004/
Sterner, M.; Stadler, I.: Energiespeicher, Springer Vieweg, ISBN 978-3-642-37379-4, 2014

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Energy process engineering (Exercise) (Übung, 3 SWS)
Gaderer M [L], Gaderer M

Energy process engineering (Lecture) (Vorlesung, 2 SWS)
Gaderer M [L], Gaderer M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0133: Mechanical process engineering | Mechanical process engineering [MVT]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment takes the form of a written examination (90 minutes).
The students prove that they can solve computational problems and apply methods of mechanical particles and process engineering as well as answer questions about plants and apparatuses of mechanical process engineering.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Thermodynamics, Reaction Technology, Heat Transfer, Fluid Mechanics

Content:
The module teaches the basics necessary for the description of particle systems:
Particle size and shape, distribution functions, particle motion and interactions in heaps.
Furthermore, the basic operations applied to particles are presented: Crushing, mixing, separating, agglomerating, fixed and fluid beds, filtration.
For example, reference is made to applications in material and energy systems with regard to wood chipping, conveying, fermenter stirring and biomass combustion.

Intended Learning Outcomes:
After participating in the module, the students are able to apply the mathematical fundamentals of particle technology and to interpret the basic operations of particle process technology.

Teaching and Learning Methods:
The module consists of lecture and exercise.
The content of the module is conveyed during the lecture by speech and presentations. The students are encouraged to engage actively with the topics by integrating various self-search tasks and comprehension questions.
In the exercises, which take place in alternation with the lecture, serve for a stronger comprehension of the teaching contents. Hence, the students work on various calculation exercises and conduct different lab experiments in small groups.

Media:
Presentations, scripts, exercises

Reading List:
Bohnet, M., Hg.; 2014. Mechanische Verfahrenstechnik. Weinheim: Wiley-VCH-Verl. ISBN 9783527663569
Müller, W., 2014. Mechanische Verfahrenstechnik und ihre Gesetzmäßigkeiten. 2. Aufl. München: De Gruyter. Studium. ISBN 3110343568.
Rhodes, M.J., 2008. Introduction to particle technology. 2nd ed. Chichester, England: Wiley. ISBN 047072711X.
Schubert, H., 1990. Mechanische Verfahrenstechnik. Mit 36 Tabellen. 3., erw. und durchges. Aufl. Leipzig: Dt. Verl. für Grundstoffindustrie. Verfahrenstechnik. ISBN 9783342003816.
Schwister, K., Hg., 2010. Taschenbuch der Verfahrenstechnik. Mit 49 Tabellen. 4., aktualisierte Aufl. München: Fachbuchverl. Leipzig im Carl-Hanser-Verl. ISBN 3446424350.
Stiess, M., 1997. Mechanische Verfahrenstechnik 2. Berlin, Heidelberg: Springer Berlin Heidelberg. Springer-Lehrbuch. ISBN 978-3-662-08599-8.
Stiess, M., 2009. Mechanische Verfahrenstechnik. Partikeltechnologie. 3., vollständig neu bearbeitete Aufl. Berlin, Heidelberg: Springer Berlin Heidelberg. Springer-Lehrbuch. ISBN 978-3-540-32552-9.
Zogg, M., 1993. Einführung in die mechanische Verfahrenstechnik. Mit 29 Tabellen und 32 Berechnungsbeispielen. 3., überarb. Aufl. Stuttgart: Teubner. ISBN 9783519163190.

Responsible for Module:
Prof. Matthias Gaderer

Courses (Type of course, Weekly hours per semester), Instructor:
Mechanical process engineering (Lecture) (Vorlesung, 2 SWS)
Gaderer M [L], Herdzik S

Mechanical process engineering (Exercise) (Übung, 2 SWS)
Gaderer M [L], Herdzik S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0134: Conceptual process design | Conceptual process design

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam performance is effected by an oral exam. It is reviewed whether the students know the fundamentals of conceptual design of chemical and biotechnological processes and if they can apply this knowledge on the design and evaluation of complex processes. The exam consists of two parts: (a) 30 minutes preparation through solving a given problem set (b) 30 minutes of oral examination. In the beginning of part (b) the results of part (a) are presented by the student. (total duration 60 min)

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Basics of cenceptual design of (bio)processes; Basics of computational process design including calculation of process parameters; transfer of fundamental scale-up criteria towards real problem solving; Balancing of all process streams; Deepened knowledge of engineering principles.

Intended Learning Outcomes:
The students are qualified to understand the fundamentals of design, calculations, and balancing of chemical as well as biotechnological processes after the course. They will aquire knowledge of different challenges of process design and how to master them.

Teaching and Learning Methods:
The module consists of lectures and parallel tutorials. Contents of the lecture shall be imparted in speech and by presentation. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of calculations and examples from targeted aspects of process design and calculation. based on a direct comparison of a chemical process with it´s biotechnical alternative they learn to apply their knowledge on reality based challenges. Additionally they will be qualified by an in-depth knowledge of the design of operation units including calculation of process parameters based on utilization of selected software tools.

Media:
Panel, slides, scripts, practical exercises

Reading List:

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Conceptual process design (Lecture) (Vorlesung, 2 SWS)
Burger J [L], Burger J

Conceptual process design (Exercise) (Übung, 2 SWS)
Burger J [L], Burger J, Göttl Q
For further information in this module, please click campus.tum.de or here.

Module Description

CS0135: Cooperative Design Project | Cooperative Design Project

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 120	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module concludes with the creation, presentation and positive evaluation of a final presentation. In the presentation, the students should present tasks, solutions, procedures in project management, and the project results in a concise form. The presentation should also show which contributions to teamwork have been made by the students themselves. In regular meetings with the supervisors, the individual achievements will be monitored.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The task describes a technical problem in the field of the use of biogenic resources for which the team has to find a solution. Examples are e.g:
1. preparation of a concept and design of a biogas plant for an agricultural business
2. Feasibility Study on the conversion of high performance packaging in space application from fossil-based plastics to bio-based plastics

Intended Learning Outcomes:
After successful participation in the module, students will be able to
- organize and evaluate the cooperation in a team with heterogeneous knowledge,
- delegate tasks,
- apply the basics of process and energy technology to practical questions,
- design a project in terms of time management, balancing, interaction, objectives,

- analyse projects and to present them to outsiders,
- lead works in a hierarchical organization

Teaching and Learning Methods:
The module consists of a project work, which is carried out in a cooperative team between Bachelor and Master students. Depending on the given task, the team size is 2-6 persons. The Master students assume the role of project leaders and are responsible for formulating and achieving the project goals. The Bachelor students carry out research, analysis and calculations and are supported by the Master students if required. Progress, role identification, and individual involvement are monitored in regular meetings with the supervisor.

Media:
Will be adapted to task at the project start by the supervisor

Reading List:
Rowe, S. (2015). Project Management for Small Projects, 2nd Edition. Oakland: Berrett-Koehler Publishers.
Specific literature will be announced by the supervisor before the project starts.

Responsible for Module:
Alle prüfungsberechtigten Dozenten/innen des Studienganges Technologie biogener Rohstoffe

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0136: Energetic use of biomass and residuals | Energetic use of biomass and residuals [EBR]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment consists of a written examination (60 minutes) based on the various potential uses of biomass for energy and a presentation on a concept students have developed individually regarding the use of biomass. The written part constitutes 50% of the grade and the presentation as well with 50%.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics, Energy Process Engineering

Content:
Lectures are dedicated to potential technology for using biomass and residuals as a source of energy. In particular, heat generation, energy conversion, power-heat coupling and the process for generating gaseous and fluid sources of energy are discussed. In addition, the generation of biogas (fermentation process) is discussed in detail. However, as there is another lecture dedicated to this topic, this section will be restricted to the technical basics. Practical exercises focus on conception and planningof plants. As part of a seminar, participants should develop voluntary examples and assess these using an economic efficiency calculation. For the tutorial, students work individually in the group on a concept for biomass use. This concept is analyzed in regard to technical and economic feasibility with the result being presented and assessed in a presentation.

Intended Learning Outcomes:
After completion of the module, students are able to evaluate the various systems for use of biomass. They have got a broad overview of options. In addition, they are able to develop a relevant concept, argue in favour of it, and evaluate the economic profit.

Teaching and Learning Methods:
Lecture (talk by teaching staff) with media, tutorial on calculation of examples, presentation of a voluntary concept regarding biomass or residual use.

Media:
Presentation, script, examples, excursion

Reading List:
Script/
Kaltschmitt, M.; Hartmann, H.; Hofbauer, H.: Energie aus Biomasse, 2. Auflage, Springer, ISBN 978-3-540-85094-6, 2009
Karl, J.: Dezentrale Energiesysteme, Oldenbourg, ISBN 3-486-27505-4, 2004/

Responsible for Module:
Prof. Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Electives | Wahlmodule

Technical Electives | Fachspezifische Wahlmodule

Module Description

WZ1240: Advanced Simulation Topics | Fortgeschrittene Simulationsthemen

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2016/17

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination performance is provided in the form of a project work. By working on a more in-depth task, the students demonstrate that they can select and apply methods appropriate to the problem. In the written elaboration, the participants show that they can establish connections, correctly classify facts and adequately present the results achieved.

Repeat Examination:

(Recommended) Prerequisites:
Modules Physics, Mathematics, Simulation and Optimization in Power Engineering, Matlab +Programming Knowledge

Content:
Depending on the topics chosen for the seminar paper, a selection of the following topics will be covered:
advanced concepts of Matlab programming & visualization
- practical modelling & simulation (e.g. motor process simulation, heat conduction equation)
- Import and processing of measurement data
- Advanced simulation and modelling (e.g. neural networks in practice, partial differential equations)

- Deepening theoretical concepts of modelling (e.g., finding nonlinear model parameters, evolutionary algorithms, Fourier analysis, different types of neural networks)

Intended Learning Outcomes:
After participating in the module events, the participants will understand advanced methods for modelling, simulation and optimisation and will be able to select and apply methods appropriate to the problem at hand. The chosen approach and the essential implementation steps are presented and explained in a seminar paper.

Teaching and Learning Methods:
The module includes a seminar part. Here the students work out a solution for a more extensive problem on their own. This usually requires the preparation of more extensive programming tasks and the presentation and justification of the chosen approach in a seminar paper. To support this activity, in the lecture part of the module more in-depth contents are imparted in the lecture and practiced in the exercise part of the module by independent processing of exercises by the students. In the context of the exercise an accompaniment of the seminar work is offered in addition.

Media:
Presentations, slide scripts, blackboard writing, demonstration of programs/scripts

Reading List:
O. Nelles, Nonlinear System Identification, Springer, Berlin, 2010
M. T. Hagan, H. B. Demuth, M. H. Beale, O. De Jesus, Neural Network Design, ISBN 0-9717321-1-6, http://hagan.okstate.edu/NNDesign.pdf+B32

Responsible for Module:
Josef Kainz josef.kainz@hswt.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0003: Production of alternative fuels | Production of alternative fuels

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The learning results are going to be proven in form of an oral exam that consists of two parts: (a) 30 minutes preparation through solving a given problem set (b) 30 minutes of oral examination. In the beginning of part (b) the results of part (a) are presented by the student. Along the problem set it is checked whether the student is able to understand, improve and assess indsutrial processes for the production of alternative fuels. No aids permitted. Total examination duration: 60 Minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technology of Chemical Processes (WZ1617) or comparable

Content:
Requirements for fuels, linkage of energetic and chemical value chains, fossil fuel production as reference, balancing and assessments (Well-to-Wheel), Hydrogen and methanol economy, alternative fuels on C1-basis, fisher-tropsch fuels, OME, bio-based oil fuels, biodiesel, green diesel, HEFA, bio-based alcohols.

Intended Learning Outcomes:
This module aims at making the students familiar with the industrial processes to produce non-fossil fuels. They are able to set up material and enegry balances of these processes and assess their sustainablility. Limitations with repsect of raw material supply, energetic efficiencies and market requirements are understood. The students understand the interactions of fuel market and energy market.

Teaching and Learning Methods:
The module consists of a lectures and exercises. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students are encouraged to study the literature and examine with regards to content the topics. In the exercises learned theory is applied with a practical orientation by means of arithmetic examples.

Media:
Lecture notes, slides, excersises

Reading List:
• Jacob A. Moulijn, Michiel Makkee, Annelies E. van Diepen: Chemical Process Technology, Wiley (2013).
• George Olah et al.: Beyond Oil and Gas: The Methanol Economy, Wiley VCH (2006)
• Volker Schindler: Kraftstoffe für morgen: Eine Analyse von Zusammenhängen und Handlungsoptionen, Springer (1997)
• Martin Kaltschmitt, Hans Hartmann, Hermann Hofbauer: Energie aus Biomasse; Grundlagen, Techniken und Verfahren, Springer Vieweg (2016)
• Jochen Lehmann, Thomas Luschtinetz: Wasserstoff und Brennstoffzellen, Springer (2014)

Responsible for Module:
Burger, Jakob; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Production of alternative fuels (Lecture, Straubing) (Vorlesung, 2 SWS)
Burger J [L], Burger J, Tönges Y

Production of alternative fuels (Tutorial, Garching) (Übung, 2 SWS)
Burger J [L], Burger J, Tönges Y

Production of alternative fuels (Tutorial, Straubing) (Übung, 2 SWS)
Burger J [L], Burger J, Tönges Y

Production of alternative fuels (Lecture, Garching) (Vorlesung, 2 SWS)
Burger J [L], Burger J, Tönges Y
For further information in this module, please click campus.tum.de or here.

Module Description

CS0092: Wind Power | Windkraft [Wind]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level:	Language:	Duration:	Frequency:
Master	German/English	one semester	summer semester
Credits:*	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**
4	120	82	38

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The basics of energy generation from wind are assessed in a written examination (60 minutes). The students prove that they have understood the technology of wind turbines and that they are able to carry out calculations on the design, energy yield and economic efficiency of wind turbines. They also show that they have understood the special problems in the project planning phase as well as during operation within the framework of legal requirements, the requirements for nature and species protection as well as the local acceptance of wind power use and ecology and acceptance and that they are able to evaluate plants and sites in this respect.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in Mathematics and Physics
Basics in Energy Technology

Content:
This module teaches in-depth knowledge about energy generation from wind power. The technology is described using the following points:
- Physical basics
- Designs and system components
- Planning, construction and operation
- Power output and energy supply

In addition to the technical characteristics of the plants, the module also focuses on their effects on the environment, legal framework conditions and economic

Intended Learning Outcomes:
Having attended the module, the students will be able to characterize and recognize different types of wind turbines and to understand them from a technical and energetic point of view. The students understand the processes involved in planning, erecting and operating wind turbines and are able to evaluate turbines from an economic and ecological point of view.

Teaching and Learning Methods:
The module consists of lecture and exercise. The contents of the lectures are primarily conveyed by the lecturers and through presentations. The students should get a well-founded insight into the topic. The exercises cover on the one hand technical calculations on wind turbines, on the other hand the different aspects of turbine project planning, in particular economic and ecological aspects, as well as acceptance by public. Among other things, plan and role plays in groups are planned to achive this goal. Some of the exercises are to be prepared by the students themselves, others are to be carried out as face-to-face exercises. This should encourage students to work independently and to deal more intensively with the respective topics. Simulation and role-playing games help students to gain a deeper understanding of the opportunities and problems in the field of wind power technology.

Media:
PowerPoint, blackboard, publications

Reading List:
Erich Hau: Windkraftanlagen. Springer, 2008. ISBN 978-3-540-72150-5

Responsible for Module:
Doris Schieder Doris.schieder@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0100: Microbial and plant biotechnology | Microbial and plant biotechnology [MPBioTech]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In order to check whether students have understood and are able to apply the principles and relevant methods and techniques of microbial biotechnological production processes, the students answer questions about production processes and fermentation strategies in a written exam (90 min, 50% weighting) and prove that they have understood the correlations of microbial metabolism. Allowed tools are calculators. The learning results in the field of plant biotechnology are going to be proved in form of a written exam (60 min., 50% weighting) . In this written exam it will be evaluated to which extent the students are able to describe and assess the topics of the lecture correctly in appropriate scientific language. The seminar talk (20 Min., ungraded) will be evaluated to assess the ability of the students to correctly summarize the content of a complex scientific publication in the field of plant biotechnology and to comprehensively and convincingly present it to an audience.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fundamentals of Biology or of cell and microbiology from the Bachelor's courses

Content:
Relevant topics and techniques of microbial biotechnology: - microbial metabolism (biosynthesis and degradation pathways) - industrial microbiology: production of alcohols, amino and organic acids, vitamins, antibiotics, enzymes, etc. - bioprocessing techniques - metabolic engineering strategies (e.g. optimization of precursor and cofactor availability) - quantitative biology. In the lecture plant biotechnology the most important model and crop plants in biotechnology are presented, classified and their morphological and physiological properties are emphasized. Major

questions, methods and solutions will be discussed with thier pros and cons. Current topics will be discussed based on selected original publications. Some of the topics to be discussed: legal framework, major appication of current plant genetic engineering, the Arabidopsis model system, novel concepts for yield and quality improvement.

Intended Learning Outcomes:
Upon successfull completion of the module, students will be familiar with the principles and techniques of relevant bioprocesses. The students have acquired knowledge of fermentation processes and are able to develop strategies for process control for selected product classes. The students have learned to quantitatively describe microbial growth and fermentation processes and to calculate mass balances. The students have acquired in-depth knowledge of relevant production processes for selected products of industrial biotechnology. The students know the most important methods and applications in plant biotechnology and are able to assess them.

Teaching and Learning Methods:
The contents of the lectures are conveyed by a talk of the lecturer, based on PowerPoint presentations.The blackboard might additionally be used to explain more complex relationships. To a limited extent, this can be supplemented by self-study of the literature mentioned in the lecture. Seminar: recent publications well be selected and briefely discussed with the students, then presented by the students. The presentation will be discussed and evaluated.

Media:
PowerPoint, whiteboard

Reading List:

Responsible for Module:
Bastian Blombach bastian.blombach@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Applied Microbiology and Metabolic Engineering (Lecture) (Vorlesung, 2 SWS)
Blombach B [L], Blombach B
For further information in this module, please click campus.tum.de or here.

Module Description

CS0105: Modelling and Optimization of Energy Systems | Modelling and Optimization of Energy Systems [MOES]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment is done in a written examination (90 minutes). Participants of the course solve programming tasks to demonstrate that they are able to apply the methods aquired in the course. By answering questions related to case examples they show that they have learned to put things into their proper context.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Bachelor modules Mathematics, Physics, Numerical Methods;
Basic knowledge in Energy technology; basic programming experience (ideally with Matlab)

Content:
Basics of Modelling and Simulation:
- physical models
- data-based models (look-up tables, polynomials, neural networks)
- methods for generating models

Fundamental optimization methods:
- linear optimization (linear regression)
- nonlinear optimization

Intended Learning Outcomes:
After attending the course the participants understand basic methods for creating models, simulation and optimization. In addition, they are able to apply these methods by creating

appropriate program code in Matlab. Furthermore, the participants acquire Matlab programming experience.

Teaching and Learning Methods:
The module consists of a lecture and an excercise. Lectures include presentations whose content is deepened by solving excercise problems autonomously. In order to improve the learning outcome, participants work at homework excercise problems. These are discussed in the next lecture.

Media:
PP presentation, whiteboard, demonstration of programs

Reading List:

Responsible for Module:
Josef Kainz

Courses (Type of course, Weekly hours per semester), Instructor:
Modelling and Optimization of Energy Systems (Vorlesung, 4 SWS)
Kainz J [L], Kainz J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0137: CO2 capture, storage, and utilization | CO2 capture, storage, and utilization

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 82	**Contact Hours:** 38

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The basics of CO2 capture, storage and use will be tested in an oral examination (25 minutes). The students demonstrate that they have understood the technology of CO2 separation plants and that they are able to carry out calculations on the design, energy yield, and economic efficiency of such plants. They also show that they have understood technologies for sequestration and short-term storage of CO2 and are able to balance and evaluate chemical processes that use CO2 as a raw material.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Thermodynamics of Mixtures, Fluid Separation processes

Content:
Physical and chemical properties of CO2 and mixtures containing CO2; basics of sorption processes; processes for CO2 separation from natural gas and flue gas; processes for direct air capture; processes for CO2 sequestration; CO2 as raw material for C1-Chemistry, reverse-water-gas-shift; CO2 as substrate for biotechnological processes; CO2 as chemical product

Intended Learning Outcomes:
After attending the module, the students will be able to characterise different types of CO2 capture systems for both industrial gas streams and the atmosphere. They recognise and understand the plants from a technical and energy point of view. The students understand the challenges involved in sequestering and storing CO2, as well as in converting it into valuable chemical products and

fuels. They are able to evaluate the plants along the CO2 value chain from an economic and ecological point of view.

Teaching and Learning Methods:
The module consists of a lecture and an exercise. The contents of the lectures are primarily conveyed by the lecturers through presentations. Thereby, the students should get a well-founded insight into the topic. The exercises include technical calculations for the process units presented in the lecture on the one hand, and the various aspects of the sustainability calculation of CO2 value chains on the other. In the excercise, both classroom sessions and self-study are used. Therby, students are motivated to research the current state of the art in this highly topical field of technology.

Media:
Scriptum, handouts, scientific and technical literature

Reading List:
- Wilcox, Jennifer. Carbon capture. Springer Science & Business Media, 2012;
- Aresta, Michele, ed. Carbon dioxide as chemical feedstock. Vol. 416. Weinheim: Wiley-VCH, 2010.
- Fischedick, Manfred, Klaus Görner, and Margit Thomeczek, eds. CO2: Abtrennung, Speicherung, Nutzung: Ganzheitliche Bewertung im Bereich von Energiewirtschaft und Industrie. Springer-Verlag, 2015.;

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0138: Research lab energy and process engineering | Research lab energy and process engineering

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 75	**Contact Hours:** 75

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In the practical course, the exam is taken by positively elaborated written internship reports. Thereby the correct presentation of the theoretical basics, the reproduction of the experimental procedure, and the correct data evaluation are essential. Thereby the students show that they understand basic processes and principles of energy and process engineering and that they can design and calculate corresponding transformations.
The students prove that they can execute and evaluate experiments with technical plants in small groups.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Chemical reaction engineering, Fluid separation processes, Energy Technology

Content:
Experimental methods used in research. These include e.g. phase equilibrium measurements, elucidation of reaction kinetics, classification of particle sizes.

Intended Learning Outcomes:
After graduation of the practical course, the students are able to independently design, execute, and evaluate research experiments in energy and process engineering (for exampel in reaction engineering or separation science).

Teaching and Learning Methods:
The acquisition of the basics is to be prepared by the literature handed out. Under supervision, students plan experiments to solve given problems. They will be supported and supervised by laboratory personnel during the setup and execution of the experiments.

Media:
Practical course script, laboratory equipment

Reading List:
Practical course script

Responsible for Module:
Jakob Burger burger@tum.de Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0139: Flowsheet balancing and simulation | Flowsheet balancing and simulation [ABS]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level:	Language: German/English	Duration: one semester	Frequency: winter semester
Credits:* 5	Total Hours: 150	Self-study Hours: 90	Contact Hours: 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination is performed in the form of a seminar paper, in which an energy-technical task is to be solved with the software program. The learning result is checked by the way the work is carried out within the scope of the examination and the result achieved. The students prove that they can solve balancing tasks by using the software. It is proven that the students have understood the principles of balancing.

Repeat Examination:

(Recommended) Prerequisites:
Basic knowledge of the most important physical relationships (basic quantities with units, definition of pressure, temperature, enthalpy, entropy, etc.) must be available. Furthermore, the establishment and solution of mathematical systems of equations as well as the mastery of simple integral and differential calculus are assumed. Knowledge of mathematics, thermodynamics, energy and process engineering are required.

Content:
In this module, knowledge of the application of a selected software program (e.g. Aspen) for the calculation and design of energy engineering tasks is taught.
The selection of the software is based on the availability of the program and the availability of a teacher with the technical knowledge of the program.

Intended Learning Outcomes:
After the participation in the module the students are able to understand simple tasks for the calculation of energy systems with the software program, to build up, define and solve them in the used program environment (Aspen).

Teaching and Learning Methods:
The module consists of a seminar, because this form of learning is best suited for the introduction to software. The introductions take place in short presentations, which are followed by direct working with the program.

Media:
Presentations, slide scripts, program exercises

Reading List:

Responsible for Module:
Matthias Gaderer gaderer@tum.de Christian Schuhbauer schuhbauer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Flowsheet balancing and simulation (Seminar, 4 SWS)
Gaderer M [L], Klüh D, Tilk G, Weiker S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0141: Machine Learning | Machine Learning [ML]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Learning outcomes shall be verified in a written test. Tasks shall be specified by means of which the students are to demonstrate that they know the machine learning methods imparted as part of the module and that they have understood and are able to apply them for specific case studies.
Exam duration: 90 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic Mathematical Skills, Basic Programming Skills

Content:
"Technologies that generate analyses or predictions based on data can be found in almost all areas of our daily live (e.g. recommender systems, autonomous driving and credit card fraud detection). In this course we will learn the fundamentals of machine learning and will apply these methods on various real-world problems.
The following contents will be treated exemplarily:
• Similarity and Distance Metrics
• Data Preprocessing and Visualization
• Classification
o Nearest-Neighbor
o Perceptron & Adaline
o Logistic Regression
o Decision Tree
o Support Vector Machines (SVM)

o Artificial Neuronal Networks
• Model Selection and Hyperparameter Optimization
o Confusion Matrix and Evaluation Measures
o Cross-Validation
o Line Search
o Over- vs. Underfitting
• Clustering
o K-Means
o Hierarchical Clustering
• Regression Models
o Linear Regression
o Support Vector Regression"

Intended Learning Outcomes:
The students know the fundamental and most important artifical intelligence, especially machine learning methods and are able to apply them independently on various real-world problems. The students learn the basics of the programming language Python (one of the leading programming languages in the field of machine learning) and are able to implement and apply machine-learning algorithms in Python. In addition, students are able to visualize and interpret different types of data and results independently.

Teaching and Learning Methods:
Lecture to provide the students with all necessary fundamentals of artificial intelligence, especially of machine learning which they will need to independently apply these concepts to real-world data. In the exercises the students are introduced to the programming language Python, as well as to apply and implement these algorithms for specific case studies.

Media:
The lecture shall mainly be done by using PowerPoint presentations. During the exercise the students work at PCs to gain confidence in using the programming language Python. Students implement various machine learning methods in Python (e.g. using Jupyter Notebooks) and apply them on various examples. Students work on real world problems to implement learnt skills and to gain confidence in applying these different methods independently.

Reading List:
Murphy, K. P. (2012). Machine learning: a probabilistic perspective. MIT press.
Bishop, C. M. (2006). Pattern recognition and machine learning. Springer.
Raschka, S. (2017). Machine Learning mit Python. mitp Verlag.
Friedman, J., Hastie, T., & Tibshirani, R. (2001). The elements of statistical. Springer.

Responsible for Module:
Dominik Grimm dominik.grimm@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0142: Detail Process Engineering | Detail Process Engineering [DPP]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination is provided in the form of a term paper and a written exam (90 minutes).
The students prove that they can solve specific tasks and computational tasks and apply methods of plant planning and safety analysis and answer them in writing.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Mechanical process engineering, materials engineering, mechanics

Content:
The module teaches the usual components used in plant engineering, such as machines, pipelines, valves, actuators and apparatus, and their function. Building on this, an introduction to safety and emission-relevant design guidelines such as e.g. steam boiler regulations, AD2000 leaflets, ASME, TA Luft and BimschV is given. As part of exemplary small-scale plant planning, specifications for media, machines, apparatuses and plants are drawn up and security analyzes are carried out. Their results are incorporated in the planning process. A key focus of the module concerns the practice-oriented aspect of technical plant safety as well as requirements within the scope of a CE certification in plant construction.

Intended Learning Outcomes:
After completing the module, students will be able to describe technical equipment components, perform apparatus design in terms of material, pressure, temperature, process demand according to AD2000 data sheets and steam boiler regulations, specifications for media, equipment and apparatus, VDI, DIN, To apply EN standards to the TA Luft and Bimsch laws and regulations, to

describe the course of an ASME code, to describe the content and course of CE certification and construction products, to apply system-related hazard and safety analyzes and safety-related solutions - for example by control technology Aspects - to be included in a plant design.

Teaching and Learning Methods:
The module consists of Lecture and Exercise.
In the lecture, the contents of the lectures will be conveyed during lectures and presentations. The students are encouraged by the seminar paper to actively engage with the topics.
The exercises serve to strengthen the comprehension of the teaching contents. For this exercise examples are processed.

Media:
Presentations, scripts, exercises

Reading List:

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0143: Hydropower | Wasserkraft [HyPo]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level:	Language:	Duration:	Frequency:
Master	German	one semester	summer semester
Credits:*	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**
4	10	75	45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The characteristics of various types of plants for the use of hydropower are assessed in a written examination (60 minutes). Further students shall show the understanding of planning, erecting and operating water power stations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in Mathematics and Physics
Basics in Energy Technology

Content:
In-depth knowledge regarding energy generation from water power is taught in this module. The technologies used for this purpose will be presented from the following points of view:
• Physical basics
• construction types and system components
• Planning, erection and operation
• Power output and energy supply
In addition to technical features of plants, their effects on the environment are covered. Legal framework conditions as well as the economic aspects of using water power are discussed as well.

Intended Learning Outcomes:
After completion of the module, students are able to characterize various types of plants for the use of hydropower. They can recognize and understand the plants from the point of view of energy

and technology. Students understand the processes involved in planning, erecting and operating water power stations and are in a position to analyze plants from an economic and ecological perspective.

Teaching and Learning Methods:
The module consists of a lectures with integrated excercises. Lectures include talks and presentations as well as exercises. Students should be encouraged to study the literature and discuss about the topics. In addition, practical excercises with measurement equipment and an excursion may be included.

Media:
PowerPoint, blackboard

Reading List:
Jürgen Giesecke, Emil Mosonyi: Wasserkraftanlagen. Springer, 2009. ISBN 978-3-540-88988-5

Responsible for Module:
Josef Kainz josef.kainz@hswt.de Christoph Pfeffer c.pfeffer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0147: Energy Efficient Buildings | Energieeffiziente Gebäude [EEB]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students demonstrate their knowledge and understanding of the differenct aspects of energy efficient buildings in form of a written examination (90 minutes). Students deliver definitions, describe and outline relevant processes, mechanisms and requirements of energy efficient buildings. Furthermore, students calculate different technical specifications and parameters based on provided practice-oriented examples.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics of physics, Basics of energy technology

Content:
The course focuses on the variety of options for implementation and/or enhancement of energy efficiency in new and existing buildings. This includes an introduction to relevant expert knowledge of energy and ressource efficient building materials and construction. In addition, typical measures for the enhancement of energy efficiency in existing buildings will be presented and evaluated concerning ther sustainability. The second part of the module is concerned with renerwable energy based systems for heat and warm water provision of buildings. Specific advantages and disadvantages of the presented technologies will be discussed in regards to building and usage type. In addition to the presentation of individual measures, it will be analyzed how concepts for energy efficient buildings can be include in modern building infrastructure and on living quarter scale.

Intended Learning Outcomes:
"After successful completion of the module, students acquire in-depth understanding of factors determining the energy efficiency of buildings and relevant legal requirements. Students can evaluate the sustainability of actions to enhance the energy efficiency of (existing) buildings. In addition, students can understand as well as evaluate and explain advantages and disadvantages of systems for heat and warm water provision based on renewable energies in regards to building and usage type.

Students prepare short, practice-oriented tasks as homework in a project team (group work). Thereby, they acquire the ability to view and assess information within a limited period of time and solve practice-oriented questions. The edited information and results are passed on to the other participants accordingly with the focus on sharing results in the form of a written report as well as team work.

Teaching and Learning Methods:
The content is taught in lecturs and presentations. In addition, case studies and exercises will bei discussed. Students should bei encouraged to individual literature study and discussions on the theme.

Media:
PowerPoint, blackboard, videos

Reading List:
Bauer, M., Mösle, P., Schwarz, M. (2010): Green Building
Guidebook for Sustainable Architecture. Springer Vieweg. Daten von Fachagenturen: BINE Informationsdienst, vom Bundesumweltministerium bzw. entsprechenden Landesministerien und anderen internationalen Organisationen.

Responsible for Module:
Thomas Vienken thomas.vienken@hswt.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0164: Basics of Numerical Methods and Simulation | Grundlagen Numerik und Simulation [NumS]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2020

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam achievement shall be done in the form of a written test. As an aid the materials (lecture slides, example programs) used during the lecture may be employed. The students show by solving programming tasks that they know the basics of Matlab and are able to implement simple numerical methods. By using case studies they apply methods to specific technical problems.
Exam duration: 90 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
WZ1600 Physics, WZ1601 Mathematics

Content:
'- Basics of programming by Matlab/Simulink
- simple numerical methods: Equation systems, integration, differentiation, zero search
- numerical solution of differential equations
- application of methods by using case studies (e.g. mechanical and electric systems)

Intended Learning Outcomes:
After having participated in the module units the students know the basics of handling Matlab/ Simulink and simple methods of numerical mathematics. For the treated case studies they are able to independently implement these methods in Matlab programmes and thus find solutions to problems and assess the solution found.

Teaching and Learning Methods:
The module consists of one lecture and an associated session of exercises. Contents of the lecture shall be imparted in a speech and deepened through independent preparation of exercises by the students. Processing of exercises is often done by independent preparation of programming tasks.

Media:
Presentations, writing on the board, demonstration of programmes/scripts

Reading List:

Responsible for Module:
Prof. Josef Kainz

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1120: Medicinal and spice plants | Heil- und Gewürzpflanzen

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In a written examination (60 minutes), students demonstrate their ability to identify important medicinal and aromatic plants, as well as outline methods of cultivation, harvesting and drying. In addition, they have a limited time frame to classify medical effects and chemical compounds. During the course of the module, students give a detailed presentation on certain medicinal and aromatic plants, which also informs the assessment.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Organic and anorganic chemistry, botany, plant cultivation or Introduction to biology (WZ1110), chemistry (WZ1106), cultivation systems (WZ1107).

Content:
History of medicinal plants, identification of medicinal plants, special aspects of cultivation of aromatic plants, plant protection and harvesting. Drying methods used for herbs. Different classes of active substances, such as terpenes, coumarin, flavonoids and certain effect-determining ingredients. Several extraction and analysis methods of isolation of the active substance, e.g. Soxhlet extraction, thin-layer chromatography or infrared spectroscopy. Frequent mechanisms of action, e.g. inflammation cascade, infections, neurotransmission or digestion system. Current cultivation systems and use of medicinal and aromatic plants.

Intended Learning Outcomes:
After participation in the module, students know how to characterize medicinal and aromatic plants, inclucing basics of cultivation systems in herb gardens and fields. They are aware of different

techniques such as drying and harvesting of various medicinal and aromatic plants. Examples are used to demonstrate the students' ability to classify medical effects and chemical compounds. Participating in tutorials on laboratorial work, students learn how to perform analytical-chemical analyses on medicinal and aromatic plants as well as deducing the respective classes of active substance.

Teaching and Learning Methods:
Lecture (talks given by teaching staff using PowerPoint media, books and other written material), excursion to process engineering company. Tutorials (e.g. students perform supervised experiments)

Media:
PowerPoint presentation and lecture notes.
Laboratory equipment for experiments, exercises about analysis

Reading List:
Deutschmann, F., Hohmann, B., Sprecher, E., Stahl, E., Pharmazeutische Biologie, 3 Bde., G. Fischer Verlag, 1992
Wendelberger, E., Heilpflanzen: Erkennen | Sammeln | Anwenden Broschiert – BLV Buchverlag Januar 2013
Dingermann, Hiller, Schneider, Zündorf 2011, Arzneidrogen Spektrum akademischer Verlag

Responsible for Module:
Alexander Höldrich (alexander.hoeldrich@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1128: Geothermal Energy Systems | Geothermische Energiesysteme [GeoE]

Potentials of geothermal energy supply

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students demonstrate their knowledge and understanding of geothermal systems and their potential for energy supply in form of a written examination (90 minutes). Students deliver definitions, describe and outline relevant processes for the geothermal energy supply. Furthermore, students calculate different technical specifications and parameters based on provided practice-oriented examples.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful completion of the module "Basics in engineering" and "Introduction to Energy conversion and Energy economy". Knowledge and interest in Geology and Physics are valuable.

Content:
The course focuses on the variety of options for geothermal energy supply. This includes an introduction to relevant geological expert knowledge such as formation of the earth, earth’s structure, geothermal heat sources, the rock-cycle as well as mechanism of subsurface heat transport. After an introduction to deep geothermal exploration (drilling, drilling technology and related risks) the focus of the course is placed on shallow geothermal energy and use of ground-coupled heat pump systems.

This includes the design and working principle of a heat pump system and its integration in technical building equipment as well as the analysis of their ecological and economic

sustainable operation on living quarter scale. The analysis is also done with regards to existing technical guidelines as well as legal boundary conditions. Practice-oriented tasks will be used to demonstrate and critically evaluate the basic planning steps of heat pump systems and obtaining the relevant parameters. Existing and innovative geothermal exploration concepts will be analyzed and discussed against this background.

Intended Learning Outcomes:
After successful completion of the module, students acquire in-depth understanding of geothermal energy systems including relevant geological and hydrogeological processes. Students can evaluate the ecological as well as economic sustainability of geothermal heat source systems. They can test plausibility of dimensioning ground-coupled heat pump systems and understand, explain and simulate heat transport processes and regeneration processes within the subsurface.

Students prepare short, practice-oriented tasks as homework in a project team (group work). Thereby, they acquire the ability to view and assess information within a limited period of time and solve practice-oriented questions. The edited information and results are passed on to the other participants accordingly with the focus on sharing results in the form of a written report as well as team work.

Teaching and Learning Methods:
The lecture given in talks is supplemented by tutorials and possibly an excursion.

Media:
Lecture, Power Point presentation, blackboard, case examples, topics prepared and presented by participants

Reading List:
Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen (2005): Oberflächennahe Geothermie.

Bauer, M., Freeden, W., Jacobi, H., Neu, Th. (Hrsg.) (2018): Handbuch Oberflächennahe Geothermie. Springer Spektrum, 1. Auflage.
Stober, I. & Bucher, K. (2014): Geothermal Energy. Springer Spektrum, 1st edition.

Hölting, B., Coldewey, W.G. (2013): Hydrogeologie. Springer Spektrum, 8. überarbeitete Auflage.
Dassargues, A. (2018): Hydrogeology: Groundwater Science and Engineering, CRC Press, 1st edition.

Grotzinger, T. & Jordan, T. (2017): Press/Siever Allgemeine Geologie. Springer Spektrum, 7. Auflage
Grotzinger, T. & Jordan, T. (2014): Understanding Earth. W.H. Freeman & Company, 7th edition

Responsible for Module:
Prof. Thomas Vienken

Courses (Type of course, Weekly hours per semester), Instructor:
Geothermal Energy Systems (Vorlesung, 4 SWS)
Vienken T [L], Vienken T
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1151: Biogenic Polymers | Biogene Polymere

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
During the seminar, students independently work on a topic from the field of biogenic polymers, and give an oral presentation. Group work is optional. Assessment requires an oral examination (30 minutes). Students demonstrate their knowledge of physico-chemical properties of biogenic polymers as well as possible applications. Students are able to develop options for chemical synthesis and analysis of physico-chemical properties of bioplastics. No further tools are allowed in the examination.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in "Basics in Chemistry" (WZ1106) and knowledge of materials and chemical compounds, or comparable knowledge on chemistry and physics.

Content:
The module deals with structure and function of natural bio-macromolecules (in particular polysaccharids and proteins). Furthermore, basics of biogenic polymers will bei discussed in the view of polymers holding potential for applications in future technology. The topic of chemical synthesis and derivatization of bioplastics for use in industry is introduced (e.g. cellulose derivatives). Special focus is set on the development of options for chemical synthesis and its competent application. Physico-chemical properties of bioplastics as well as their characterization is central to the lecture.
The seminar takes the form of a journal club with students independently work on reserach papers and their presentation to fellow students.

Intended Learning Outcomes:
After participation, students are able to classify different kinds of bioplastics with respect to their possible application. They are competent to evaluate the production processes of biopolymers used in technology and can classify them according to their profile of properties. The module enables students to decide on appropriate synthesis methods to meet specific requirements in the industry. Students will also be able to use physico-chemical analysis methods in a competent way.

Teaching and Learning Methods:
Lecture (talks given by teaching staff using PowerPoint media, books and additional written document), seminar (independent work on a topic including a presentation, peer instruction and constructive criticism)

Media:
Presentations, slide notes

Reading List:
Endres, H.J., Seibert-Raths, A., Technische Biopolymere, Carl Hanser Verlag, München, 2009

Responsible for Module:
Cordt Zollfrank (cordt.zollfrank@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Biogenic Polymers (Lecture) (Vorlesung, 2 SWS)
Zollfrank C [L], Zollfrank C

Biogenic Polymers (Seminar) (Seminar, 1 SWS)
Zollfrank C [L], Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1152: Plastics Technology | Kunstofftechnologie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
This module involves a practical course. Prior to each experiment, students will take an oral test to verify that they are properly prepared for experimental work. Following their experimental work, students will submit a written report which demonstrates their acquired knowledge of production technologies as well as testing and measuring procedures. Students will also show their ability to analyze data, evaluate outcomes and document this information in reports.
Assessment takes a written examination (60 minutes). Answering questions without any external tools and under time constraints, students demonstrate their theoretical knowledge of production technologies and for testing and measuring procedures. They will also have to assess possible effects of changing parameters on various processes.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic knowledge in organic and inorganic chemistry, module biogenic polymer

Content:
The lecture introduces to basic technologies and methods of plastics and polymer processing, e.g. injection moulding, extrusion, remodelling and typical applications. Methods for characterization of thermic and mechanical properties are presented. A focus will bei set on the connections between processing parameters and final properties. The lectures comprise the following topics: chemistry, structure and classification of plastics and polymers, physical properties, materials science, mechanical and thermic properties as well as their effects on processing, viscosity and viscoelastic behavior, filler material, processing engineering and production, and rapid prototyping. Students' knowledge will be deepened in the accompanying seminar. Here, experiments in

injection moulding and extrusion will be performed and the resulting specimens be characterized with respect to their thermic, visual and mechanical proberties.

Intended Learning Outcomes:
After completion of the module, students will be able to classify plastics and polymers according to their chemical and physical properties, and use them for specific purposes. They will know basics of plastics and polymer production technology, In addition, students are able to distinguish between a range of traditional and innovative procedures of processing and apply them as required. Practical exercises enable students to apply and assess the most appropriate methods for testing and characterization.

Teaching and Learning Methods:
Lecture (talks given by teaching staff using PowerPoint media, books and additional written material), laboratry course (demonstration of equipment and supervised experiments performed by students)

Media:
PowerPoint presentation and printed lecture notes, laboratory equipment used for experiments

Reading List:
Michaeli, W. Einführung in die Kunsstoffverarbeitung, Carl Hanser Verlag, München Wien 2010
Menges, G. Werkstoffkunde der Kunststoffe, Carl Hanser Verlag, München Wien 1990

Responsible for Module:
Cordt Zollfrank (cordt.zollfrank@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Polymer Processing (Practical) (Praktikum, 1 SWS)
Zollfrank C

Polymer Processing (Lecture) (Vorlesung, 2 SWS)
Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1154: Biorefinery | Biorefinery [BioRaff]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2020

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students answer questions in a written examination (60 minutes) that will be graded. They thereby show that they have understood, can explain and are able to assess the various steps and processes involved in biorefinery. In an additional coursework, which is not part of the written exam, students individually study selected topics in the field. Here, they apply their knowledge acquired in lectures to deduce and/or evaluate processing methods. Findings are presented in a "research paper" that will be reviewed by students.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge in chemistry and biology; Module "Renewables utilization"

Content:
Contents of the module include:
comparison of biorefinery and mineral oil refinery;
description of different biorefinery systems (e.g. green biorefinery, lignocellulose biorefinery);
selected procedures for the extraction of resources (focused on lignocellulose);
components of plants and raw material important for further processing (e.g. saccharides, lipids/ oils, lignin);
selected pathways of their use (e.g. bioalcohols, polylactic acid, proteins, succinate and other components);
cascade use of materials and energy.

Intended Learning Outcomes:
After completion of the course, students will have understood the concept of biorefinery, analogous to and in contrast with mineral oil refinery. Students are able to describe various biorefinery concepts and methods for processing renewable resources in a biorefinery. They are able to apply their knowledge to the analysis and assessment of viable biorefinery systems, taking into account their respective advantages and disadvantages. In addition, they have trained their competences in literature research and critical evaluation as well as in the preparation of "research papers".

Teaching and Learning Methods:
Lecture: talks given by teaching staff; Exercise: more detailed studies on selected topics; students individually prepare one topic and finally present their results ("research paper").

Media:
PowerPoint presentation, blackboard

Reading List:
B. Kamm, P. R. Gruber, M. Kamm (Hrsg.), Biorefineries - Industrial Processes and Products, Vol. 1-2, Wiley-VCH, Weinheim, Germany, 2006

Responsible for Module:
Doris Schieder (doris.schieder@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Biorefinery (Lecture) (Vorlesung, 2 SWS)
Schieder D

Biorefinery (Seminar) (Übung, 1 SWS)
Schieder D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1157: Sustainable Chemistry | Nachhaltige Chemie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination will take the form of a written test (60 minutes). In this examination the competence for the evaluation of chemical processes and for the derivation of optimization strategies shall be proven. No aids are permitted in the written examination. In order to additionally check whether the students are able to communicate scientific topics in front of an audience and whether they are able to critically deal with problems in individual steps, the results of the processing of the case studies are presented in the form of a 20-minute presentation alone or in a group (ungraded study achievement).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in the module "Basics in chemistry" or comparable knowledge in chemistry.

Content:
The module teaches basic principles of sustainable chemistry. Focus is set on the evaluation of chemical processes in view of efficiency, atom economy and amount of waste. In addition, optimizsation strategies related to catalytical methods, raw material and energy efficiency are discussed. Students individually prepare current topics related to sustainable chemistry and present them in the seminar.

Intended Learning Outcomes:
By attending the module events, students are able to highlight the principles of sustainable chemistry. Students can analyze the efficiency and waste quantities of chemical reactions and

evaluate various alternative processes. Furthermore, they are able to discuss further chemical aspects of the conversion of renewable raw materials into valuable products. Through the independent development of case studies, the students master all the steps that are important in the critical examination of problems (consideration of the example, development of criteria for evaluation, assessment, presentation of the results to an audience).

Teaching and Learning Methods:
Lecture with board addresses and presentations: Basic development and derivation of technical contents; seminar with written tasks. Consolidation of the technical learning contents through learning activity of the students themselves, e.g. through independent development of case studies from the field of sustainable chemistry.

Media:
Presentation, script, examples

Reading List:
Stanley E. Manahan: Green Chemistry, ISBN: 0-9749522-4-9

Responsible for Module:
Cordt Zollfrank (cordt.zollfrank@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1173: Bioinspired Materials and Processes | Bioinspirierte Materialien und Prozesse

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
During the seminar, students individually study the literature and prepare topics from the area of bioinspired materials which they finally present to the class. Group work is optional. Assessment takes the form of an oral examination (30 minutes).Here, students should demonstrate their ability to categorize biological materials and processes. Students also show their ability to develop options for their application in technology and medicine as well as the production of bioinspired materials. No external tools are allowed in the examination.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Successful participation in the module "Basics of chemistry", "Biochemistry" and "Biopolymers" or comparable knowledge in chemistry, physics and materials science.

Content:
The fundamental principles of composition, structure and function of biological materials are introduced on the course. Topics covered include growth, the creation of biological forms and evolutionary strategies for optimization. Aspects of materials science in terms of self-organisation, stimulus dependence and adaptation are explained. The key properties and functions of biological materials are outlined, using selected examples This also includes biochemical processes in the formation of biological materials as well as strategies for the production of bioinspired materials. Current concepts and designs are developed using examples. Possible fields of application in technology and medicine are outlined in detail. The lecture comprises the following contents, among others:

Introduction: nature and technology, bionics, biomimetics, bioinspiration Fundamental aspects of biological materials: evolution, optimization, development, structures (lotus effect). hierarchy, biology vs. technology
Biominerals and hard tissue: cristallization, types of biomineralization, biominerals
Bioinspired materials: principles, strategies, production, zero-dimensional nanomaterials to complex structures, biotemplating
Fields of application: life sciences (materials for biomedine), technology (materials for energy and environment, materials for optics and technologies)

Intended Learning Outcomes:
After completion of the module, students are able to evaluate complex material systems in nature and work out differences between bionic and bioinspired materials. They feel able to select appropriate biomaterials and concepts for application to technical tasks and develop solutions including the synthesis of bioinspired materials meeting the demands. In addition, students can deduce production processes of new materials for medicine and technology.

Teaching and Learning Methods:
Lecture (talks given by teaching staff using PowerPoint and additional written material), seminar (students independently prepare a topic and present it in an oral presentation, peer instruction and constructive feedback

Media:
Presentations, lecture notes

Reading List:
D'Arcy W Thompson, On Growth and Form, Cambridge University Press (2000)
H Lowenstam, S Weiner, On Biomineralization, Oxford University Press (1989)
JF Vincent, Structural Biomaterials, Princeton University Press (1990)
P Gomez-Romero, C Sanchez Functional Hybrid Materials, Wiley-VCH (2004)
B Ratner, Biomaterials Science, Academic Press, London (2004)

Responsible for Module:
Cordt Zollfrank (cordt.zollfrank@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1180: Introduction Energy Conversion and Energy Economics | Einführung Energiewandlung und Energiewirtschaft

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment takes the form of a written examination (60 minutes). Students demonstrate their understanding of connections relevant to energy conversion, the use of renewable resources as a source of energy, energy supply in general, and the current political and economic situation.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The module deals with the basics of the heat, electricity and fuel market and the use of renewable raw materials, including an introduction to simple technical systems and current topics relating to the energy industry. For example, electricity trading, CO2 trading and the situation of generation plants are dealt with.
In exercises, small examples of the economic efficiency (production costs) of plants are calculated (e.g. combined heat and power generation).

Intended Learning Outcomes:
After participation students understand the basics of energy conversion with regard to heat, electricity and fuel. They can explain the role of market forces in in the electricity and CO2 trade as well.

Teaching and Learning Methods:
The module comprises lectures and tutorials (including an excursion). The contents are presented in talks and presentations. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, practical course

Reading List:
Kaltschmitt, M.; Hartmann, H.; Hofbauer, H.: Energie aus Biomasse, 2. Auflage, Springer, ISBN 978-3-540-85094-6, 2009
Karl, J.: Dezentrale Energiesysteme, Oldenbourg, ISBN 3-486-27505-4, 2004/

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung Energiewandlung und Energiewirtschaft / Energie und Wirtschaft (Übung) (Übung, 1 SWS)
Gaderer M [L], Gaderer M

Einführung Energiewandlung und Energiewirtschaft / Energie und Wirtschaft (Vorlesung) (Vorlesung, 3 SWS)
Gaderer M [L], Gaderer M, Tilk G
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1191: Phytopharmaceuticals and Natural Products | Phytopharmazie und Naturstoffe [Phytopharm]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Knowledge of the covered topics of phytopharmaceuticals and their compounds is assessed in a written examination (60 minutes). In addition, the medical effects of medicinal herbs are to be explained by students using examples. During the examination the tasks are set in both languages and the processing of the examination tasks can take place either in German or English.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Organic and anorganic chemistry, botany

Content:
Content of the lecture:
-definition of medicinal plants and phytopharmaceuticals
-position of phytopharmaceuticals in pharmacology
-compounding (tea drugs, soluble extracts, sCO2 extracts, steam destillation, pure substances)
-effect-determining components and frequent mechanisms (inflammation cascade, infections, coagulation system, neurotransmission, digestive system)
-typical medicinal plants grown in Europe
-international trade in medicinal plants
-important classes of compounds (terpenes, steroids, coumarine, alcaloids, vitamins, saccharides)
-quality determination and typical methods (chromatography)
-falsification and chemotype (chemical race)
-drug regulator affairs (authorisation, documents)

-use of medicinal plants in practice

The practical course teaches basic practical work on chemical analysis of plants.

Intended Learning Outcomes:
After their participation, students can explain the production of phytopharmaceuticals derived from typical medicinal plants (from collection to quality control). They can relate chemical compounds and medical effects of typical examples. The practical course enables students to perform basic steps in chemical analysis and evaluate the results.

Teaching and Learning Methods:
The Lecture takes the form of talks given by teaching staff with the help of PowerPoint media, books and other written material. During the practical course, students perform supervised experiments related to plant analysis.

Media:
PowerPoint presentation and printed handout. Laboratory equipment for experiments.

Reading List:
Deutschmann, F., Hohmann, B., Sprecher, E., Stahl, E., Pharmazeutische Biologie, 3 Bde., G. Fischer Verlag, 1992

Responsible for Module:
Herbert Riepl (herbert.riepl@hswt.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1193: Biogas Technology | Biogastechnologie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2016/17

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 100	**Contact Hours:** 50

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students take a written examination (60 minutes) to demonstrate their knowledge of microbial breakdown processes in the biogas process, as well as their ability to assess influencing factors. They also demonstrate their knowledge of various technologies for using biogas and can explain their respective advantages and disadvantages. Additionally, they demonstrate that they have understood the legal and economic framework conditions of biogas technology and are able to translate these to case examples. Students also show that they can develop basic concepts of biogas plants.They will answer questions on the topic in their own wording and explain case examples or work out calculations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Required: basic knowledge in biology, especially microbiology, as well as general and organic chemistry, mathematics, physics and thermodynamics of cycles; of advantage: knowledge in agriculture and agricultural engineering

Content:
Microbiology of biogas processing, anaerobic substrate breakdown, factors influencing the fermentation process, process management strategies, biogas storage and purification; biogas recovery (e.g. use of a motor for power generation with or without the use of heat or feeding into the gas grid); legal-economic framework conditions; competition for raw material and acceptance of biogas plants; aspects of biogas plant design.

Intended Learning Outcomes:
After successful completion of the module, students are able to develop concepts for biogas generation and recovery in a specific context. Students are aware of microbial breakdown processes in biogas plants and can differentiate between various influencing factors. They are also aware of various processes for the use of biogas (e.g. feeding power by a motor, gas supply) and understand their advantages and disadvantages. Students have a good knowledge of legal and economic framework conditions in the field of biogas generation and they are able to conceptualize basic biogas plants.

Teaching and Learning Methods:
Lectures given as presentations, with the help of a blackboard and interactive elements, in particular group work on case examples; optional: excursion to a biogas plant to deepen acquired knowledge in a real-life setting

Media:
PowerPoint presentation, slide notes

Reading List:
Kaltschmitt, Hartmann (2004): Energie aus Biomasse; Bischofsberger (2005): Anaerobtechnik; Eder, Schulz (2007): Biogas Praxis; KTBL (2010) Faustzahlen Biogas
Journals: Biogas Journal; EnergiePflanzen; Biomass&Bioenergy
Internet: www.fnr.de; www.fachverband-biogas.de; www.biogas-forum-bayern.de; www.carmen-ev.de

Responsible for Module:
Doris Schieder (doris.schieder@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung/Übung
Biogastechnologie
3,5 SWS

Doris Schieder (doris.schieder@tum.de)
Josef Kainz (j.kainz@wz-straubing.de)
Robert Wagner (Robert.Wagner@carmen-ev.bayern.de)
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1664: Energy Storage | Energiespeicher

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2016/17

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination is a 90-minute written final exam. Students prove in exercices their ability to perform the laying-up of energy storage systems and to calculate their specifications and properties. Furthermore the general understanding of different storage technologies and their specific characteristics is tested. The only aid allowed is a handheld calculator.
A term paper is a requirement for the final exam but is not part of the final grade.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
basic but profound knowledge in physics

Content:
The course energy storage gives an overview of established storage systems as well as those being under way. The setup and operation mode of different kinds of energy storage (thermal, mechanical, chemical, electrical and eletrochemical) as well as their application and integration is presented. The status quo of technology and the potential for improvement is depicted.

Intended Learning Outcomes:
The course enables the students to fully understand the complex structures involved in energy storage. They know about different storage types and concepts for heat and electricity. Characterisation on the basis of technical and economic figures is possible.

Teaching and Learning Methods:
The module consists of a lecture course with integrated practical elements. The lecture's content are mediated by the instructor's presentation and exercise examples. By solving given tasks at home and if necessary students presentations the acquired knowledge is consodiated.

Media:
Powerpoint, whiteboard, exercise sheets

Reading List:
Sterner, M.; Stadler, I.: Energiespeicher, Springer Vieweg, ISBN 978-3-642-37379-4, 2014
Rummich, E.: Energiespeicher, expert-Verlag,
ISBN: 978-3-8169-3297-0, 2015
Karl, J.: Dezentrale Energiesysteme, Oldenbourg,
ISBN 3-486-27505-4, 2004

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Energiespeicher (Vorlesung) (Vorlesung, 2 SWS)
Gaderer M [L], Weinrich J

Energiespeicher (Übung) (Übung, 2 SWS)
Weinrich J [L], Weinrich J, Schropp E
For further information in this module, please click campus.tum.de or here.

Interdisciplinary Electives | Fachübergreifende Wahlmodule

Module Description

CS0111: Advanced Development Economics | Advanced Development Economics

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination will be given in the form of a written examination. The students should be able to evaluate and justify general and detailed theories, methods and concepts of the environmental and resource economy. Important international examples will be explained. Type of examination: written, no additional tools allowed, duration of examination: 60 minutes

Repeat Examination:

(Recommended) Prerequisites:
Micro- and Macroeconomics

Content:
Why are some countries developing and some are trapped in poverty? What are the determinants of economic growth? What is the role of demography, institutions (in particular the state), the environment, labor, migration, capital or credit markets in the development of states? What is the importance of development aid & cooperation? These are some of the questions that decision-makers in the developed and developing countries have to discuss every day. This course provides a theoretical foundation and empirical evidence for the analysis of the most important questions of today's development of the world.

Intended Learning Outcomes:
After visiting the module, the students can use the development economy to understand what is hindering development and what factors lead to success. They can apply theories, concepts, and analytical techniques associated with macroeconomics. Students learn to understand the difference between growth and development, the reasons and impact of migration, the role of institutions (e.g. properte and use rights), development cooperation and international trade. The students are able to analyze empirical evidence on economic development and to critically read the literature in the field of economic development.

Teaching and Learning Methods:
The lecture and the seminar will be done by PowerPoint. In addition, current examples from newspapers and journals will be integrated into the lectures. In the seminar, the students research current case studies linked to the theories and concepts presented in the lecture. These case studies are then individually and / or groupwise discussed and questioned from different perspectives together with the students. Web lectures by internationally renowned experts and researchers will be integrated into the lecture.

Media:
Presentations, slide scripts, Articles, online lecture examples

Reading List:
Alain de Janvry, Elisabeth Sadoulet (2016). Development Economics - Theory and Practice. Routledge; Michael Todaro, Stephen Smith (2012). Economic Development, Pearson.

Responsible for Module:
Anja Faße

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Development Economics (Tutorial) (Übung, 2 SWS)
Faße A [L], Faße A, Ngassa C

Advanced Development Economics (Lecture) (Vorlesung, 2 SWS)
Faße A [L], Faße A, Ngassa C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0033: Accredited Module 3 ECTS | Anerkanntes Modul 3 ECTS

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level:	Language:	Duration:	Frequency:
Credits:* 3	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0034: Accredited Module 5 ECTS | Anerkanntes Modul 5 ECTS

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level:	Language:	Duration:	Frequency:
Credits:* 5	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0102: Introduction to Game Theory | Einführung in die Spieltheorie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Bachelor/Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment takes an oral form (25 minutes). Students show the extent to which they have understood the taught definitions and terminology from the area of cooperative and non-cooperative games. They show to which extend they are able to use games in order to model problems from economics and engineering. They are also expected to apply important solution concepts to concrete games. Students demonstrate their understanding of these solution concepts when answering comprehension questions concerning their properties and the advantages and disadcantages of the different concepts.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Cooperative and non-cooperative games, solution concepts for cooperative games, core, Shapley value, solution concepts for non-cooperative games, pure Nash equilibria, mixed Nash equilibria, dominant strategies, Bayesian games

Intended Learning Outcomes:
Students have aquired basic theoretical and practical knowledge on cooperative and non-cooperative games. They know the basic definitions and terminology and are able to model problems from economics and engineering as games. Students know the most important solution concepts for cooperative games (such as the core and the Shapley value) and non-cooperative

games (such as Nash equilibria and dominant strategies). They have gained a good understanding of these concepts and are able to analyze concrete games by using them.

Teaching and Learning Methods:
Lectures introduce basic knowledge; tutorials practice modelling of application problems as games and applying solution concepts to concrete examples.

Media:
Lectures given as presentations (projector and/oder blackboard), tutorials with group work and exercise sheets

Reading List:
Manfred J. Holler, Gerhard Illing, Stefan Napel - Einführung in die Spieltheorie, 8. Auflage, Springer Gabler, 2019.
Steven Tadelis - Game Theory: An Introduction, Princeton University Press, 2013.
M. J. Osborne and A. Rubinstein - A Course in Game Theory, MIT Press, 1994

Responsible for Module:
Prof. Clemens Thielen

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die Spieltheorie (Vorlesung mit integrierten Übungen, 4 SWS)
Thielen C [L], Thielen C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0148: Measurement, Testing, Modeling | Messen, Testen, Modellieren [MTM]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Examination in form of a final presentations (15 min) of the task of the individual groups and a written documentation (report: 25 pages) of the group work. Students will prove their understanding and autonomous application of the teachning content (formulation and testing of hypotheses). The presentation will be weighted 1 to 2 compared to the report.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics of physics, Basics of measurement technology

Content:
The course focuses on planing and conduction of laboratory or field experiments of aplied energy and environmental research, e.g. ground water heat transport and heat storage. Therefore, the module starts with an introduction to relevant underlying technical and natural science content. Students will work on an assigned practice-oriented tasks in the further module. Students will in groups formulate working hypotheses to solve this task and will test these hypotheses by means of laboratory or field experiments. These experiments will be planed and conducted autonomously by students. Planing process includes modelling of respective experiments via existing analytical or numerical (using simulation software) solutions. Students will be able to use existing sensors for the eperiments or design basic measuring devices on their own. Students will critically evaluate obtained results (modelling and measurement results) and identify and quantify resulting uncetrainties. Individual groups present results of their task and work approach as well

as obtained results to the other students. Thereby, students will learn to critically question scientific questions and concepts.

Intended Learning Outcomes:
After successful completion of the module, students acquire in-depth understanding of formulating scientific hypotheses in regards to scientific questions. Students obtain skills to test these hypotheses using laboratory and field experiments. Students will be able to plan, this includes modeling of expected results via existing analyitcal or numerial solutions, and to conduct basic scientific experiments. Students will be able to critically evaluate measurement data and underlaying scientific concepts and present this to a group.

Teaching and Learning Methods:
After an introductary lecture, groups of students will review textbook and non-traditional textbook literature, e.g. tutorials and teach relevant aspects for their work between groups. Thereby, students take responsible to teach relevant content to peers.

Media:
PowerPoint, blackboard, videos

Reading List:
Eden, K., Gebhard, H. (2014): Dokumentation in der Mess- und Prüftechnik. Springer Vieweg.
Daten von Fachagenturen: BINE Informationsdienst, vom Bundesumweltministerium bzw. entsprechenden Landesministerien und anderen internationalen Organisationen.

Responsible for Module:
Thomas Vienken thomas.vienken@hswt.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0161: Accredited Module 6 ECTS | Anerkanntes Modul 6 ECTS

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level:	Language:	Duration:	Frequency:
Credits:* 6	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

SZ0414: English - Intercultural Communication C1 | Englisch - Intercultural Communication C1

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:**
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
A classroom presentation (including a handout and visual aids) (50%) and a final exam (50%) form the basis for final assessment. Duration of the final examination: 60 minutes. In the presentations and final exam students demonstrate a critical awareness of various dimensions and theories of cultural difference and show that they can apply them in situations where intercultural communication occurs.

Repeat Examination:

(Recommended) Prerequisites:
Ability to begin work at the C1 level of the GER as evidenced by a score in the range of 60 – 80 percent on the placement test at www.moodle.tum.de. (Please check current announcements as the exact percentages may vary each semester.)

Content:
This course, taught in English, should familiarize you with some dimensions of cultural variation and theories of culture and communication. While learning to understand and appreciate cultural difference, you will improve your ability to communicate effectively in a global context.

Intended Learning Outcomes:
After completion of this module, students can communicate more effectively with partners from other cultures. Specifically, they can recognize cultural differences when they occur, understand some specific ways in which cultures can differ, and have developed self-awareness of their own

cultural behaviors and values, which helps them be more effective in cross-cultural communication situations.

After completion of this module, non-native speakers of English can better understand a wide range of demanding, longer texts, and recognize implicit meaning; they can express themselves fluently and spontaneously without much obvious searching for expressions; they can use language flexibly and effectively for social, academic and professional purposes and they can produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors and cohesive devices; They are better prepared for studying or working abroad. Corresponds to C1 of the CER.

Teaching and Learning Methods:
Communicative and skills oriented treatment of topics with use of group discussion, case studies, presentations, writing workshops, listening exercises, and pair work to encourage active use of language, and provide opportunities for ongoing feedback.

Media:
Textbook, use of online learning platform, presentations, film viewings, podcasts and audio practice.

Reading List:
Tuleja, Elizabeth (2007) Intercultural Communication for Business (2nd Edition). Mason: Southwestern.

Spencer-Oatey, Helen and Franklin, Peter (2009) Intercultural Interaction: A Multidiscioplinary Approach to Intercultural Communication. Palgrave Macmillan.

Responsible for Module:
Heidi Minning

Courses (Type of course, Weekly hours per semester), Instructor:
Englisch - Intercultural Communication C1 (Seminar, 2 SWS)
Hughes K, Minning H, Neumeier M, Ritter J
For further information in this module, please click campus.tum.de or here.

Module Description

SZ04311: English - Basic English for Academic Purposes B2 | Englisch - Basic English for Academic Purposes B2

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:**
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessement is based on: two written homework assignments for a total of 50% (based on multiple drafts to encourage learning by means of revision) in which students are able to produce clear, detailed text on a topic related to their fields of study and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options; a presentation (including a handout and visual aids) 25% in which oral fluency is demonstrated and an ability to conduct technical discussions in their fields of specialization; a final written examination 25% which they demonstrate that they understand the main ideas of complex text in their field on both concrete and abstract topics, including technical discussions, and can express their opinions using a wide range of grammatical structures and collocations accurately. Dictionaries and other aids may not be used during the exam. Duration of the final examination: 60 minutes.

Repeat Examination:

(Recommended) Prerequisites:
Ability to begin work at the B2 level of the GER as evidenced score in the range of 40 – 60 percent on the placement test at www.moodle.tum.de. (Please check current announcements as the exact percentages may vary each semester.)

Content:
This course includes note-taking in lectures, practising tutorial participation, academic writing and presenting a topic on a related field of study. Common verb forms such as present simple vs continuous, future forms, present perfect and past simple as well as conditionals will be reviewed and practiced. Other grammatical structures covered include: modal verbs of likelihood,

comparatives and superlatives and uses of articles. Oral and written communication skills needed in academic life will be introduced and practiced, as well as aspects of intercultural communication needed for achieving professional success. Emphasis is placed on developing strategies for continued learning.

Intended Learning Outcomes:
On completion of this module students will have gained some of the study skills required for participating in an English-speaking academic environment. Students are able to produce some academic level work in degree courses held in English. They can understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in their fields of specialization; they can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party; they can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options. Corresponds to B2 of the CER.

Teaching and Learning Methods:
This course involves practising study situations (participating in seminars, tutorials, note-taking in lectures), communicative and skills-oriented treatment of topics with use of group discussion, case studies, presentations, writing workshops, listening exercises, and pair work encourage active use of language, as well as opportunities for feedback.

Media:
Textbook, online learning platform such as www.moodle.tum.de or Macmillan English Campus online resources (www.mec-3.com/tum), presentations, film viewings and audio practice.

Reading List:
Textbook to be announced in the course description. Handouts.

Responsible for Module:
Heidi Minning

Courses (Type of course, Weekly hours per semester), Instructor:
Englisch - Basic English for Academic Purposes B2 (Seminar, 2 SWS)
Bhar A, Ritter J, Starck S
For further information in this module, please click campus.tum.de or here.

Module Description

SZ1202: Spanish A2.1 | Spanisch A2.1

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor/Master	**Language:** Language taught	**Duration:** one semester	**Frequency:**
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Schriftliche Abschlussprüfung (keine Hilfsmittel erlaubt). Prüfungsdauer: 90 Minuten. In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Lese- und Hörverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen/-Fragebogen überprüft. Die Aufgabestellung einiger Prüfungsfragen fordert von den Studierenden in schriftlicher Form eine adäquate Reaktionsfähigkeit ähnlich wie in mündlichen Situationen.

Repeat Examination:

(Recommended) Prerequisites:
Gesicherte Kenntnisse der Stufe A1
Einstufungstest mit Ergebnis A2.1

Content:
In diesem Modul werden Grundkenntnisse in der Fremdsprache Spanisch vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden, z.B. auf Reisen, bei der Wohnungssuche, unter Kollegen, Freunden und Nachbarn, Austausch von Erfahrungen etc. Dabei werden interkulturelle und landeskundliche Aspekte berücksichtigt.
Die grammatikalischen Strukturen werden weiter aufgebaut, wie z.B. Verwendung von den Vergangenheiten Pretérito Perfecto - Pretérito Indefinido, ser und estar, unbetonte Personal Pronomen.
Es werden Strategien vermittelt, die mündlich wie schriftlich eine Verständigung trotz noch geringer Sprachkenntnisse ermöglichen.

Intended Learning Outcomes:
Dieses Modul orientiert sich am Niveau A2 "Elementare Sprachverwendung" der GER. Nach der Teilnahme an der Modulveranstaltung sind die Studierenden in der Lage die Bedeutung von kurzen, klaren und deutlich artikulierten Mitteilungen und Durchsagen zu erfassen. Die Kommunikation ist im Rahmen von einfachen, routinemäßigen Kontexten möglich. Der Austausch von Informationen erfolgt über kurze Dialoge mit verschiedenen Zeitbezügen (z.B.: Gegenwart, Vergangenheit, einfaches Futur) und umfasst einfache Satzgefüge mit beschränkten Strukturen zu vertrauten Tätigkeiten. Der/Die Studierende kann einfache Fragen zu Inhalten stellen und auch beantworten. Gespräche und Dialoge sind kurz, zeitlich beschränkt und orientieren sich inhaltlich an Kontexten, wie z.B. Familie, Freunde, Lebens- und Wohnraum, Reisen. Die Studierenden können kurze Texte oder Briefe lesen und verstehen, wenn diese einen häufig gebrauchten Wortschatz und bekannte Strukturen beinhaltet und wenn darin vertraute Informationen zu finden sind. Er/Sie ist in der Lage mithilfe feststehender Wendungen kurze, einfache Mitteilungen oder persönliche Briefe zu verfassen.

Teaching and Learning Methods:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezieltem Hör-, Lese-, Schreib- und Sprechübungen in Einzel-, Partner und Gruppenarbeit kommunikativ und handlungsorientiert erarbeitet werden. Durch die Kombination dieser Übungen wird die Interaktion mit den Partnern unterstützt und gefordert. Die Studierenden erwerben Teamkompetenz durch kooperatives Handeln in gemischten Gruppen.
Es werden Möglichkeiten aufgezeigt, den Lernprozess in der Fremdsprache Spanisch eigenverantwortlich und effektiver zu gestalten und damit die eigenen Lernfähigkeiten zu verbessern.
Durch kontrolliertes Selbstlernen grundlegender grammatischer Phänomene und Kommunikationsmuster in der Fremdsprache mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Grundlagen vertieft.
Freiwillige Hausaufgaben (zur Vor-und Nacharbeitung) festigen das Gelernte.

Media:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online.

Reading List:
Lehrbuch (wird im Kurs bekanntgegeben)

Responsible for Module:
Maria Jesús García

Courses (Type of course, Weekly hours per semester), Instructor:
Spanisch A2.1 (Seminar, 2 SWS)
Barreda C, Galan Rodriguez F, Guerrero Madrid V, Hernandez Zarate M, Mayea von Rimscha A, Neumeier M, Rey Pereira C, Rodriguez Garcia M, Sosa Hernando E, Tapia Perez T
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1100: Advanced Environmental and Resource Economics | Advanced Environmental and Resource Economics

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2016/17

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination will be given in the form of a written examination. The students should be able to evaluate and justify general and detailed theories, methods and concepts of the environmental and resource economy. Important international examples will be explained. Type of examination: written, no additional tools allowed, duration of examination: 60 minutes

Repeat Examination:

(Recommended) Prerequisites:
Mikroökonomie, Makroökonomie

Content:
The field of environmental and natural resource economics is rapidly growing, as many environmental issues have become of a global importance. This course provides concepts for the optimal use of renewable and non-renewable resources. The economics of water, energy markets, as well as natural resources such as fish and forestry are deepened. The theoriy of the New Institutional Economics illustrate the problem of the tragedy of the commons. Macroeconomic concepts such as "Pollution Haven" and the "Environmental Kuznets curve" illustrate the effect of environment on development and trade.

Intended Learning Outcomes:
After visiting the module, the students have an understanding of the role of renewable and non-renewable resources in the economy. Students can differentiate between the maximum economic and sustainable yield. They have an understanding of the functioning of energy and water

markets. The students gain an understanding of the New Institutional Economics, in particular the property rights of land and the sustainable use of the global commons. In addition, the students understand the influence of the environment on the economic development of a country as well as on international trade.

Teaching and Learning Methods:
The lecture and the tutorial take place by means of powerpoint. In Addition articles from newspapers and scientific journals will be integrated into the lectures. Based on the provided references, students will discuss concepts and derive hypotheses individually and/or groupwise from different perspectives of the current literature. For selected topics, classroom experiments will add up to this. Online lectures from international renowned experts and researchers will be integrated in the lecture.

Media:
Presentations, slide scripts, Articles, online lecture examples

Reading List:
Pearce, D. and R.K. Turner(1990). Economics of Natural Resources and the Environment. Johns Hopkins Univ Pr.
Tietenberg, T. and L. Lewis (2008). Environmental & Natural Resource Economics. Addison Wesley; 8 edition.

Responsible for Module:
Anja Faße a.fasse@wz-straubing.de

Courses (Type of course, Weekly hours per semester), Instructor:
Lecture
Advanced Environmental and Ressource Economics
2 SWS
Anja Faße

Tutorial
Advanced Environmental and Ressource Economics
2 SWS
Anja Faße

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1139: Consultancy and Communication | Beratung und Kommunikation

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Over the course of the semester, students will be expected to work on several presentations (individual and group presentations, role play, case studies in groups, video analysis). Those will not be assessed. The module will conclude with a written examination (90 minutes) in which students are required to describe and analyze different theories and findings from communication and consulting psychology without the aid of any further tools.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The module Consultancy and Communication is subdivided into the following areas:

• Basics of communication and communication methodology
• Rules of communication and their application in everyday working life
• Target-oriented dialogue
• Meaning and function of consultancy
• Approaches to consulting and the taxonomy of consultancy work
• Forms of communication, methods, objectives, roles and procedures for consultancy sessions
• Favourable attitudes and communication techniques for indirect dialogue

Intended Learning Outcomes:
Students who have completed this module will be able to analyze basic communication and consultancy models and categorize the theories behind them accordingly.
The students can also apply consultancy and communication models drawing on case examples. Moreover, they can test their own attitudes and reflect on their individual behavior in terms of consultancy and communication.

Teaching and Learning Methods:
Students will prepare a presentation (including discussion) during the course. Roll plays and case reports will be run in tutorials. Single and group presentations are given and analyzed with the help of video analysis.

Media:
Presentations, script, videos, exercise sheets, Flipchart,
PowerPoint, documentaries

Reading List:
"Schulz von Thun, F. (2014). Miteinander reden 1-4: Störungen und Klärungen. Stile, Werte und Persönlichkeitsentwicklung. Das ""Innere Team"" und situationsgerechte Kommunikation. Fragen und Antworten. Hamburg: Rowohlt Verlag.

Responsible for Module:
Claudia Martin (martin.cm@t-online.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in Beratung und Kommunikation (Übung) (Übung, 2 SWS)
Martin C [L], Martin C

Einführung in Beratung und Kommunikation (Vorlesung) (Vorlesung, 2 SWS)
Martin C [L], Martin C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1142: Renewable Raw Materials at Schools | NaWaRo an Schulen

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination is divided into three parts. The first part involves a teaching exam at German high schools and other post-primary schools in which students have to apply the teaching skills learnt on this course. The second part of the exam involves a 20-minute presentation in front of other students and the examiner. The presentation must be polished and present the contents of the Renewable Resources course in appropriate language. The third part of the examination involves the organisation of administrative tasks such as press work, co-ordinating appointments with the schools and internal matters. Students must show their ability to apply strategies for public relations. Each part of the assessment is weighted equally.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Students will learn strategies of presentation, contents, and practical ways of teaching those. Additionally, organisation of teaching units for various schools and determination of teaching requirements will be introduced, as well as the basics of public relations work and didactics.

Intended Learning Outcomes:
After completion of the module, students will be able to outline the presented topics and relate them to research at the Straubing Center of Science. Students will be able to analyze content requirements of different schools and plan teaching lessons. Students will be able to co-ordinate press and public relations work involving contents and goals in relation to renewable resources.

Teaching and Learning Methods:
Besides lectures, turorials and excursions will be held. In addition, a demonstration lesson will be given at a regional grammar school.

Media:
Script, demonstration material (renewable resources), case reports, blackboard, PowerPoint

Reading List:
Birkenbihl, (2010) Rhetorik: Redetraining für jeden Anlass Verlag: Ariston,
nach Bedarf Pädagogikliteratur wie Büchin-Wilhelm, Jaszus (2013) Fachbegriffe für Erzieherinnen und Erzieher Verlag: Holland + Josenhans; Auflage: 8. Unveränd. (2013);
Wisniewski (2013): Schule auf Abwegen: Mythen, Irrtümer und Aberglaube in der Pädagogik

Responsible for Module:
Joseph-Emich Rasch (joseph-emich.rasch@online.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1146: Social Media Marketing | Social Media Marketing

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 30	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The assessment includes an oral presentation (30-45 minutes) to demonstrate the students' knowledge and ability to apply basic issues of marketing.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Social media marketing: social media strategies, social media monitoring, online reputation management, forums and und rating platforms, blogs, twitter, social networks, social sharing, mobile social marketing, social commerce, crowdsourcing

Intended Learning Outcomes:
Students gain basic knowledge of marketing. They understand how communication works and can apply certain aspects of the field of social media marketing.

Teaching and Learning Methods:
The module includes lectures and seminars, including work on case studies, videos and best practice examples.

Media:
Script, ppt, internet

Reading List:
Bibliography shall be compiled according to key aspects

Responsible for Module:
N.N.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1167: Work Science and Work Safety | Arbeitswissenschaft und Arbeitssicherheit

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In a written examination (60 minutes), students should be able to retrieve their knowlege of work management and occupational safety. Various scenarios will be introduced to illustrate the relationship between risks and accidents. Under time contraints, students should be able to list and evaluate scientific methods to measure work load and difficulty as well as their various potential uses.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Basics of work science such as the physiological principles of human work, knowledge of working place and ergonomics, allocation of working hours, occupational planning and costs. Examples of measurement of work load and difficulty as well as the impact of work. Occupational safety in dangerous situations arising from human error. Occupational psychology, motivation and staff management, taking examples from the production of renewable resources.

Intended Learning Outcomes:
After completion of this module, students are aware of the basics of work management. They can analyze work processes in the sector renewable resources production and strategic planning for mechanisation. Students recognize the importance of occupational safety and understand particular workplace situations on the basis of occupational psychology. They recognize the

importance of motivation and the factors influencing it and can apply various aspects of project management.

Teaching and Learning Methods:
Lectures to teach basic knowledge; presentations; exercises to apply scientific methods to measure work load and difficulty. Films to highlight the risks inherent to the production of renewable resources.

Media:
Script, PowerPoint presentation, internet research, Film presentations, work in groups

Reading List:
Arbeitswissenschaft Gebundene Ausgabe – Springer; Auflage: 2. vollst. neubearb. Aufl. (16. Dezember 1997)
von Holger Luczak (Autor), J. Springer (Assistent), T. Müller (Assistent), M. Göbel (Assistent) ;
Arbeitswissenschaft Gebundene Ausgabe – Springer; Auflage: 3., vollst. überarb. u. erw. Aufl. 2010
von Christopher M. Schlick (Autor), Ralph Bruder (Autor), Holger Luczak (Autor) ;
Schriften der schweizerischen SUVA

Responsible for Module:
Alexander Höldrich (Alexander.hoeldrich@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Übung
Arbeitswissenschaft und Arbeitssicherheit
2 SWS

Alexander Höldrich (alexander.hoeldrich@tum.de)
Simone Walker-Hertkorn (s.walker-hertkorn@wz-straubing.de)
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1181: Corporate Sustainability Management | Betriebliches Nachhaltigkeitsmanagement

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students take a written exam (60 minutes) to demonstrate their understanding of basic issues of corporate sustainability management as well as their ability to apply specific strategies to organisations and staff participation.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge in Basics of economics

Content:
-basics of corporate sustainability management
-management of sustainability in corporate environments
-development of sustainability strategies
-modules and areas of sustainability
-tools of sustainability management
-areas of application

Intended Learning Outcomes:
Students are able to apply basic ideas of sustainability to organisations. They have the ability to involve staff in order to integrate important aspects of sustainability in operational procedures. In addition, participants will learn how to initiate and promote sustainability management outside operational activities. They are able to examin respective measures and integrate sustainabilities strategies as part of organisation development.

Teaching and Learning Methods:
Lessons in the form of seminars or workshops, case examples, exercises in teamwork

Media:
Presentation, script, case examples

Reading List:
A. Baumast, J. Pape (2013) Betrieblisches Nachhaltigkeitsmanagement, Ulmer Verlag UTB, ISBN-10: 3825236765

Responsible for Module:
Alexander Höldrich (alexander.hoeldrich@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar
Betriebliches Nachhaltigkeitsmanagement
2 SWS

Dirk Dobermann (dobermann@imu-augsburg.de)
Lisa Schröder (lisa.schroeder@hswt.de)
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1198: Applied Statistics | Angewandte Statistik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment includes introduction on a given topic of applied statistics. A written draft and the oral presentation in a talk will both add up 50% to the final grade.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basics in statistics and probability calculation

Content:
The modules provides an overview of key issues of applied statistics (e.g. principle component analysis, regression, neuronal networks, suppor vector machines).

Intended Learning Outcomes:
Students get familiar with a given topic of applied statistics (individual literature research) and present and discuss the gathered information. They are aware of key statistics methods required in the fields of natural sciences, engineering and economics. They have gained a good understanding of those methods and can choose and apply those appropriate to distinct examples.

Teaching and Learning Methods:
Lectures take the form of a seminar with participants giving talks to certain topics and actively participating in discussions on the issue.

Media:
Presentation (usually using PowerPoint)

Reading List:
Fahrmeir, Künstler, Pigeot, Tutz: Statistik - Der Weg zur Datenanalyse; Springer 7. Auflage; ISBN 978-3-642-019388; Witten & Frank: Data Mining, Elsevier ISBN: 0-12-088407-0

Responsible for Module:
Dominik Grimm (dominik.grimm@hswt.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar
Angewandte Statistik
2 SWS

Dominik Grimm
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1209: Applied Ethics to Regrowing Resources | Angewandte Ethik zu Nachwachsenden Rohstoffen

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In a written examination (60 minutes), students relate on fundamental approaches to bioethics. Social issues will translate into students' tasks. Students thereby demonstrate the connections between risks and injustice. Drawing on special scenarios, students will identify areas of conflict and propose possible solutions.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Definition of ethics terminology, main schools of thought in approaches to bioethics such as Kantian ethics / deontological ethics
Utilitarianism (theory of consequentialism), liberal individualism (rights-based theory), communitarianism (community-based theory); how bioethical issues are perceived in society, such as
-red gene technology
-green gene technology
-Areas of conflict based on the use of renewable resources: "food before fuel" slogan, exploitation of agricultural land for chemical products or for re-use as energy in light of the world's hunger epidemic. This module will also discuss food waste along the value chain from field to fork.
Legislation laid down in the Convention on Biomedicine (Council of Europe); selected areas of

contention such as bioethics for all living creatures; human bioethics; definition of life; definition of death; medical ethics; research; exploitation of resources (production); resource waste (efficiency)

Intended Learning Outcomes:
After completion of the module, students will understand the fundamentals of bioethics. They will be able to gather information on the main schools of thought in approaches to bioethics. Students will have formed their own opinions on aspects of the social issues covered. They will be able to identify issues arising from the production of renewable resources and propose possible solutions using methods learnt in class.

Teaching and Learning Methods:
Lectures teach basic knowledge, presentations, tutorials on practical approches in bioethics, expert lectures on selected topics related to the ethical evaluation of using renewable resources

Media:
script, PowerPoint presentation, documentaries, group work

Reading List:
"Günter Altner: Naturvergessenheit. Grundlagen einer umfassenden Bioethik. WBG, Darmstadt 1991 ISBN 3534800435;
Suhrkamp Taschenbuch Wissenschaft Nr. 1597: Bioethik - Eine Einführung Taschenbuch – 2003
von Marcus Düwell (Herausgeber, Vorwort), Klaus Steigleder (Herausgeber, Vorwort)
European Union, 2014, Health and Consumers. Food. Stop Food Waste. European Commission. Http://ec.europa.eu/food/food/sustainability/index-en.htm [acessed June 6, 2014]
Agrarethik: Landwirtschaft mit Zukunft Gebundene Ausgabe – Juli 2012
von Uwe Meier (Herausgeber)
Energie aus Biomasse - ein ethisches Diskussionsmodell - Michael Zichy, Christian Duernberger, Beate Formowitz, Anne Uhl, Maendy Fritz, Edgar Remmele, Stephan Schleissing, Bernhard Widmann (2011): ""Energie aus Biomasse - ein ethisches Diskussionsmodell"". Darmstadt, Vieweg +Teubner, ISBN: 978-3-8348-1733-4"

Responsible for Module:
Alexander Höldrich (Alexander.hoeldrich@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Angewandte Ethik zu Nachwachsenden Rohstoffen (Vorlesung) (Vorlesung, 1 SWS)
Höldrich A [L], Höldrich A, Potzler A

Angewandte Ethik zu Nachwachsenden Rohstoffen (Übung) (Übung, 1 SWS)
Höldrich A [L], Potzler A
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1721: Renewable Resources in Medicine | Nachwachsende Rohstoffe in der Medizin

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The Assessment consists of a written examination (90 minutes)

Repeat Examination:

(Recommended) Prerequisites:
Requirements for the successful participation is basic knowledge in chemistry, cell and microbiology, biochemistry, materials science and renewable ressources

Content:
The course provides basic knowledge on the human anatomy, cell biology on general and the cell membranes in particular. The interaction of materials with cell surfaces and tissue will be introduced. The general issues related to pharmacology and the fabrication of drugs from from renewable ressources will be discussed. The application of renwable resources as the main course topic in surgery, internal medicine, plastic and reconstructive surgery as well as wound dressings will introduced. Future tasks for the medical application of renewable resources are outlined. The legislative framework for application of medical products and fabrication will be discussed.

Intended Learning Outcomes:
The successful visit of this course enables the students to select materials from renewable ressources for relevant fields in medicine (skin, muscle, bone) and can particularly assess the valueof their applicability. They are able to apply the most important legislation in medical application and to validate the material reqeuiements for the application in humans

(biocompatibility). They are able to identify and develop new concepts for sustainable materials from renwable ressources in medicine due to their aquired medical, chemical and materials science knowledge and they can set the base for the potiental application of such materials.

Teaching and Learning Methods:
Lecture (talk by teaching staff) with media, seminar on case studies

Media:
Presentation, script, examples, case studies

Reading List:
The following literature is recommended: Buddy Ratner et al.: Biomaterials Science - An Introduction to Materials in Medicine, Elsevier

Responsible for Module:
Cordt Prof. Dr. Zollfrank cordt.zollfrank@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Nachwachsende Rohstoffe in der Medizin (Vorlesung, 2 SWS)
Zollfrank C [L], Karl R, Riepl H, Solleder A, Zollfrank C

Nachwachsende Rohstoffe in der Medizin Seminar (Seminar, 1 SWS)
Zollfrank C [L], Solleder A, Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9120: Psychology | Führungspsychologie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
For assessment, students answer questions and work on case studies applying the discussed problem-solving strategies.
It is to test whether students are able to understand the concepts and methods learnt and to reproduce them independently, where necessary, putting them into context and differentiating between their areas of application. Type of exam: In writing, Exam duration: 60 minutes

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Interest in leadership and willingness to reflect on oneself and on others

Content:
Communicating and working out fundamental leadership skills and abilities in view of the shift from the industrial age to the information and knowledge age. This primarily concerns communication, motivation, conflict management, target-setting and delegation. Topics also include how a modern manager can build and lead a team effectively and productively. Practical examples are worked on and practised with the help of various leadershipp sychology models and communication tools. The utility of a consistent, principle-based enterprise culture and its associated common language, including global aspects, is demonstrated and thereby rendered easily understandable.

Intended Learning Outcomes:
The seminar offers an overview of leadership skills and fields of competence. Seminar participants thereby gain an understanding of management tasks. They can recognise the demands of a manager's role-model function in the information and knowledge age. They are also aware of

their competences and abilities they should individually improve and develop if they reach a management position. After the course, participants can apply management tools on a small scale through exercises and role-playing with case examples. They can identify problem areas in this regard and deduce a corresponding need for action.

Teaching and Learning Methods:
Interactive teaching, talks, group work, discussions, practices, roll plays, short presentations

Media:
Flipchart, presentation, white board, work sheets

Reading List:
Kaunzner, C.: Herzschrittmacher für Teams
Covey, (Dr.) S.: 7 Wege zur Effektivität
Covey, S.: Schnelligkeit durch Vertrauen
Covey, S.: Führen unter neuen Bedingungen

Responsible for Module:
Christine Kaunzner (christinekaunzner@takechances.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Führungspsychologie (Vorlesung, 2 SWS)
Kaunzner C [L], Kaunzner C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9121: Rhetoric and Dialectic | Rhetorik und Dialektik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The oral examination (20 minutes) evaluates a speech/talk regarding linguistic, stilistic and contentual aspects. Students individually work on a speech/talk and decide about their applied tools (e.g. overhead projector, beamer).

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
The basic forms of speech and response are analysed first. Thereafter, rhetorical and linguistic possibilities are studied specifically in the light of modern communicative systems.
Rhetoric – terminology and analysis. Vocabulary, syntax and logical structure form the next aspects of the lecture. Students are required to identify empty phrases and platitudes in their own way of expression and consciously avoid them in oral reports and presentations. Students are made aware of the rhetorical structure not only of speeches but also short statements, outlines and oral contributions to discussions. Students' own body language (facial expressions, gestures) and behavior are analyzed and adapted to their language and general verbal expression. The background of established behaviors is also explored. Not only the effect of one's own oral presentation on oneself, but also the impressions on others are discussed and criticized. Methods of argumentation are analyzed in dialectical terms. Speech and response are situated in the context of rhetorical possibilities.

Intended Learning Outcomes:
Students are able to demonstrate their skills in expression and content presentation applying the most appropriate rhetorical means. The German language is correctly used both from the grammatical and stylistical point of view. In particular, general linguistic errors and empty phrases are largely avoided. Students can structure opinions, presentations and talks according to the presented principles. Communicative alternatives are identified. In discussions, dialogues and debates, verbal and non-verbal rules are implemented. In the end, students are able to prepare and give a full speech (oral presentation). Referring to important and historic speeches (Plato to Walter Jens), students should recognize the various rhetorical means and analyze them for their own work. The quality of the German and a holistic mode of expression in correct, well-formed sentences are an important criterion.

Teaching and Learning Methods:
Analysis of the term "rhetoric", various schools of rhetorics (Plato: Beauty of speech; Huxley: Efficiency of speech); internet research and secondary literature; turorial within the lecture

Media:
Manuscript, multimedia teaching and learning tools

Reading List:
Sekundary literature Kommunikation und Rhetorik wie Birkenbihl, (2010) Rhetorik: Redetraining für jeden Anlass Verlag: Ariston, Literatur der Klassik und Moderne. Tagesaktuelle Redebeiträge in Parlamenten.

Responsible for Module:
Joseph-Emich Rasch (j.e.rasch@das-pulverturm-theater.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Master's Thesis | Master's Thesis

Module Description

CS0144: Master's Thesis | Master's Thesis

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 30	**Total Hours:** 900	**Self-study Hours:** 450	**Contact Hours:** 450

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module examination consists of the preparation and positive evaluation of the Master´s Thesis (depending on selection of topics 25 to 75 pages).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
60 Credits in compulsory and elective mdoules of the master study course Technology of biogenic resources

Content:
consolidation of the knowledge of a specific topic in technologies of biogenic resources which is arbitrary in consultation with the supervisor / consolidation of practical skills in the lab / presentation of a research-based topic in the field of biotechnology

Intended Learning Outcomes:
After completion of the module, the students are able to work self-reliant on complex scientific problems on the basis of scientific methods and analytical thinking. The can present their results in a conclusive way, are able to discuss and to draw conclusions.

Teaching and Learning Methods:
During the Master’s Thesis, the students work on a scientific problem. At this juncture amongst others literature research as well as lab work and presentations are used. The actual teaching and

learning methods depend on the respective problem and have to be discussed with the supervisor for each single case.

Media:
Specialist literature, software and so on

Reading List:
in consultation with the supervisor

Responsible for Module:
Alle prüfungsberechtigten Dozenten/innen des Studiengangs des Studienganges Technology of biogenic resources

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Obligations | Auflagen

Requirement Proof of Proficiency in German | Nachweis Deutschkenntnisse

Module Description

WZ8000: Accredited Requirement Proof of Proficiency in German | Anerkennung Nachweis Deutschkenntnisse

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2018

Module Level:	Language:	Duration:	Frequency:
Credits:*	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0001: Foundations of Computer Science | Grundlagen der Informatik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam achievement shall be done in the form of a written test (90 minutes). Knowledge questions check the treated basic concepts of computer science. Small programming and modelling tasks test the ability to apply the learned programming and query languages and the modelling techniques in order to solve simple problems.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
In the module following contents are treated exemplarily:
- database management systems, ER modelling, relational algebra and SQL
- Python as programming language:
o Basic constructs of imperative programming ((if, while, for, arrays etc.)
o Object-oriented programming (inheritance, interfaces, polymorphism etc.)
o Exception handling
- Basic algorithms and data structures:
o Algorithm term, complexity
o Data structures for sequences (linked lists, arrays, stacks & queues)
o Recursion
o Hashing (chaining, probing)
o Search (binary search, balanced search trees)
o Sorting (Insertion-sort, selection-sort, merge-sort)

Intended Learning Outcomes:
After successful participation in this module students will be able to understand important fundamental terms, concepts and approaches of computer science. Particularly the students know fundamental concepts of programming, databases as well as algorithms and data structures.They are enabled to apply the learnt concepts to develop own programms for data storage and analysis.

Teaching and Learning Methods:
Lecture and practical exercises: In addition to a central exercise,
in which the concepts of the lecture were deepend on the basis
of examples, tutorials, in which simple tasks were solved on the computer under intensive support, impart important practical
basic skills of programming, in order to apply the self-study acquired knowledge. In the second half of the semester
students work on a practical project, that should deepen the
related unterstanding with regard to the desired learning
outcomes.

Media:
Slide presentation, blackboard, lecture and exercice recording, discussion forums in e-learning platforms; Working on the PC

Reading List:
- Heinz-Peter Gumm, Manfred Sommer, 2012, Einführung in die Informatik, Degruyter Oldenbourg
- Marco Emrich, 2013, Datenbanken & SQL für Einsteiger, Create space independent publishing platform

Responsible for Module:
Dominik Grimm (dominik.grimm@hswt.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0036: Technical Mechanics Statics | Technische Mechanik Statik [TMStat]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The course will be evaluated in a 90 minute written exam.
In the examination, students shall demonstrate their knowledge of statics by solving arithmetic problems. In particular, constructions shall be evaluated on the basis of the method of sections.

Repeat Examination:

(Recommended) Prerequisites:
None

Content:
This module encompasses the fundamentals of technical mechanics. These comprise degrees of freedom in planar and spatial systems, kinematic dependencies, spacial, planar and linear and discrete forces, their resultant stresses, single forces and moments, area moments, centers of gravity, equilibria, the principle of virtual work, the method of sections, support reactions and sectional quantities, adhesion and friction, stabilities of stiff systems, second order theories, multiaxial stresses and load hypotheses for multiaxial stress states.

Intended Learning Outcomes:
After completion of the module, students are able to calculate and evaluate statically determined systems on the basis of occurring stresses and strains. They can apply the method of sections, also to trace complex multiaxis stress states.

Teaching and Learning Methods:
The module consists of lectures and parallel tutorials. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Blackboard, slides

Reading List:
Gross D, Hauger W, Schnell W & Wriggers P. Technische Mechanik. 10, Springer, (1986).
Magnus K & Müller HH. Grundlagen der technischen Mechanik. 7, Springer, (1974).
Müller HH & Magnus K. Übungen zur technischen Mechanik. 23, Springer-Verlag, (2013).

Responsible for Module:
N.N.

Courses (Type of course, Weekly hours per semester), Instructor:
Technische Mechanik I (MW1937) (Vorlesung, 3 SWS)
Wall W, Pröll S, Geitner C

Technische Mechanik I Vertiefungsübung (MW1937) (Übung, 2 SWS)
Wall W, Pröll S, Geitner C

Technische Mechanik I Übung (MW1937) (Übung, 2 SWS)
Wall W, Pröll S, Geitner C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0038: Mathematics Advanced Analysis and Linear Algebra | Mathematik Vertiefung Analysis und Lineare Algebra [MathAnal]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The course will be evaluated in a 90 minute written exam.
In the examination, students shall reproduce basic theoretical concepts of real analysis in multidimensional compression, as well as adequately discuss correlations in example situations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Module Mathematics

Content:
Sets and figures, structure of the number system, sequences and series of real and complex numbers, completeness of real numbers, space of continuous functions, uniform convergence, one-dimensional differentiation, Taylor's theorem, differentiation of series of functions, power series and elementary functions, rule integral or Riemann integral, improper integrals, theorem of Stokes with applications in vector analysis and topology, examples of partial differential equations and partial differential equations of the first order, existence and uniqueness theorems, basic equations of mathematical physics, boundary value problems, maximum principle and Dirichlet problem.

Intended Learning Outcomes:
After completion of the module, students know and can apply the fundamental concepts and important methods of vector analysis on manifolds and of partial differential equations. They can develop mathematical arguments in this field on their own and can express them verbally and in

writing. Further, they can apply the central methods of proof and concepts of geometrical analysis and partial differential equations and know their analysitc background.

Teaching and Learning Methods:
Lecture including speech. Based on case studies fundamental mathematical methods shall be presented. General methodology shall be deducted from case studies.

Media:
Blackboard, slides

Reading List:
K. Königsberger, Analysis 1, 6. Auflage, Springer 2003.
W. Rudin, Principles of Mathematical Analysis, 2nd ed, McGraw Hill, 1964.

Responsible for Module:
Prof. Clemens Thielen

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0040: Materials fundamentals | Werkstoffkunde [Wkd]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The course will be evaluated in a 90 minute written exam.
In the examination, students shall demonstrate their knowledge of the fundamentals of materials from all classes of materials. They shall demonstrate their ability to sketch processing routes and aspects of applications.

Repeat Examination:

(Recommended) Prerequisites:
None

Content:
This module covers the fundamental material classes, their typical properties and applications. Further, the technologically most important materials, their production, properties and applications from each class will be discussed.

Intended Learning Outcomes:
After completion of the module, the participants are enabled to name typical properties of the basic material classes. They can name technologically important materials and routes for their preparation, as well as typical applications.

Teaching and Learning Methods:
The module shall be organised as a lecture, i.e. presentations are performed by PP media. Based on book reviews self-instruction will be encouraged. Illustrating examples and case studies will be used to clarify and deepen the course contents.

Media:
Blackboard, slides

Reading List:

Responsible for Module:
N.N.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0065: Fundamentals of Thermodynamics | Grundlagen Thermodynamik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam performance is effected by a written test. The students solve thermodynamical arithmetic problems and answer questions regarding the definitions and relations of thermodynamics. The students prove that they have understood the basic principles of thermodynamics by setting up and solving equations. Non-programmable calculators and a handed-out formulary are allowed aids. Exam duration: 90 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Mathematics

Content:
State variables, thermodynamic system, 1st and 2nd law, equations of state for ideal gases and fluid of constant density, process cycles, efficiencies, phase diagrams of pure substances

Intended Learning Outcomes:
After sucessful completion of the module the students know the 1st and 2nd law of thermodynamics; the are able to use thermal and caloric equations of state for ideal substance classes; they unterstand thermodynamic phenomena of phase change and related diagrams; they can apply the ideal gas law and the 1st and 2nd law to technical problems.

Teaching and Learning Methods:
The module consists of lectures and parallel tutorials. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, slide scripts, exercises

Reading List:
P. STEPHAN, K. SCHABER, K. STEPHAN, F. MAYINGER: Thermodynamik, Band 1 Einstoffsysteme
16. Auflage, Springer, Berlin (2006); H.D. BAEHR, S. KABELAC: Thermodynamik, 13. Auflage, Springer, Berlin (2006)

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Grundlagen Thermodynamik / Angleichung Ingenieurwissen (Übung) (Übung, 2 SWS)
Burger J [L], Baumeister E, Burger J, Göttl Q

Grundlagen Thermodynamik / Angleichung Ingenieurwissen (Vorlesung) (Vorlesung, 2 SWS)
Burger J [L], Burger J, Göttl Q
For further information in this module, please click campus.tum.de or here.

Module Description

CS0066: Introduction to Process Engineering | Einführung Verfahrenstechnik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam performance is effected by a written test. Through comprehension questions it is reviewed whether the students have understood the basic priciples of process engineering. The students solve balance arithmetic problems and answer questions regarding the definitions and relations of material and energy balances. The students prove that they have understood the basics of conceptual process design by selecting suitable process units for a given separation task and by drawing of the process flowsheet. Non-programmable calculators and a handed-out formulary are allowed aids. Exam duration: 90 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Mathematics

Content:
Most important unit-operations: reactors, distillation, extraction, crystallization, absorption, membranes, filtration, evaporatoin. Material und energy balances of single units and whole processes. Conceptual process design.

Intended Learning Outcomes:
After sucessful completion of the module the students know the most important separation technologies of process engineering; they are able to balance them with respect to material and energy; they unterstand basics of reaction engineering; they can safely select unit operations and describe their mode of operation.

Teaching and Learning Methods:
The module consists of lectures and parallel tutorials. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, slide scripts, exercises

Reading List:
Worthof & Siemes: Grundbegriffe der Verfahrenstechnik: Mit Aufgaben und Lösungen, 2012.
Schwister & Leven: Verfahrenstechnik für Ingenieure: Ein Lehr- und Übungsbuch, 2014.

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Process Engineering (Exercise) (Übung, 1 SWS)
Burger J [L], Baumeister E, Burger J

Introduction to Process Engineering (Lecture) (Vorlesung, 3 SWS)
Burger J [L], Burger J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0087: Electrical engineering | Elektrotechnik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Examination is done with written exam of 90 minutes duration. Participants show that they are able to perform calculations using fundamental principles of electrical engineering (including DC and AC circuits). Furthermore, the participants demonstrate they understanding of energy conversion principles within the scope of electrical engineering by answering questions related to case examples.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Modules Mathematics I and II

Content:
Introduction to electrical engineering and electrical power engineering, comprising
- electrical charge, electrical field
- current, voltage, resistance
- electrical circuits, Kirchhoff's circuit laws
- magnetif field, induction
- power and energy associated with electromagnetism
- alternating current, pointer diagrams,
- semiconductors
- transformers, voltage levels
- electrical machines
- dangers from electrical currents

Intended Learning Outcomes:
After attending this module's courses the participants know the principles of electrical engineering and ist fundamental physical laws. They can apply fundamental equations of electrical engineering to perform calculations pertaining to electrical engineering and power engineering. In addition, the participants know about the various pathways for energy conversion relevant within electrical engineering.

Teaching and Learning Methods:
Lecture (oral presentation including writing on the board/document camera, PP media, cloze lecture notes), exercise (deepening of course contents with tutors) with work in small groups.

Media:
beamer presentation, cloze lecture notes, demonstration experiments

Reading List:
Fischer, R.; Linse, H. (2012): Elektrotechnik für Maschinenbauer, 14. Auflage, ISBN: 978-3-8348-1374-9;
Klaus Heuck, Elektrische Energieversorgung, 2010, Vieweg Teubner;
Panos Konstantin, Praxisbuch Energiewirtschaft, 2009, Springer;

Responsible for Module:
Josef Kainz josef.kainz@hswt.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0088: Measurement and Control | Mess- und Regelungstechnik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam duration (in min.): 90. Proof of performance is provided in the form of a written examination. The students should prove that that essential concepts of measurement and control can be compiled, have been understood, can be presented in compressed form and procedures for evaluation can be applied. This implies in particular various aspects of error calculation, statistics, practical measurement technology, analysis of dynamic systems and controller design. Students should be able to create analytical solutions to problems from the mentioned subjects under time pressure and only with a simple calculator

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fundations mathematics, electrical engineering

Content:
Theoretical basics of measurement technology, statistics, error propagation, practical effects, basics of electrical engineering for low-voltage measurement technology. Fundamentals of sensor technology and analog-to-digital conversion. Terms in control, modelling, laplace transformation, analysis of dynamical systems, feedback control and stability, controller design

Intended Learning Outcomes:
By completion of the module, the students are able to
- understand the problems of practical measurement with respect to accuracy,
- interpet measurement results,

- understand the basics of measurement in low voltage applications, the basics of sensoring, and the basics of analog-to-digital conversion,
- set up models of simple mechanical and electical systems in the time and frequency domain,
- analyse system properties like stabillity, transfer behavior, linearity,
- calculate system responsen with the help of the Laplace-Transformation,
- apply simple controller designs in the time and frequency domain and apply stability criteria,

Teaching and Learning Methods:
lectures with experiments and exercise

Media:
powerpoint/PDF-presentions, blackboard,
experiments

Reading List:
- Moeller, Fricke, Frohe, Vaske: Grundlagen der Elektrotechnik. B.G.Teubner, Stuttgart (2008).
- Bantel, M.: Grundlagen der Messtechnik Messunsicherheit von Messung und Messgerät. Fachbuchverlag Leipzig (2000).
- Schanz, G.W.: Sensoren. Hüthig Verlag, Heidelberg (2004)
- Föllinger, O.: Regelungstechnik. 10. Auflage, Hüthig-Verlag 2008. Ein Standard-Werk. Der Vorlesungsstoff wird bis auf wenige Ausnahmen gut abgedeckt.
- Lunze, J.: Regelungstechnik 1 Springer 1997. Lehrbuch in 2 Bänden, dessen 1. Band das den Stoff ebenfalls gut abdeckt. Viele Beispiele und Übungsaufgaben, auch mit MATLAB.
- Isermann, R.: Regelungstechnik I. Shaker Verlag 2002
- Horn, M. und Dourdoumas, N.: Regelungstechnik. Pearson Studium 2004

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0091: Apparatus and plant engineering | Apparate- und Anlagenbau [AAB]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination performance is provided in the form of a written examination. The students prove that they understand the structure and function of apparatuses and can carry out the basics of design, material selection and strength calculation. In the interaction of machines and apparatus, plant concepts are to be designed and/or specific aspects, such as the safety of operation, are to be discussed on the basis of P&Is. Examination: written, duration: 120 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Mechanics, Materials Science, Fluid Mechanics

Content:
Apparatus and plant engineering deals with the manufacture of primarily chemical process plants, which are of great importance for all areas of process and energy technology. The module teaches the basics of selected machines and apparatuses and their function in interaction within a plant. This includes design, material selection and the basics of strength calculation (AD) as well as the design of plants and equipment in the context of safety and environmental protection requirements. The essential basics of legally relevant aspects and the necessary procedure within the framework of plant construction are also taught, such as the Machinery Directive, placing on the market and project-related contracts.

Intended Learning Outcomes:
After participating in the module, students will be able to describe the function of selected machines and apparatuses, to select materials for apparatuses and to dimension them. Students can read the interaction of machines and apparatus in the sense of a plant using P&Is and present it constructively in the form of P&Is. They can also identify safety-relevant aspects (e.g. explosion protection, environmental protection, occupational health and safety, toxic media) and develop technical solutions and assign legal bases to them.

Teaching and Learning Methods:
The module consists of a lecture in which exercises are also carried out alternately. The contents of the lecture are conveyed in the lecture and through presentations. Students should be encouraged to study literature in greater depth and to deal with the contents of the topics. In the exercises carried out within the framework of the lecture, the learned contents are applied directly in practice and partly in group work.

Media:
Presentations, exercises

Reading List:

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0093: Energy and process engineering lab | Grundlagenpraktikum Energie- und Verfahrenstechnik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 75	**Contact Hours:** 75

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In the practical course, the exam is taken by positively elaborated written internship reports (for each experiment about 5 pages of report). Thereby the correct presentation of the theoretical basics, the reproduction of the experimental procedure and the correct data evaluation are essential. Thereby the students show that they understand basic processes and principles of energy and process engineering and that they can design and calculate corresponding transformations. The students prove that they can execute and evaluate metrological experiments in small groups (2-3 persons).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Chemical reaction engineering, Fluid separation processes, Energy Technology

Content:
Basic operations of energy and process engineering, especially from the chemical, thermal and mechanic range e.g. destillation or particle distribution analysis.

Intended Learning Outcomes:
After graduation of the practical course, the students know basic processes and principles of process engineering (e.g. heat transfer and separation techniques). They know how to design and calculate a chemical, physical or mechanic transformation. Furthermore, they know the process steps which are necessary for it.

Teaching and Learning Methods:
The acquisition of basic principles is prepared by handed out literature.
The student learns the theoretical understanding, the basic engineering of the experiment and the correct use of the installed measurement technique through the graduation of the practical course. The acquisition of these properties is proved at the day of the experiment and comfirmed by producing a report. Thereby also the ability is reviewed to evaluate and report data correctly. The content and the number of experiments are chosen from a of multiplicity of basic operations and rely on the available laboratory equipment.

Media:
Practical course script, laboratory equipment

Reading List:
Practical course script

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0095: Cooperative Design Project | Kooperative Projektarbeit

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 210	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module will be completed with the production and grading of a written final report. In the report, the students shall describe problem, solution approach, individual assignments within the project team, calculations, and analyses in concise fashion. The personal contributions of the individual student shall be described. In regular meetings with the supervisor, the individual contributions are monitored.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fundamentals of Thermodynamics, Basics on renewables utilization

Content:
The task describes a technical problem in the field of the use of biogenic resources for which the team has to find a solution. Examples are e.g:
1. preparation of a concept and design of a biogas plant for an agricultural business
2. Feasibility Study on the conversion of high performance packaging in space application from fossil-based plastics to bio-based plastics

Intended Learning Outcomes:
"After successful participation in the module, the students will be able to
- understand and classify the cooperation in a team with heterogeneous knowledge base,
- apply the basics of process and energy engineering to practical problems
- discuss the interrelationships between different aspects of a project (time management, balancing, interaction, objectives),

- present self-developed balance sheets and calculation results in text form,
- carry out work in a hierarchical organisation"

Teaching and Learning Methods:
The module consists of a project work, which is carried out in a cooperative team between Bachelor and Master students. Depending on the given task, the team size is 2-6 persons. The Master students assume the role of project leaders and are responsible for formulating and achieving the project goals. The Bachelor students carry out research, analysis and calculations and are supported by the Master students if required. Progress, role identification, and individual involvement are monitored in regular meetings with the supervisor.

Media:
Will be adapted to task at the project start by the supervisor

Reading List:
Rowe, S. (2015). Project Management for Small Projects, 2nd Edition. Oakland: Berrett-Koehler Publishers.
Specific literature will be announced by the supervisor before the project starts.

Responsible for Module:
Jakob Burger burger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

CS0130: Basic Biology | Grundlagen Biologie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2020/21

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Learning outcomes shall be verified in a written test in which the students are to call up and remember important basics of biology without tools. Besides the students shall demonstrate that they are capable of recognizing and solving a problem in a given time by answering questions of comprehension relating to treated basic biological and biotechnological processes. The answering of the questions requires own formulations. Thus correct memory of important technical terms shall be verified as well. Participation in laboratory exercises shall be deemed an academic performance. The latter shall not be integrated into the overall performance. Exam duration: 60 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge in biology and chemistry corresponding to basic knowledge of A-level students.

Content:
Lecture: Basics of cell biology (textural cell structure, differences between procaryotic and eucaryotic organisms, theoretical basics of microscopy), genetic flow of information and basis of molecular genetics (e.g. structure of DNA, transcription, translation, DNA duplication), important metabolic pathways (e.g. Glycolysis, citrate-cycle), basics of biological system at the example of selected beneficial organisms (e.g. coli, S. cerevisiae, algae, fungi), use of microorganisms in industrial biotechnology (e.g. ethanol fermentation, ABE fermentation, protein synthesis). Exercises: seminar-style and practical exercises for lectures, basic introduction into laboratory work, basics of microbiological working, microscopic examination of different microorganisms

Intended Learning Outcomes:
After attending the module the students possess basic knowledge about structure and function of biomolecules. They know important components of procaryotic and eucaryotic cells and are able to differentiate between these forms of life. They know the basics of the genetic flow of information and the most important metabolic pathways and are able to assign bacteria, fungi and plants to higher- ranking systematic groups. Furthermore the students are able to convey technical terms and define processes and are able to use their knowledge to solve issues. After completing the module participants are familiar with the microscope. They are capable of identifying and designating microorganisms and master the basics of microbiological working. These abilities are the basis of further practical working in the subsequent course of the study.

Teaching and Learning Methods:
Lecture and associated exercise including independent processing of specific examples. Selected associated experiments in the (micro)biological laboratory. Seminar-style exercises for lectures.

Media:
Presentation, writing on the board, laboratory equipment. Optional: Script

Reading List:
• „Allgemeine Mikrobiologie (General Microbiology)“ by Georg Fuchs published by Thieme, Stuttgart (aperback - 11 October 2006)
• "Brock Mikrobiologie" von Michael T. Madigan and John M. Martinko, Pearson, 11th edition (2008)
• "Biologie" by Neil A. Campbell and Jane B. Rice, Pearson, 8th edition (2011)

Responsible for Module:
Erich Glawischnig glawischnig@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Grundlagen Biologie (Vorlesung) / Angleichung Biologie (Vorlesung, 2 SWS)
Glawischnig E [L], Glawischnig E

Grundlagen Biologie (Übung) (Übung, ,5 SWS)
Glawischnig E [L], Glawischnig E
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1601: Mathematics | Mathematik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Learning outcomes shall be verified in a written test (90 min). Tasks shall be specified by means of which the students are to demonstrate that they know the mathematical methods imparted as part of the module and that they have understood and are able to apply them for specific case studies.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge in mathematics corresponding to basic knowledge of A-level students.

Content:
Selected mathematical methods required for calculations in the scientific, engineering or economic field, especially analysis (e.g. complete induction, differential and integral calculus, arithmetic progression and series), calculations with real and complex numbers as well as selected chapters of linear algebra (e.g. linear equation systems, matrices, eigenvalues and eigenvectors).

Intended Learning Outcomes:
The students know the most important mathematical methods required for calculations in the scientific, engineering or economic field. They have understood these methods and are able to calculate specific case studies and perform basic mathematical proof by means of complete induction.

Teaching and Learning Methods:
Lecture, presentation and associated exercises with independent processing and teamwork of specific examples. Mathematical methods shall be presented during the lecture. Within the scope of the exercise their application shall be practised based on specific case studies.

Media:
Digital presentation, writing on the board, exercise sheets

Reading List:
Forster, Otto 2004. Analysis 1 Vieweg Teubner Verlag

Responsible for Module:
Dominik Grimm (dominik.grimm@hswt.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Mathematik (Vorlesung, 2 SWS)
Grimm D [L], Grimm D

Mathematik (Übung) (Übung, 2 SWS)
Grimm D [L], Grimm D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1607: Basics Silviculture | Grundlagen Waldbau [BiS]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In a test the students shall give answers to silvicultural issues in their own words and without tools. In doing so definitions of different site characteristics and consequences for silviculture shall be given in short answers. In longer answers different silvicultural concepts shall be illustrated. One or more trees of the twenty economically most important tree types shall be determined by means of clear photos and/or branches with leaves. Type of exam: In writing, Exam duartion: 60 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics of biology: WZ 1603
Basics of plant production WZ 1604
Basic knowledge of plant build-up, nutrient cycles, soil structures.

Content:
The module aims at providing to students basic knowledge of cultivation, breeding, harvest of trees as well as botany and dendrology. Special techniques and instruments of silviculture shall be imparted: Techniques of reforestation,
young plantation care,
Thinning,
Pruning, Forestry systems as well as
strategies for timber production with hardwood and softwood tree types.
For this purpose parts of location study and teaching of forest soils with pedogenesis and soil chemistry shall be imparted.

Intended Learning Outcomes:
After attending the module the students understand the most important basic forms of forest treatment as well as its ecological special features and the structure and dynamic of forest resources. The students recognize different forest-related tree types and are able to distinguish their demands. After attending this module the students are additionally able to explain different forest soils and different silvicultural farming strategies by using the given information from the fields of forest ecology and location study. Silvicultural techniques shall be recognized and may be used accordingly. The most important forest soil types shall be recognized by means of cross-sections.

Teaching and Learning Methods:
The course of basics of silviculture consists of one lecture, preparing and giving a speech for which material research is necessary and first rhetoric skill are trained. A study trip into the forest and lectures held by qualified personnel from practice on site at different stations with common rounds of questions shall open a deeper insight into the topic. For that purpose also first determination exercises shall be performed at the object in the forest. A cut out soil profile serves to recognize theoretically acquired knowledge of soil horizons.

Media:
In the course the following media forms shall be used:
Script, powerpoint, films, for lectures also blackboard and flipchart, for determination exercises also branches and leaves to be determined. Study trip.

Reading List:
Burschel, P. & Huss, J. 1987. Grundriss des Waldbaus (Ground Plan of Silviculture). Ein Leitfaden für Studium und Praxis (A Guide for Study d Practice). Parey, Hamburg und Berlin. 352 S.
Elverfeldt, Freiherr von A. Rittershofer, F. 1999. Waldpflege und Waldbau (Forest Management and Silviculture). Für Studium und Praxis (For Study and Practice). 492 S.

Responsible for Module:
Alexander Höldrich (alexander.hoeldrich@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
Grundlagen Waldbau
3 SWS
Übung
Grundlagen Waldbau
1 SWS

Alexander Höldrich (alexander.hoeldrich@tum.de)
Cordt Zollfrank (cordt.zollfrank@tum.de)
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1609: Scientific Working | Wissenschaftliches Arbeiten

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Concepts of scientific working shall be practically applied and deepened by the preparation of homework. Homework shall be done as an academic performance and shall not be integrated into the overall performance. Teamwork is possible here. Exam achievement shall be done by a written test. In this test students shall prove that they are familiar with the rules of good scientific working, that they master a methodological approach to planning, execution, evaluation and discussion of a scientific work and that they are able to take a very critical look at experiments, data collection, data processing and evaluations. No tools are allowed. Exam duration: 60 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
As scientific working is essential for all disciplines the module may be attended by students of all kinds of studies.

Content:
The module of scientific working shall impart knowledge for preparing academic theses satisfying a scientific demand. The students discover different methods for scientific working as well as practical working methods and formal guidelines. The course shall illustrate how to prepare the state of knowledge of research as well as topic formulation at the beginning of a scientific work. An important focus of the module is research of literature. Students shall be taught how to handle libraries and quotable sources and shall be explained different possibilities of citation. Form and writing style as well as structuredness and goal orientation (thread) as essential elements of a scientific work shall be part of teaching in the module. Besides independence of participants

as well as skills in working collaboratively and taking a very critical look at own results and approaches shall be developed.

Intended Learning Outcomes:
After successfully completing the module the students shall be qualified in preparing a scientific work by well-founded methodological approach. Participants also master a scientifically suitable form and language. They know the laws of good scientific working, correct citation methods and where scientific misconduct results in. In addition the students are able to plan a scientific work and estimate time requirement in a realistic way. Subsequent to this lecture they are able to take a critical look at an experiment and perform data collection, processing, evaluation and discussion.

Teaching and Learning Methods:
Lecture illustrating case studies. In the exercise ... shall be given and the term paper be mentored.

Media:
Presentations, slide scripts

Reading List:
Eco, U.; Schick, W. (2010): Wie man eine wissenschaftliche Abschlußarbeit schreibt (How to Write a Scientific Thesis). Heidelberg: UTB
Heesen, B. (2009): Wissenschaftliches Arbeiten (Scientific working). Vorlagen und Techniken für das Bachelor-, Master- und Promotionsstudium (Templates and Techniques for Bachelor, Master and Doctoral Studies). Berlin: Spinger
Rückriem, G. M.; Stary, J.; Franck, N. (2009): Die Technik wissenschaftlichen Arbeitens (Technique of Scientific Working). Eine praktische Anleitung (A Practical Instruction). Stuttgart: UTB
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

Responsible for Module:
Cordt Zollfrank (cordt.zollfrank@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Wissenschaftliches Arbeiten (Vorlesung) (Vorlesung, 2 SWS)
van Opdenbosch D [L], van Opdenbosch D

Wissenschaftliches Arbeiten (Übung) (Übung, 1 SWS)
van Opdenbosch D [L], van Opdenbosch D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1618: Biopolymers | Biopolymere [BP]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In the course of the seminar the students independently develop current topics from the field of biopolymers through literature review. As an academic performance they shall elaborate a topic in form of a term paper and present it during the seminar. Teamwork is possible. Exam achievement shall be done as a written test. In this test students shall demonstrate that they are able to classify polymers with respect to structure and function, that they know methods for physical and chemical description and analysis of polymers, that they are able to describe basic synthesis processes and chemical functionalisations of biopolymers and outline biological degradation processes.
No tools are allowed in the exam. Exam duration: 90 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in the modules "Basics of Chemistry" (WZ 1602) and "Materials and chemical precursors", "Physics" (WZ 1600) or comparable chemical knowledge.

Content:
The module addresses structure and function of polymers deriving from nature as well as from synthetically manufactured and biodegradable polymers. In this respect it is dealt with the significance of microstructure as well as physical and chemical properties in biological functions for application-related relevance of biopolymers used as raw and functional materials. Polymer-analogous reactions, basic synthesis processes as well as chemical functionalisation of biopolymers (cellulose derivatives) shall be represented. Biological degradation processes in relation to biopolymers shall be discussed. Simultaneously physical and chemical description

methods of biopolymers as well as methods for analysing this class of molecules shall be presented.
Based on current scientific publications a topic shall be worked out independently by the students (literature review) and presented to their fellow students during the seminar.

Intended Learning Outcomes:
By attending the module the students are capable of distinguishing biopolymers and classifying them in an application-relevant way. The students acquire basic knowledge to understand biopolymers, their physical and chemical properties and are able to describe them and compare them among each other. Thus they are capable of differentiating biopolymers and chemical synthesis methods in an application-oriented way.

Teaching and Learning Methods:
Lecture, speech by experts using PP media, books and other written material, seminar - independent elaboration of a specialist topic by the students with subsequent presentation.

Media:
Presentations, slide scripts

Reading List:
- G. Habermehl, P. Hamman, Naturstoffchemie (Natural Product Chemistry) Springer, 1992
- D. Klemm, B. Philipp, T. Heinze, U. Heinze, W. W.Wagenknecht, Comprehensive Cellulose Chemistry; Volume (1) und (2), Wiley-VCH, 1998
- Endres, H.J., Seibert-Raths, A., Technische Biopolymere (Technical Biopolymers), Carl Hanser Verlag, München, 2009

Responsible for Module:
Cordt Zollfrank (cordt.zollfrank@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Biopolymere (Seminar) (Seminar, 1 SWS)
Zollfrank C [L], Zollfrank C

Biopolymere (Vorlesung) (Vorlesung, 2 SWS)
Zollfrank C [L], Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1632: Basics on renewables utilization | Grundlagen der stofflichen Biomassenutzung

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Assessment takes a written examination (60 minutes), with students recall structure, transformation and use of different renewable resources. Students are required to answer questions using individual formulations and outline structures and reactions. In addition, sample calculations are to be worked out.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Introduction to various kinds of constituents of renewable resources: sugars, polysaccharides, fatty acids and oils, amino acids, proteins, terpenes, aromatics. Their structure, composition, distribution, characteristics, analytics and kind of added value, as well as their use will be introduced.

Intended Learning Outcomes:
After completion of the modules, students understand the chemical composition of renewable resources as well as their production and application. Using this knowledge students are able to explain the respective advantages and disadvantages as well as analyze the underlying physical, chemical and biotechnological principles of their conversion into valuable products.

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using powerpoint presentations and case studies. Corresponding to the teaching content exercise sheets are prepared on which the students work in self-study. The solution and discussion of the exercises takes place in the tutorial.

Media:
Presentation, script, examples and solutions

Reading List:
script, sample solutions for exercises

Responsible for Module:
Rühmann, Broder; Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1659: Energy Technology | Energietechnik - Systeme zur Energiewandlung

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Die Prüfungsleistung wird in Form einer schriftlichen Prüfung erbracht. Die Studierenden beweisen, dass sie Rechenaufgaben zur Energietechnik der Strom und Wärmeerzeugung lösen können. Es wird nachgewiesen, dass die Studierenden die Prinzipien der thermischen Energiewandlung verstanden haben.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Modul Thermodynamik und Wärmelehre TDW

Content:
Im Modul werden vor allem die Grundlagen der thermischen und dezentralen Energietechnik vermittelt.
Schwerpunkte sind Grundlagen der dezentralen Kraft Wärme Kopplung (vor allem mit Erneuerbare Energieträgern), Biomasse, Biogas und Kraftwerkstechnik.

Intended Learning Outcomes:
Nach der Teilnahme an dem Modul sind die Studierenden in der Lage, die Grundlagen der thermischen Energietechnik sowie die Funktion und den Einsatz der unterschiedlichen Techniken zu erklären. Sie können grundlegende Gleichungen zur Bilanzierung anwenden.

Teaching and Learning Methods:
Das Modul besteht aus einer Vorlesung in der auch Übungen abwechselnd durchgeführt werden. Die Inhalte der Vorlesung werden im Vortrag und durch Präsentationen vermittelt. Studierende sollen zur Vertiefung zum Studium der Literatur und der inhaltlichen Auseinandersetzung mit den Themen angeregt werden. In den im Rahmen der Vorlesung durchgeführten Übungen werden die gelernten Inhalte direkt praxisnah und teilweise in Gruppenarbeit angewandt.

Media:
Präsentationen, Übungen

Reading List:
[] Skriptum
[75] Kaltschmitt, M.; Hartmann, H.; Hofbauer, H.: Energie aus Biomasse, 2. Auflage, Springer, ISBN 978-3-540-85094-6, 2009
[127] Karl, J.: Dezentrale Energiesysteme, Oldenbourg, ISBN 3-486-27505-4, 2004

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1922: General Chemistry | Allgemeine Chemie [Chem]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The performance test will be in the form of a written examination rendered. The students should demonstrate in the exam the understanding of the structure of chemical compounds and their typical reactions and chemical conversions. It will also be tested the ability to formulate reaction equations, calculate reaction kinetic and thermodynamic parameters, as well as to transfer the acquired knowledge about the structure and reaction behavior of chemical substance groups to new chemical questions. No auxiliary means are allowed in the exam. 120 min examination time

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge of chemistry, mathematics and physics, which correspond to the basic course knowledge of the gymnasiale upper school

Content:
General principles of inorganic and physical chemistry: Atomic and molecular construction, structure of compounds, acid / base equilibria, redox reactions, thermodynamics,reaction kinetics and catalysis, fundaments on electrochemistry, selected reactions of inorganic chemistry

Intended Learning Outcomes:
The students will know and understand the basic principles of chemical reactions and will be able to formulate correct reaction equations and simple reaction kinetic and thermodynamic calculations. Moreover, they will be able to apply the knowledge acquired with model reactions about chemical transformations of chemical substances and substance groups to answer new

chemical questions. The successful participation in the module will enable the students to participate in the module of basic organic chemistry.

Teaching and Learning Methods:
Lectures and corresponding exercises with self analysis and workup of specific case studies. In relation to the teaching content exercise sheets are disbursed on which the students work in self-study before the tutorials. The solution and discussion takes place in the tutorials. At the postprocessing of the lecture exspecially while the exercises are solved the students keep themselves intensive busy with the teaching contents of the lecture and reach in this way a understanding of the structure and reaction behavior of chemical substance groups and practise the formulation of reaction equations.

Media:
Blackboard, presentation (using script), exercises.

Reading List:
1) Theodore L., H. Eugene LeMay, Bruce E. Bursten, Chemie Studieren Kompakt, 10. aktualisierte Auflage, Pearson Verlag, München;
2) Charles E. Mortimer, Ulrich Müller, Chemie, 10., überarbeite Auflage, Thieme Verlag, Stuttgart

Responsible for Module:
Riepl, Herbert; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Allgemeine und anorganische Chemie / Angleichung Chemie (Vorlesung) (Vorlesung, 2 SWS)
Riepl H [L], Karl R, Klier-Richter M, Riepl H

Allgemeine und anorganische Chemie (Übung) (Übung, 2 SWS)
Riepl H [L], Riepl H
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1924: Basic Organic Chemistry | Grundlagen Organische Chemie [OrgChem]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The performance test will be in the form of a written examination rendered. The students should demonstrate in the exam the understanding of the structure of organic chemical compounds and their typical reactions and chemical conversions. It will also be tested the ability to formulate reaction equations, as well as to transfer the acquired knowledge about the structure and reaction behavior of organic chemical substance groups to new chemical questions. No auxiliary means are allowed in the exam. 120 min examination time

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge of chemistry, mathematics and physics, which correspond to the basic course knowledge of the gymnasiale upper school

Content:
General principles of organic chemistry:
Structure of organic compounds, carbon-atom hybridization, important functional groups, nomenclature and structure of organic molecules, selected reactions of organic chemistry for important groups of substances including central natural substances.

Intended Learning Outcomes:
The students will know and understand the basic principles of organic chemical reactions and will be able to formulate correct organic reactions. Moreover, they will be able to apply the knowledge acquired with model reactions about chemical transformations of organic chemical substances and

substance groups to answer new chemical questions.The successful participation in the module will also enable the students to participate in the practical course and the module advanced organic chemistry.

Teaching and Learning Methods:
Lectures and corresponding exercises with self analysis and workup of specific case studies. In relation to the teaching content exercise sheets are disbursed on which the students work in self-study before the tutorials. The solution and discussion takes place in the tutorials. At the postprocessing of the lecture exspecially while the exercises are solved the students keep themselves intensive busy with the teaching contents of the lecture and reach in this way a understanding of the structure and reaction behavior of organic chemical substance groups and practise the formulation of reaction equations.

Media:
Blackboard, presentation (using script), exercises, laboratory equipment.

Reading List:
K.P.C. Vollhardt, N.E. Schore, Organische Chemie, Verlag VCH Weinheim

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
Organische Chemie
2 SWS

Übung
Organische Chemie
2 SWS
Cordt Zollfrank
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1935: Chemical reaction engineering | Chemische Reaktionstechnik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Learning outcomes of the students shall be verified in a written test. Through this test they show that they are able to outline and explain kinetics in technical reactors in a diagrammatic way. They demonstrate that they are able to answer questions on the fundamentals of catalysis as a chemical formula equation. Based on different tasks (including computational tasks) the ability is verified to use acquired knowledge within limited time for solving fundamental process technology issues (dimensioning of stirrers, tube reactors etc.). Exam duration: 90 minutes
For questions regarding the language of the exam, please seek contact with the lecturer.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
general inorganic and organic chemistry, physics, mathematics

Content:
Reaction kinetics, catalysts, features of homogeneous and heterogeneous catalysis; chemical reaction technology: homogeneous/heterogeneous reactions, reactor forms (e.g. stirrer tanks, tube reactor, packed bed, fluidized bed), indicators for reactor types (e.g. reaction vessels, flow tube), types of reaction control (e.g. fixed, not fixed, continuous, isothermal), flow conditions and residence time behaviour in reactors, heat balance of reactors, strategies for optimising reaction control.

Intended Learning Outcomes:
After having participated in the module the students are familiar with the most important reaction types and parameters of chemical catalysis and reaction technology and are able to apply suitable

reaction controls for predefined chemical reactions and to perform kinetic calculations for common reaction types as well as to calculate parameters such as residence time behaviour and heat demand of reactors. Thus they are capable of also transferring methods learned from examples to new processes.

Teaching and Learning Methods:
The module consists of lectures and parallel tutorials. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Black board, presentation sheets, exercise sheets

Reading List:
O. LEVENSPIEL:
Chemical Reaction Engineering
3. Auflage, John Wiley & Sons, New York (1998)

G. EMIG, E. KLEMM:
Chemische Reaktionstechnik
6. Auflage, Springer Vieweg, Berlin (2017)

Responsible for Module:
Jakob Burger (burger@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Chemische Reaktionstechnik / Prozesstechnik (Übung) (Übung, 2 SWS)
Burger J

Chemische Reaktionstechnik / Prozesstechnik (Vorlesung) (Vorlesung, 2 SWS)
Burger J [L], Burger J
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1936: Mixture thermodynamics and mass transfer | Thermodynamik der Mischungen und Stofftransport

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam performance is effected by a written test. The familiarising of the students with the basics and methods of molecular mass transport and the thermodynamics of mixed phases as well as the reference to real assignment of tasks is reviewed by calculations and by the evaluation of diagrams. The students prove the comprehension of the content of the module by application of the learned relations. Thereby the whole procedural spectra is extended for the chemical and material topics. The students calculate chemical equlibria and phase equilibria. Exam duration: 120 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics of Mathematics, Physics and Chemistry, Physical Chemistry

Content:
Introduction to phenomenological thermodynamics, data on chemical media, mass transport phenomena and equilibrium state. Graphical presentation of state variables, thermal state equations for ideal and real pure substances, Gibbs's Thermodynamics, application of the Maxwell's relations (Maxwell's equations), caloric standard data, thermodynamics of mixtures, calculation of chemical and phase equilibria, basics of molar transition and equilibria in one and between several phases (mass transition, diffusion processes, mass transfer), chemical potential, ideal and real phase equilibria, equilibrium coefficients, equilibrium diagrams, mass/ energy/ momentum balance, Fick´s law, film theory, penetration theory.

Intended Learning Outcomes:
The lecture is aimed at familiarising the students with the basics and methods of molecular mass transport and the thermodynamics of mixed phases. Thereby they are qualified to understand the different calculation methods for material properties and phase equilibria in process engineering and to estimate their application possibilities and limits. Thereby the basics for further understanding of thermal and chemical processes are laid.

Teaching and Learning Methods:
The module consists of a lecture during which also exercises will be performed alternately. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, slide scripts, exercises

Reading List:

Responsible for Module:
Burger, Jakob; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1937: Technical Thermodynamics | Technische Thermodynamik [TTD]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level:	Language: German	Duration: one semester	Frequency: winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam achievement shall be done in the form of a written test. The students calculate thermodynamic and thermotechnical tasks, state variables, efficiencies of thermodynamic systems and heat transfers. They show that they are able to outline and explain cyclic processes. They demonstrate that they are able to mathematically and systematically solve questions on the fundamentals of thermodynamics and heat transfer. Exam duration: 120 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of the most important physical correlations (basic parameters with units, definition of pressure, temperature etc.) must be available. Besides formation and solution of systems of equations as well as command of simple integral and differential calculus is a requirement.
Physics WZ1600, Mathematics WZ1601

Content:
In this module thermodynamic fundamental concepts such as open and closed system, enthalpy, first and second laws, energy balancing, state variables and the most important changes of state (isobaric, isochoric, isothermal, isentropic, polytropic) shall be explained as well as different cyclic processes. Application of the T-s, h-s and t-Q diagrams shall be illustrated.
An introduction is given to heat transfer (conduction, convection, radiation). Moist air, h-x diagram, energy and material balancing of chemical processes and combustion calculation as well as calculation of heat of combustion shall be represented. Application of the theory to a series of technical plants shall be imparted (e. g. steam turbine, gas turbine, boiler, heat pump).

Intended Learning Outcomes:
After having participated in the module the students are capable of understanding thermodynamic systems and fundamental concepts. They are able to apply first and second laws of thermodynamics and are thereby be able to explain functioning of thermal engines.

Teaching and Learning Methods:
The module consists of a lecture during which also exercises will be performed alternately. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, slide scripts, exercises

Reading List:
[223] Pischinger, R.; Klell, M.; Theodor, S.: Thermodynamik der Verbrennungskraftmaschine, 3. Auflage, Springer-Verlag, ISBN 978-3211-99279-0, 2009
[224] Stephan, P.; Schaber, K.; Stephan, K.; Mayinger, F.: Thermodynamik, Band 1: Einstoffsysteme, 17. Auflage, Springer, ISBN 978-3-540-70813, 2006
[226] Baehr, Hans Dieter; Kabelac, Stephan: Thermodynamik, 14. Auflage, Springer, ISBN 978-3-642-00555-8, 2009
[] Wärme- und Stoffübertragung, Hans Dieter Baehr und Karl Stephan, Springer, ISBN 978-3-642-36558-4 , 2013
[227] HSC Chemistry, Outokumpu Research Oy, Pori, Finnland, A. Roine, Ver. 1.10, 1990
[233] Stephan, P.; Schaber, K.; Stephan, K.; Mayinger, F.: Thermodynamik Grundlagen und technische Anwendungen, Band 2: Mehrstoffsysteme und chemische Reaktionen, 15. Auflage, Springer, ISBN 978-3-540-36709-3, 2010
[234] Gmehlin, J.; Kolbe, B.: Thermodynamik, 2. Auflge, VCH, ISBN 3-527-28547-4, 1992
[235] Atkins, Peter W.: Physikalische Chemie, VCH, ISBN 3-527-25913-9, 1990
[237] Schnitzer, H.: Grundlagen der Stoff- und Energiebilanzierung, 9. Auflage, Vieweg, ISBN 3-528-04794-1, 1991
[268] GTT-Technologies; Programm Factsage 6.3, http://www.gtt-technologies.de
[242] VDI Wärmeatlas, VDI-Gesellschaft Verfahrenstechnik und Chemie-Ingenieurwesen 9.Auflage, Springer-Verlag ISBN 3-540-41201-8 9.Auflage

Responsible for Module:
Gaderer, Matthias; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Technische Thermodynamik / Thermodynamik & Wärmelehre (Übung) (Übung, 2 SWS)
Gaderer M [L], Gaderer M

Technische Thermodynamik / Thermodynamik & Wärmelehre (Vorlesung) (Vorlesung, 2 SWS)

Gaderer M [L], Gaderer M, Tilk G
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1938: Fluid separation processes | Thermische Verfahrenstechnik [TVT]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam performance is effected by a written test. Arithmetic problems concerning fluid separation processes are assigned. Therefore design and mass balance study of process steps and implementation of basic concepts and relations in the field of fluid separation processes are proven. Exam duration: 90 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Physical Chemistry, Mixture thermodynamics and mass transfer

Content:
Introduction to fluid separation processes, design methods (calculation and graphical), single-stage and multi-stage operations, Mc-Cabe-Thiele-Construction, HTU-NTU-concept, fixed-point construction for extraction columns, feasibility limiations of unit operations. Applications in the field of distillation, absorption, extraction, membranes, adsorption.

Intended Learning Outcomes:
After completion of the module, the studens are able to design and assess the fluid separation processes distillation, extraction, absorption and membranes based on state diagrams. In addition, the students understand the basic principles of the said separation processses and the apparatus employd in an industrial context.

Teaching and Learning Methods:
The module consists of a lecture during which also exercises will be performed alternately. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, scripts, exercises

Reading List:

Responsible for Module:
Jakob Burger (burger@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1940: Bioprocess Engineering | Bioverfahrenstechnik [BPE]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
To proof whether the students acquired detailed and differentiated knowledge about concepts, calculations and the general design of various bioprocesses, a written examination takes place with a duration of 60 minutes. A bonus of 0,3 is credited on the grade of this written examination when during the module at least 65% of the exercise sheets are handed in and are marked with a positive result (an increase of the grade from 4,3 to 4,0 is not possible). Thereby students shall be motivated to participate in the tutorial which is very important for them.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
The lecture provides a fundamental overview of bioprocess engineering including all relevant process parameters, calculations and balances.This includes basic calculations of generation times, maximal specific growth rates as well as balancing of batch, fed-batch and continous fermentation processes. Furthermore, process relevant parameters such as oxygen transfer rates and heat transfer will be conveyed. Additionally, basic operation unit design as well as scale-up aspects will be examined.

Intended Learning Outcomes:
The students acquire detailed and differentiated knowledge about concepts of various bioprocesses. Finally they are able to describe, calculate and design classical as well as complex

bioprocesses. They will be able to evaluate the applicability of mathematical modelling of bioprocesses and will use this knowledge to analytically simplify highly complex process variants.

Teaching and Learning Methods:
The lecture will be perormed as ex-cathedra teaching to provide the students will all necessary fundamentals. Within the tutorial the students learn how to transfer this knowledge and get practically used with the content of the lecture. The tutorial will be used to internalise the theoretical knowledge based on case studies which allows the transformation on real-world as well as highly specific challenges of bioprocesses.

Media:
PowerPoint, short films, scripts, exercise sheets

Reading List:

Responsible for Module:
Schmid, Jochen; Prof. Dr.-Ing. habil.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ1954: Fluid mechanics | Strömungsmechanik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module will be assessed by a written examination. Students calculate tasks of fluidmechanics based on its fundamental equations. In addition, the unterstanding of content is tested by the explanation of theoretical operations. Dimensionless numbers to evaluate complex task are applied and explained. Altogether the students show that they can solve known tasks from the fluid mechanics area and transfer their acquired knowledge to new assignments of tasks. Exam duration: 90 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of the most important physical correlations (basic parameters with units, definition of pressure, temperature etc.) must be available. Besides formation and solution of systems of equations as well as command of simple integral and differential calculus as well as Physics and Mathematics is a requirement.

Content:
This module provides basics of fluid mechanics, that are relevant for further engineering applications . Therefore the theoretical fundamentals are derived and deepened throug illustrating examples . The content will cover the following topics: hydrostatics, fluid dynamics (Bernoulli , Navier-Stokes , flow resistance), CFD.

Intended Learning Outcomes:
After participating in the module, students are able to understand and analyze simple tasks regarding flows, to apply the methods for their solution and to give a mathematical solution. In

particular the students can transfer the learned methodology and the obtained results to new assignments of tasks.

Teaching and Learning Methods:
The module consists of a lecture during which also exercises will be performed alternately. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, slide scripts, exercises

Reading List:
Siekmann, Thamsen: Strömungslehre, 2. Auflage, Springer
Örtel: Strömungsmechanik für Ingenieure und Naturwissenschaftler, 7. Auflage, Springer
[226] Baehr, Hans Dieter; Kabelac, Stephan: Thermodynamik, 14. Auflage, Springer, ISBN 978-3-642-00555-8, 2009
[242] VDI Wärmeatlas, VDI-Gesellschaft Verfahrenstechnik und Chemie-Ingenieurwesen 9.Auflage, Springer-Verlag ISBN 3-540-41201-8 9.Auflage

Responsible for Module:
Gaderer, Matthias; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
Strömungsmechanik
2 SWS

Übung
Strömungsmechanik
2 SWS
Matthias Gaderer, Bastian Alt
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1955: Heat transfer | Wärmeübertragung

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam achievement shall be done in the form of a written test. The students calculate heat transfer tasks. They are able to explain dimensionless quantities and apply them in arithmetic examples. They explain and calculate different mechanisms of heat transfer. Altogether the students show that they are able to understand and solve assignments of tasks from the heat transfer area.
Exam duration: 90 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of the most important physical correlations (basic parameters with units, definition of pressure, temperature etc.) must be available. Besides formation and solution of systems of equations as well as command of simple integral and differential calculus is a requirement.
Physics, Mathematics and Thermodynamics

Content:
In this module knowledge in heat transfer gained from the lecture of Technical Thermodynamics (TTD) shall be extended, deepened computation bases are created and dimensionless numbers are deduced. Topics will be: heat conduction, covection, heat radiation, heat transfer through objects, calculations based on Nusselt and Prandtl number, dimensioning and calculation of heat exchangers, transient heat conduction, influence of phase changes and knowledge transfer on parallel issues in mass transfer.

Intended Learning Outcomes:
After having participated in the module the students are capable of understanding and analysing simple tasks relating to heat transfer (convection, conduction, radiation). Additionaly the student will be able to apply methods to solve problems concerning heat transfer systems.

Teaching and Learning Methods:
The module consists of a lecture during which also exercises will be performed alternately. Contents of the lecture shall be imparted in speech and by presentation. To deepen their knowledge students shall be encouraged to study the literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples. Thus for instance the construction of a heat exchanger is outlined.

Media:
Presentations, slide scripts, exercises

Reading List:
[224] Stephan, P.; Schaber, K.; Stephan, K.; Mayinger, F.: Thermodynamik, Band 1: Einstoffsysteme, 17. Auflage, Springer, ISBN 978-3-540-70813, 2006
[226] Baehr, Hans Dieter; Kabelac, Stephan: Thermodynamik, 14. Auflage, Springer, ISBN 978-3-642-00555-8, 2009
[] Wärme- und Stoffübertragung, Hans Dieter Baehr und Karl Stephan, Springer, ISBN 978-3-642-36558-4 , 2013
[227] HSC Chemistry, Outokumpu Research Oy, Pori, Finnland, A. Roine, Ver. 1.10, 1990
[233] Stephan, P.; Schaber, K.; Stephan, K.; Mayinger, F.: Thermodynamik Grundlagen und technische Anwendungen, Band 2: Mehrstoffsysteme und chemische Reaktionen, 15. Auflage, Springer, ISBN 978-3-540-36709-3, 2010
[234] Gmehlin, J.; Kolbe, B.: Thermodynamik, 2. Auflge, VCH, ISBN 3-527-28547-4, 1992
[235] Atkins, Peter W.: Physikalische Chemie, VCH, ISBN 3-527-25913-9, 1990
[268] GTT-Technologies; Programm Factsage 6.3, http://www.gtt-technologies.de
[242] VDI Wärmeatlas, VDI-Gesellschaft Verfahrenstechnik und Chemie-Ingenieurwesen 9.Auflage, Springer-Verlag ISBN 3-540-41201-8 9.Auflage

Responsible for Module:
Matthias Gaderer (gaderer@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Wärmeübertragung / WSSP / Wärmelehre (Übung) (Übung, 2 SWS)
Gaderer M [L], Gaderer M, Klüh D

Wärmeübertragung / WSSP / Wärmelehre (Vorlesung) (Vorlesung, 2 SWS)
Gaderer M [L], Gaderer M, Klüh D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1980: Production of biogenic Resources | Produktion biogener Ressourcen

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2018/19

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam achievement shall be done in the form of a test. In this test it shall be proved that students are capable of describing important requirement for the required biogenic resources and are capable to devlop important rules for the production of the raw materials in a limited time. On the basis of different examples (e.g. algae productions) and scenarios the students shall discuss pros and cons and the possibilities for the transformation of the different biomass to products.
Type of exam: In writing
Exam duration: 90 min.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The module aims at providing in-depth knowledge to the students in the prodution and cultivation of renewable raw materials. Beside the areal-bound production by agriculture and forest, production processes such as Algae bioreactors where integrated. Differences, advantages and disadvantages and possible perspectives are discussed.
Essential crop characteristics shall be discussed for the treated crops and if required differences shall be addressed by various product use (energy and/or industrial crops). As to crops important performance parameters (yields etc.) shall be debated and integration into a concrete cultivation system (farm) be discussed. For this purpose pros and cons shall be worked out and possible

actions shall be discussed for optimizing cultivation. For selected topics current main points of research shall be presented and results discussed.

Intended Learning Outcomes:
After having participated in the module units the students know the most important biogenic ressources for renewable raw materials.
- They are capable of describing important requirement for the required biogenic resources and are capable to devlop important rules for the production of the raw materials
- For the desired raw materials, the required starting materials or biomass can be described (e.g. in the form of agricultural crops (example starch production: cereals, maize)). Based on the agricultural and wood procution of raw materials students can characterize the cropping system and cultivation methods
- They are able to describe possible effects on the environment for selected main crops (cereals, corn, oil crops)
- The students know selected research activities in the field of renewable raw materials and are able to analyse their results concerning their relevance and significance

Teaching and Learning Methods:
The module shall primarily be held as a lecture. For different courses it will be completed by individual and group projects. Demonstration of research activities and presentation of the cultivation by practitioners is partly performed by external guests (lecture, presentation). Further reading and questions for follow-up will be made available for different teaching units in moodle.

Media:
Lecture, presentations, (individual and group projects)

Reading List:
Lütke- 2006: Lehrbuch des Pflanzenbaus, Band 2: Kulturpflanzen, Verlag Th. Mann Gelsenkirchen.
Diepenbrock, Ellmauer, Leon, 2009 : Ackerbau, Pflanzenbau und Pflanzenzüchtung. Ulmer Verlag.
Pflanzenbau, Ein Lehrbuch - Biologische Grundlagen und Technik der Pflanzenproduktion, Gerhard Geisler, Paul Parey Verlag: Parasitäre Krankheiten und Schädlinge an landwirtschaftlichen Kulturpflanzen, Ulmer Verlag, G.-M. Hoffmann und H. Schmutterer
Diepenbrock 2014: Nachwachsende Rohstoffe, Ulmer UTB, Stuttgart
Kaltschmitt etal. 2009: Energie aus Biomasse, Springer, Heidelberg

Responsible for Module:
Siebrecht, Norman; Dr. agr.

Courses (Type of course, Weekly hours per semester), Instructor:
Produktion biogener Ressourcen / Grundlagen Pflanzenproduktion (Vorlesung, 4 SWS)
Siebrecht N [L], Höldrich A, Siebrecht N
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