Module Catalog

M.Sc. Chemical Biotechnology

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 185

Compulsory Courses | Pflichtmodule

Module Description

CS0007: Applied Microbiology and Metabolic Engineering | Applied Microbiology and Metabolic Engineering [MetabEng]

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:* 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 order to check whether students have understood the principles and relevant methods and techniques of applied microbiology and metabolic engineering not only in theory, but can also apply them practically, two forms of examination are used. On the one hand, the students answer questions on fermentation strategies during a written exam (90 min) and prove that they have understood the correlations of microbial metabolism. On the other hand, by drawing up written protocols for the laboratory tests carried out, the students demonstrate that they can carry out a selected production process and describe it quantitatively (for each experiment about 5 pages of protocol / not graded course achievement). Allowed tools are calculators. Additional resources may be approved by the lecturer if required.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fundamentals of Microbiology and Molecular Biology from the Bachelor's courses

Content:
Relevant techniques of applied microbiology and metabolic engineering:
- 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

Intended Learning Outcomes:
Upon successful completion of the module, students will be familiar with the principles and relevant methods and techniques of applied microbiology and metabolic engineering. The students have gained knowledge of microbial fermentation processes and are able to develop strategies for the manipulation of cellular metabolism for selected product classes. The students have learned how to quantitatively describe fermentation processes and calculate mass balances. After completing the practical course, students will be able to cultivate a production strain, optimize process parameters, analyze biomass, substrate and product concentrations, and create a carbon balance of the process.

Teaching and Learning Methods:
The contents of the lectures are conveyed by a talk of the lecturer, based on ppt-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. In the practical course the implementation of the theoretically learned knowledge takes place, thereby the students' laboratory skills are trained with regard to the development and optimization of fermentation processes.

Media:
PowerPoint, whiteboard

Reading List:

Responsible for Module:
Bastian Blombach

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

CS0009: Enzymatic Biotransformations | Enzymatic Biotransformations [IBT]

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:* 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:
To prove whether the students are able to understand and to describe possibilities and limitations of established industrial enzymatic processes and whether they are able to apply this knowledge to derive ways to improve existing processes, making them more sustainable and to establish new ones), a written examination takes place with a duration of 90 minutes (approved tool: calculator). 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 exercise which is very important for them.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
The lecture provides a broad overview about applications of enzymes in industrial processes and detailed insight into the corresponding technically important aspects by means of current examples. Essential contents are: industrially relevant properties of enzymes, essential enzyme classes and the most important enzymatic mechanisms, whole cell catalysis vs. enzyme catalysis, biocatalysis vs. classical chemical catalysis, methods of enzyme immobilization, enzymes in aqueous and non-aqueous systems, enzymatic reactions combined with chemical reactions, large-scale supply of enzymes. On the application side, biotransformations which are necessary for

the conversion of biogenic ressources are treated as well as reactions for the synthesis of bulk chemicals, fine chemicals and food additives.

Intended Learning Outcomes:
After participating in the lecture the students will be able to review possible applications of enzymes in different chemical and technical processes, to understand the behaviour and limitation of enzymes in these processes and to derive ways to establish new reactions biocatalytically and to propose technically meaningful scenarios for newly developed enzymatic processes respectively.

Teaching and Learning Methods:
The lecture will be performed as ex-cathedra teaching which is interrupted by queries to familiarize students with all necessary basics and to stimulate independent, critical thinking. In the exercise, the students will deepen the knowledge they have learned and solve specific problems of varying complexity, either alone or in group work.

Media:
PowerPoint, white board, exercise sheets

Reading List:

Responsible for Module:
Voker Sieber

Courses (Type of course, Weekly hours per semester), Instructor:
Enzymatic Biotransformations (Exercise) (Übung, 1 SWS)
Sieber V [L], Sieber V

Enzymatic Biotransformations (Lecture) (Vorlesung, 2 SWS)
Sieber V [L], Sieber V
For further information in this module, please click campus.tum.de or here.

Module Description

CS0011: Conceptual Design of Bioprocesses | Conceptual Design of Bioprocesses [CDBP]

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:* 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 an written exam (60 min). It is reviewed wheter the students know the fundamentals of chemical and bioprocess engineering and if they can apply this knowledge on the design and evaluation of complex processes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

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 and calculations of chemical as well as biotechnological processes after the course. They will aquire knowledge of all aspects of process design.

Teaching and Learning Methods:
The module consits 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:
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

CS0012: Artificial Intelligence for Biotechnology | Artificial Intelligence for Biotechnology [AI]

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:
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). These methods are also important for analyzing biological and biomedical data, e.g. for finding novel patterns in biological data. to predict the disease state of a patient or the 3D structure of proteins. 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:
Lectures 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

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

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

Module Description

CS0013: Advanced scientific planning based on current research topics at TUM | Fortgeschrittene Projektplanung anhand aktueller Forschungsthemen an der TUM [FoPro]

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:** 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:
In order to show that the students are able to develop ideas from the presented research topics and to create an appropriate project plan, the participation in the seminar is followed by the scientific elaboration (maximum 5 pages) of a possible research topic, which should contain all points of a project plan from the idea development over the methods to be applied up to a suitable method for data analysis.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Being motivated, open-minded and having an interest in practical problem solving via scientific methods

Content:
The Inter-disciplinary course arises from an initiative of the various chairs of TUM dealing with the topic of biotechnology at all TUM sites. The seminar aims at teaching the principles of scientific planning for a research internship by applying scientific methods to practical problems. In particular, students will be inspired by presentations of current research topics in the field of biotechnology at the different chairs of TUM. Based on these topics students will identify and design topics for their own research internship in tune with the up-to-date research activities and with their academic background. Supported by the seminars on scientific planning and applying analytical techniques as well as scientific methodologies, they will outline a project schedule including analytics and statistical tools including all project management issues and tasks

necessary to provide answers to the main scientific question addressed in their respective projects. By means of different methodically approaches and intensive mentoring by the corresponding seminar leaders, students will be confronted with project planning strategies and will have the opportunity to get insights into current research topics at TUM. Thereby, they will be asked to go into an own area of expertise which might be followed by a bachelor or master thesis in that field. The students will tackle issues related to project and time managment, literature survey and experimental work in the field of biotechnology.

Intended Learning Outcomes:
Students acquire the ability to develop ideas and create a clear and precise project plan.
For the students from the different biotechnological courses at the TUM, the seminar is an opportunity to develop highly topical research projects, to learn the basics of scientific project planning, the methods and techniques for a successful scientific data analysis and are capable of self-management and the elaboration of a project plan. Ideally, students will have become experts in a specific field very early on through a subsequent research internship or a thesis on the same topic.

Teaching and Learning Methods:
Seminar talks and developement of a project plan

Media:

Reading List:
Basic literature on the methods applied in context of the projects.

Responsible for Module:
Volker Sieber

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

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

Module Description

CS0014: Research Internship Master Chemical Biotechnology | Forschungspraktikum Master Chemical Biotechnology

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/summer semester
Credits:* 15	**Total Hours:** 450	**Self-study Hours:** 90	**Contact Hours:** 360

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

Description of Examination Method:
Exam achievement consists of a graded practical course report (15-25 pages) about contents and results of the practical course containing at least an overview of the level of knowledge relating to the project subject as well as representation of used working methods and a representation of the results including interpretation. In a final grade quality of familiarisation with the topic of experimental work, interpretation of results and written elaboration shall be evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
no

Content:
Research-related works at the chairs and working groups of the TUM Campus Straubing/Garching/ Freising (area of biotechnology). The students shall each get tasks from the research field of the mentoring examiner. They shall work on these tasks under supervision in form of projects. Topics have to be allocated with regard to content and expertise to one of the core themes (cultivation, economy, material use, energetic use). The students shall largely independently plan project works under supervision of the mentors. Project works shall be documented and evaluated in form of an internship report. Optionally a completing presentation of work progress may be done in form of oral presentations. Project works can also be done in cooperation with external institutions, e.g. companies.

Intended Learning Outcomes:
After having participated in the module the students especially understand principles of approach to (research) projects, planning of project works and critical evaluation of project results beside subject-specific knowledge and working methods each imparted in the practical course in scientific working. The students will be able to apply these principles to new project tasks. Besides they are able to document, to interpret and summarise project works and results in a meaningful way in written form.

Teaching and Learning Methods:
According to the core theme and topic, e.g. experimental equipment (laboratory), databases, libraries, subject-specific software, project and experiment design software

Media:
dependent on focus and topic e.g. experimental equipment (lab), databases, libraries,subject-specific software, project/ experiment planning software

Reading List:
Technical literature

Responsible for Module:
Volker Sieber

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

Technical Electives Micro-/Molecular Biology | Fachspezifische Wahlmodule Mikro-/Molekularbiologie

Module Description

CS0008: Enzyme Engineering | Enzyme Engineering [EE]

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/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:
To proof whether the students are able to show ways to optimize enzymes in their properties and to perform this methodically, a written examination takes place with a duration of 60 minutes and a internship report must be created. The total note consists of the written exam grade (67%) and the grade of the internship report (33%).

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
This course aims to convey molecular biology and protein chemistry
approaches to optimize enzymes especially by variation of the primary structure.
Essential contents are: analysis of the limitation at the molecular level, rational methods, computer-based methods, evolutionary and combined procedures, high-throughput methods, robotics. The practical course aims to convey practically molecular biology and protein chemistry methods to optimize enzymes by means of two relevant examples. Essential contents are: 1.

Rational/ computer-based approach - site-directed (random) mutagenesis by means of sequence comparisons, structural analyzes and computer models, 2. Purely evolutionary approach: undirected mutagenesis. For both approaches assay methods are established.

Intended Learning Outcomes:
After participating in the lecture the students will be able to indicate options for the improvement of technically limited enzymes, to estimate the necessary effort for this improvements and they own the theoretical ability to put these improvements in the following internship Enzyme Engineering into practice. After having participated in the practical course the students are able to perform different methods of enzyme optimization and thereby especially the essential elements (production of variants, structure/ screening of the assay, operation of necessary hardware) practically.

Teaching and Learning Methods:
The lecture will be performed as ex-cathedra teaching to provide the students with all necessary fundamentals. In addition, the students review single methods and procedures by themselves e.g. based on current scientific literature and present this review to each other in a presentation. The practical work is carried out under close supervision where some of the experiments are prepared by the students themselves to promote their own planning skills.

Media:
PowerPoint, script, internship scripts

Reading List:

Responsible for Module:
Volker Sieber

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

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

Module Description

CS0017: Regulation of Microbial Metabolism | Mikrobielle Stoffwechselregulation [MicriobReg]

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:** 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 learning results are to be proved in form of a written test (60 min). The students demonstrate that they know relevant mechanisms of metabolic regulation and that they have understood the basic connections of microbial metabolism and its regulation dealt with in the module and can apply and transfer the methods and techniques.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fundamentals of Microbiology and Molecular Biology from the Bachelor's courses

Content:
Relevant topics of metabolic regulation: i.a. catabolite repression, attenuation, autogenous regulation, endproduct inhibition, 2-component systems, quorum sensing, regulatory RNAs, stringent control, nitrogen regulation, iron homeostasis, phosphate regulation

Intended Learning Outcomes:
Upon successful completion of the module, students will be familiar with the principles and relevant mechanisms metabolic regulation. In addition, students are able to transfer the knowledge they have acquired in order to develop solutions to new problems.

Teaching and Learning Methods:
The contents of the lectures are conveyed by a talk of the lecturer, based on ppt-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. Learning methods: During the follow-up of the lecture, the students intensively deal with the teaching contents of the lecture.

Media:
PowerPoint, whiteboard

Reading List:

Responsible for Module:
Bastian Blombach

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

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

Module Description

CS0018: Plant Biotechnology | Plant Biotechnology [PlBioTech]

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:* 3	**Total Hours:** 70	**Self-study Hours:** 48	**Contact Hours:** 22

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 proved in form of a written (60 min) exam (50%) and a seminar presentation (50%). In the 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 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 / End of Semester

(Recommended) Prerequisites:
basic knowledge in biotechnology and molecular biology

Content:
In the lecture 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:
The students know the most important methods and applications in plant biotechnology and are able to assess them.

Teaching and Learning Methods:
Teaching methods: in the lecture the teaching content is communicated by a talk of the lecturer, supported by PowerPoint and skectches on the blackboard in which the latter form is chosen to derivate complex relations. To a limited extent this can be completed for selected topics by self-study by the students. 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, optional: script

Reading List:

Responsible for Module:
Erich Glawischnig

Courses (Type of course, Weekly hours per semester), Instructor:
Plant Biotechnology (Lecture) (Vorlesung, 1 SWS)
Glawischnig E [L], Glawischnig E

Plant Biotechnology (Seminar) (Seminar, 1 SWS)
Glawischnig E [L], Glawischnig E
For further information in this module, please click campus.tum.de or here.

Module Description

CS0179: Advances in Synthetic Biology | Advances in Synthetic Biology [ASB]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2020

Module Level: Master	**Language:** English	**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:
The learning outcomes are tested by a graded seminar presentation. The lecture allows the students to assess the extent to which they can summarize a complex scientific work in the field of Synthetic Biology correctly and present it to an audience in a comprehensible and convincing way.

Repeat Examination:

(Recommended) Prerequisites:
Basic knowledge of molecular biology.

Content:
The technical content of the course focuses on current research results in the field of Synthetic Biology. Molecular biological-methodical as well as biotechnological application-oriented work is dealt with, for example:
- Genome meditation using CRISPR / multiplex gene silencing approaches using CRISPRi or sRNA binding protein Hfq
- Multiplex genome editing through natural transformation (MuGENT)
- Biological sensor/reporter systems and switches
- Chassis organisms and minimal genomes by means of genome reduction and genome assembly of synthetic DNA fragments (top-down and bottom-up approaches)
- Implementation of novel capabilities and functions in established biotechnologically used organisms (e.g. C1-fixation, N-fixation...)
- Recombineering
- Biosensors

Intended Learning Outcomes:
The students know the current and relevant methods and applications of Synthetic Biology and are able to evaluate and classify them. Students can acquire, present and critically discuss relevant technical literature.

Teaching and Learning Methods:
First, a selection of current publications is made and a preliminary discussion of the respective topics with the students takes place. The students then work out a presentation which they then present and discuss in the seminar.

Media:
Powerpoint, blackboard work

Reading List:

Responsible for Module:
Bastian Blombach bastian.blombach@tum.de Daniel Siebert d.siebert@tum.de Felix Müller fsm.mueller@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Advances in Synthetic Biology (Seminar, 2 SWS)
Siebert D, Thoma F
For further information in this module, please click campus.tum.de or here.

Technical Electives Chemistry | Fachspezifische Wahlmodule Chemie

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 (Tutorial, Straubing) (Übung, 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 (Lecture, Straubing) (Vorlesung, 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

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)
Rühmann B, Sieber V
For further information in this module, please click campus.tum.de or here.

Module Description

CS0108: Catalysis | Katalyse

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:** 105	**Contact Hours:** 45

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

Description of Examination Method:
The learning results are assayed by a written test (60 min) in which the students have to reflect basic aspects of catalysis as well as the mechanistic involvement of catalysts by means of examples. Futhermore the students show by means of arithmetic problems which are assigned that they are able to quantify simple examples.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Homogenous/heterogenous catalysis, mechanistic details of activation at transition metal centers, characterisation of catalysts, mass and heat transport at the catalyst, catalytic reactors

Intended Learning Outcomes:
Students can explain crucial chemical aspects of catalysis in simple examples. They can identify the mechanistic details of catalysis during a total reaction equation. By calculations they can quantify the implication of the catalyst in characteristic numbers.

Teaching and Learning Methods:
In oral presentations, basic facts of catalysis are presented. In about 5 simple experiments done by students in small groups, quantitative results are obtained, and students themselves calculate the respective characteristic numbers.

Media:
Practical course script, PowerPoint presentations, blackboard sketch, lab, lab equipment

Reading List:
Practical course script

Responsible for Module:
Prof. Herbert Riepl

Courses (Type of course, Weekly hours per semester), Instructor:
Katalyse (Übung) (Übung, 1 SWS)
Riepl H [L], Riepl H

Katalyse (Vorlesung) (Vorlesung, 2 SWS)
Riepl H [L], Riepl H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0162: Protein chemistry | Protein chemistry [PC]

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:** 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 learning results are proved in form of a written test (60 min exam duration). Based on questions to synthesis, purification, modification, analytics, characterisation and implementation of proteins the students prove that they know the corresponding technical terms, designations and contents, that they have understand the basic relations and are able to apply their knowledge.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in the modules "Biochemistry" and "Practical course Biochemistry".

Content:
Basic principles of protein chemisty, chemical and biochemical protein synthesis, protein folding, amino acid analysis, posttranslational modifications, protein sequencing, prediction of secondary structures, tertiary structures, pI, determination of sulfylhydryl and disulfide groups, desalinisation, protein data bases, methods for protein immobilisation and labeling

Intended Learning Outcomes:
After sucessful completion of the module the students are able to describe and explain basic concepts, phenomenons and relations in the field of protein chemistry. The students can describe biological and chemical methods of protein synthesis, purification and modification of proteins and know how proteins can be characterised. In addition they can describe the impact of modifications on the protein structure or activity and apply their theoretical knowledge by means of questions.

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using powerpoint presentations and blackboard sketches. 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:
Presentations, PowerPoint, script, exercise sheets

Reading List:
"Bioanalytik, F. Lottspeich, H. Zorbas, Spektrum Akademischer Verlag
Voet, D. , Voet, J.G., Biochemistry 4th Edition, Wiley-VCH, 2011; Nelson, D.L, Cox, M.M., Lehninger Principles of Biochemistry 5th Edition, WH Freeman, 2008; Berg, J.M, Tymoczko, J.L., Stryer, L., Biochemistry 6th Edition, 2006"

Responsible for Module:
Volker Sieber sieber@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

CS0181: Electrochemistry | Electrochemistry

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:** 105	**Contact Hours:** 45

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

Description of Examination Method:
The learning results are proved in form of a written test (60 min exam duration). Based on questions to electrochemical aspects the students prove that they know the corresponding technical terms, designations and contents, that they have understand the basic relations and are able to apply their knowledge concerning the reactions taking place within the scope of kinetic and thermodynamic connections. For that purpose concrete computational tasks are assigned.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
General Chemistry and Physical Chemistry, Mathematics, Physics

Content:
- Principles of Electrochemistry: Electrochemical thermodynamics (electrochemical potential, electrode potential, half-cell), transport in solution (migration, diffusion, convection), thermodynamics of interface (the electrical double layer), electrochemical kinetics.
- Stationary Electrode Voltammetry (Potential pulse, linear sweep and cyclic voltammetry at macro- and microelectrodes) for determination of thermodynamic and kinetic parameters. Determination of reaction mechanism and catalytic cycle.
- Mass transport by convection (Rotating disc electrode and rotating ring/disk electrode), thin film methodology, ultra-micro electrodes, flow-cell electrodes.
- Electrochemical Impedance Spectroscopy (general principles, data acquisition and modelling, data analysis and interpretation).

- Implementations of electrochemistry (Renewable energy conversion, green electrosynthesis, Sustainable energy harvesting and storage)

Intended Learning Outcomes:
The students obtain basic knowledge about fundamentals of electrochemistry and electroanalytical methods. They handle principles in the field of electrochemistry and can apply these to simple problems related to electrochemical systems. In particular they understand the general interplays between electron transfer, reactions, mass transport and their respective time scale defining the overall electrochemical response. Furthermore, the students are familiar with the electrochemical processes relevant in industry, renewable energy conversion, green electrosynthesis and sustainable energy harvesting and storage, and can apply their theoretical knowledge to these processes. In addition, they know different analytical methods in electrochemistry and even actual examples of use for designing and optimizing these processes in research and industry.

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using PowerPoint presentations and blackboard sketches. This enables a way of delivering the teaching content to the students in detail and answering questions as soon as they arise. PowerPoint slides and blackboard sketches create a visual assistance to understand the complex relationships in electrochemistry. Additionally, the students are provided with exercises to consolidate what they have learned in the lecture. The solutions to those exercises are later presented and discussed by the students in a practice lesson.

Media:
Presentations, PowerPoint, script

Reading List:
Elektrochemie, Hamann/Vielstich, ISBN: 3527310681
Electrochemical Methods: Fundamentals and Applications; Bard/Faulkner, ISBN-13: 978-0471043720

Responsible for Module:
Prof. Nicolas Plumeré

Courses (Type of course, Weekly hours per semester), Instructor:
Electrochemistry (Lecture) (Vorlesung, 2 SWS)
Plumeré N [L], Moore Y, Plumeré N

Electrochemistry (Exercise) (Übung, 1 SWS)
Plumeré N [L], Moore Y, Plumeré N
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

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

WZ1197: Research Practical "Material Use of Renewable Resources" | Forschungspraktikum "Stoffliche Nutzung Nachwachsender Rohstoffe"

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

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:
Forschungspraktikum Stoffliche Nutzung nachwachsender Rohstoffe (Prof. Sieber) (Forschungspraktikum, 4 SWS)
Sieber V [L], Al-Shameri A, Beer B, Hüsing T, Kolaitis G, Rühmann B, Schieder D, Sieber V, Sutiono S

Forschungspraktikum - CBT / NaWaRo Master Prof. Zollfrank (Forschungspraktikum, 4 SWS)
Zollfrank C [L], van Opdenbosch D, Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1259: Experiment Design and Planning in Chemistry | Projektierung in der Chemie

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2016/17

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/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 first part of the assessment takes the form of project work, including e.g. planning, laboratory work and a written evaluation of the project. This is to demonstrate that students can practically apply the acquired methods (e.g. literature research or pipetting) in order to design and work on small projects independently. The second part of the assessment includes a ten-minute presentation, in which the results are briefly introduced to the class and lecturers. This serves the assessment of students' communicative proficiency in discussing scientific topics in front of an audience. Project work accounts for two-thirds of the grade, the presentation makes up the remaining one-third.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge and experience of laboratory work, such as introduced in the modules WZ 1680 (LV3641) and WZ1681 (LV968 and LV981)

Content:
The module covers various methods that are required for independent project work. The lecture first outlines the content and time requirements of chemistry projects as well as the main sources of error. It covers everything from literature research to writing reports. Finally, practical methods (pipetting, weighing, preparation of solutions and dilutions) are introduced by exercises to deepen the students' theoretical knowledge and allow them to plan and perform projects independently (starting from literature research until experiments realized in a laboratory).

Intended Learning Outcomes:
At the end of the module, students are able to complete basic work (e.g. pipetting, weighing, preparation of solutions and dilutions) in the laboratory. In addition, they can develop small projects, fulfill a project plan, as well as verify and analyse the results.

Teaching and Learning Methods:
The module consists of lectures, practical tutorials and project work. The lectures deal with the theoretical background of the topic, which is required for independent project planning. Tutorials build on these lectures and help consolidating students' knowledge in practice. In addition, students choose a project in consultation with their lecturer, which they then plan and carry out independently. Finally, students prepare a written report.

Media:
Power-Point, laboratory

Reading List:
Organikum, Lehrbuch der analytischen und präparativen anorganischen Chemie (ISBN 978-3527339686) ; 1x1 der Laborpraxis (ISBN 978-3527316571)

Responsible for Module:
Corinna Urmann (corinna.urmann@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Projektierung in der Chemie (Übung) (Übung, 3 SWS)
Urmann C

Projektierung in der Chemie (Praktikum) (Praktikum, ,5 SWS)
Urmann C

Projektierung in der Chemie (Vorlesung) (Vorlesung, ,5 SWS)
Urmann C [L], Urmann C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9427BOK: Chemicals from Biomass | Chemikalien aus Biomasse

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:* 2	**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:
oral

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
General and organic chemistry

Content:
Master HTM - Modul Bioraffinerie

The lecture gives a short introduction into the different classes of primary and secondary natural materials.

Based on the corresponding properties of these natural materials substantial applications and utilisations within the framework "Chemicals from Biomass" are elaborated and described.

Intended Learning Outcomes:
Master HTM - Modul Bioraffinerie
Establish understanding of interrelationship of the different classes of primary and secondary natural materials, their properties and resulting possible usage. Deepening knowledge about connectivity of chemical properties and usage as biobased chemicals.

Teaching and Learning Methods:
Class lecture

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Chemikalien aus Biomasse (LV-Nr. 774326)
2 SWS
Sabine Baumgartner, Stefan Böhmdorfer

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

Technical Electives Process Engineering | Fachspezifische Wahlmodule Verfahrenstechnik

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 (Exercise) (Übung, 2 SWS)
Gaderer M [L], Herdzik S

Mechanical process engineering (Lecture) (Vorlesung, 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, Göttl Q

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

CS0163: Downstream Processing | Downstream Processing [DSP]

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:** 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 teaching content will be evaluated by a written examination for the learning outcomes of the module of a duration of 60 minutes. Based on questions to definitions and methods of Down-stream processes of biologically inspired processes the students prove that they know the corresponding technical terms, designations and contents, that they have understand the basic relations and are able to apply their knowledge.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The lecture provides a fundamental overview of Downstream procesing of bioprocesses, which includes all relevant process parameters up to the effects of targeted approaches on the wholistic system.

Intended Learning Outcomes:
The students acquire detailed and differentiated knowledge about concepts and definitions of Down-stream processes of biologically inspired processes. This includes the different approaches of precipitation, filtration as well as targeted converions which massively contribute to economical bioprocesses.

Teaching and Learning Methods:
The lecture will be perormed as ex-cathedra teaching to provide the students will all necessary fundamentals which they will need for insights in the different downstream processing approaches.

Media:
PowerPoint, short films, scripts

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

WZ1154: Biorefinery | Biorefinery [BioRaff]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2020

Module Level:	Language:	Duration:	Frequency:
Master	German/English	one semester	winter semester
Credits:*	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**
5	150	105	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 (Seminar) (Übung, 1 SWS)
Schieder D

Biorefinery (Lecture) (Vorlesung, 2 SWS)
Schieder D
For further information in this module, please click campus.tum.de or here.

Technical Electives Specializations | Fachspezifische Wahlmodule Spezialisierungen

Module Description

WZ1149: Utilisation of Timber as Material | Werkstoffliche Nutzung von Holz

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2012/13

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:
Prüfungsdauer (in min.): 30 Minuten.
Die Anwendung der Lernergebnisse wird der Stoffvermittlung entsprechend in Rahmen der Vorlesung durch die Vorstellung und Besprechung von Fallbeispielen geübt. Das individuelle Beherrschen der Lernergebnisse wird in einer mündlichen Prüfung unter Beweis gestellt.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Einführung in die Grundlagen der Holzkunde und Holztechnologie

Content:
Die Vorlesung vermittelt die vielfältigen Einsatzmöglichkeiten der stofflichen Holznutzung, d.h. als Material und Werkstoff. Ausgehend von den materialtechnologischen, physikalischen und chemischen Eigenschaften werden die Anforderungen und Voraussetzungen vermittelt, um Holz in tragender, nichttragender, dekorativer, bauphysikalisch korrekter Form im Bauwesen, in der Möbel-, Transport- und Verpackungs- und Papierindustrie einzusetzen. Neben den Verarbeitungs-, Produkt- und Anwendungstechnologien werden Möglichkeiten diskutiert, um die Stoffstromlenkung im Hinblick auf eine Kaskadennutzung zu optimieren.

Intended Learning Outcomes:
Die Teilnahme an der Modulveranstaltung befähigt zur Formulierung von verwendungsspezifischen Anforderungen an die Qualität von Massivholz und Holzwerkstoffen. Die Technologien zur Verarbeitung des Holzes als Material und Werkstoff sind bekannt. Die Einsatzformen in den verschiedenen Bereichen der Zivilisationsgesellschaft sind bekannt, ein Schwerpunkt bildet die bauindustrielle Anwendung. Konzepte zur Gestaltung der Verarbeitungs- und Nutzungsformen mit dem Ziel einer besseren Umsetzung der Kaskadennutzung können entwickelt werden.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Klaus Richter (klaus.richter@wzw.tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Werkstoffliche Nutzung von Holz (Straubing) (Vorlesung, 4 SWS)
Richter K [L], Richter K, Risse M, Sanchez-Ferrer A, Windeisen-Holzhauser E
For further information in this module, please click campus.tum.de or here.

Module Description

CS0024: Electrobiotechnology | Electrobiotechnology [EBT]

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/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 an written exam (90 min). It is reviewed whether the students know the fundamentals of electrochemistry and if they can apply this knowledge on the design and evaluation of electrobiotechnological processes.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Terms and definitions of electrochemistry and bioelectrochemistry; deepened knowledge of physical-chemical fundamentals of electrochemical equilibria and electrochemical processes and reactions; fundamentals of electrochemical thermodynamics and electrochemical kinetics; fundamentals of electrochemical methods (with special focus on biological problems); bioelectrochemical processes in biological systems, especially microorganisms and enzymes; fundamentals of eletrobiotechnology especially on reactions, reactor technology and balancing. Examples of electroorganic syntheses, inter-relations with other subject areas (e.g. environmental biology); exemplarily applications in biosensoris and electrobiorefineries.

Intended Learning Outcomes:
The students are qualified to understand the fundamentals of electrochemistry and electrobiotechnology after the course. They will aquire knowledge of the different application fields of electrocchemistry as well as electroanalysis. Additionally they will be qualified by an in-depth knowledge of bioelectrochemistry especially of natural cellular bioelectrochemical processes as

well as bioelectrochemistry of enzymes and microorganisms in combination how to apply them in electrobiotechnology.

Teaching and Learning Methods:
The module consits 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 electrochemistry and electrobiotechnology.

Media:
Panel, slides, scripts, exercise sheets

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

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 (Seminar) (Seminar, 1 SWS)
Zollfrank C [L], Zollfrank C

Biogenic Polymers (Lecture) (Vorlesung, 2 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 (Lecture) (Vorlesung, 2 SWS)
Zollfrank C

Polymer Processing (Practical) (Praktikum, 1 SWS)
Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1210: Materials Science of Renewable Resources | Materialwissenschaften [MatWiss_NawaRo]

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:** 45	**Contact Hours:** 45

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

Description of Examination Method:
In a final written examination (90 minutes), students demonstrate their knowledge of generally applicable basic concepts and methods of materials science. Furthermore, they show their ability to apply such basic knowledge to materials made from renewable resources. Finally, the examination will test students' knowledge of the properties and characteristics of such materials as well as their importance for particular applications. Non-programmable pocket calculators are allowed as external tools.
In the tutorials, students independently prepare topics by studying the literature and present them to the class.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge of geometry, basics of chemistry

Content:
The module "Materials Science and Renewable Resources" introduces concepts and methods that allow materials to be categorized and evaluated in accordance with international norms, industry and expert standards, and materials science best practice. Students learn which characteristics can be used to categorize materials according to biology, solid-state chemistry, mechanics, optics and thermal properties. Building on that knowledge and complementing the modules 'Scientific Work' and 'Instrumental Analytics', they learn the most important methods to determine those properties. Selected aspects are demonstrated during short excursions using available equipment. The acquired knowledge is applied to materials made from renewable resources. Drawing on both

traditional and novel materials, the balance between their desired and actual properties, as well as the effords made for production will be discussed.

Intended Learning Outcomes:
After successful completion of the module, the students know how to evaluate a material intended for a given purpose. They know the usual procedures to evaluate key material properties and are able to apply the relevant devices they have been introduced to. They are also able to describe requirements for new materials and basic ideas for their production.

Teaching and Learning Methods:
The module consists of a lecture (teaching staff, accompanying script) and a tutorial (presentations given by students). In the tutorial, students independently study the literature and prepare and give talks about topics of materials science of renewable resources. Group work is possible. Short excursions serve as consolidation.

Media:
Presentations, lecture notes

Reading List:
Hornbogen E, Eggeler G, Werner E: Werkstoffe. Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen. Springer ISBN 978-3-642-22560-4 (Druck) ISBN 978-3-642-22561-1
Türk, O: Stoffliche Nutzung nachwachsender Rohstoffe: Grundlagen - Werkstoffe - Anwendungen. Springer ISBN 978-3-834-81763-1 (Druck), ISBN 978-3-8348-2199-7
Ilschner B, Singer R: Werkstoffwissenschaften und Fertigungstechnik. Springer ISBN: 978-3-642-01733-9 (Druck) 978-3-642-01734-6

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

Courses (Type of course, Weekly hours per semester), Instructor:
Grundlagen der Materialwissenschaften (Vorlesung, 2 SWS)
Zollfrank C [L], van Opdenbosch D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1290: Biological Materials in Nature and Technology | Biologische Materialien in Natur und Technik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2016

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

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

Description of Examination Method:
Written exam of 90 minutes duration.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge in geometry and chemistry

Content:
The module Biological Materials in Nature and Technology covers important biological functional materials, based on basic materials scientific knowledge. This encompasses such materials that fulfill, in their biological system, or in a technological application, either in native state, or modified, one or more specific functions. Differences and similarities to classical engineering materials are pointed out. In addition to the modules Bioinspired Materials and Instrumental Analysis, the students learn important methods for structural and property analysis. After a presentation of the classification of biological materials, students- are taught the basic correlations between hierarchical structuring and macroscopic properties. As the most important complex, the influence of hierarchical structuring on the mechanical properties of materials will be discussed. The students learn, which modes of failure can occur in biological systems and how they are influenced. In this context, modification routes for biological materials are shown and discussed.

Intended Learning Outcomes:
fter successful completion of the module, the students are enabled to name criteria for a proper usage of biological materials. They can name specialized methods for the analysis of hierarchical

structures and the derived material properties and explain the correlations between structure and external properties. Further, they are able to describe tailored modification routes for biological materials.

Teaching and Learning Methods:
Lecture with discussion and case studies

Media:
Presentation, slides

Reading List:
Structural Biological Materials: Design and Structure-Property Relationships. Eds Elices M, Pergamon-Elsevier Science Ltd, Oxford, (2000).
Fratzl P & Harrington MJ. Introduction to Biological Materials Science. Wiley VCH, Weinheim, Germany, (2015).

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

WZ9483BOK: Biomimetics - Technical Solutions from Nature | Bionik - technische Lösungen aus der Natur

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:* 2	**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:
written

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
No specific previous knowledge expected!
COURSE LANGUAGE IS GERMAN!

Content:
The scientific discipline bionics is concerned with the technical implementation & application of construction, processing & development principles of biological systems. Since the beginning of time, we have been learning from Nature. Today, innovation pressure & the necessity to find sustainable, resource efficient & “mature” solutions for questions & problems of our society have tremendously increased. By thorough understanding biologically optimized systems, we can obtain better solution in a faster way, by making millions of years of evolution & selection part of our research & development work.

The lecture „Bionics – technical solutions from Nature” is devoted to the following contents:
- Systematic introduction to the scientific areas of bionics
- Historical & state of the art examples, to understand the methodical approach of bionics
- Development of a fundamental understanding of the functionality of selected biological systems
- Illustration of technical applications in “bionic” products or processes as well as further possible fields of application

The lecture is held in 2 parts:

Part 1: Introduction and bionics in the animal kingdom (H. Lichtenegger)
1. Introduction: pioneers of bionics & their achievements, bionics as science, bionic approach, difference to “pseudobionics”
2. Principle of a bionic invention, example of the Bionic Car
3. Surfaces: to glide or to stick, this is the question. The tricks of sharks, sand fish and geckos, and their application.
4. High performance materials: as hard as nacre, as tough as spider silk or as shiny as a butterfly? The inner structure is key.
5. Self-assembly: principles in Nature and transfer to artificial systems.
6. Flying through the sky, a human accomplishment: what is it to do with bionics today?

Part 2: Bionics from the world of plants (N. Gierlinger)
1. Bionic “classics” from the world of plants
2. Always clean: super-hydrophobic plant surfaces – from the example to the product
3. Well protected and densely packed: Examples from the world of plants
4. Stable light weight constructions, shape optimization and self-repair: what can we learn from trees, grass, lianas & co?
5. Movement in plants as example for technical applications?

Intended Learning Outcomes:
Students graduating from this course have basic knowledge about principles of bionics. They can cite and explain examples of successful bionic applications and have the basic insight necessary for potential transfer of concepts found in nature to technical problems.

Teaching and Learning Methods:
multimedia-supported

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Bionik - technische Lösungen aus der Natur (LV-Nr. 892325)
2 SWS
Notburga Gierlinger, Helga Lichtenegger

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

Technical Electives Overarching Knowledge | Fachspezifische Wahlmodule Fächerübergreifendes Wissen

Module Description

CS0025: Advanced Analytics for Biotechnology | Advanced Analytics for Biotechnology [InstAna]

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:** 105	**Contact Hours:** 45

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

Description of Examination Method:
In the seminar, students analyze the literature, as well as work out and present methods common to the field of instrumental analytics. Group work is optional. In addition, students take a written examination (60 minutes) as the basis for assessment. Here, they demonstrate their ability to evaluate physico-chemical analysis procedures, as well as appropriate instruments for the respective requiremements of science and common practice.
No tools are allowed in the examination.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Successful participation in the modules "Basics of Chemistry" and basic knowledge of chemistry and physics.

Content:
The module deals with basics of instrumental analytics. Various physico-chemical methods for characterization, basic principles of measurement and construction of devices are demonstrated in detail, especially: optical/electrical/magnetic measurements, adsorption/desorption as the basis of chromatographic techniques, absorption / emissions in vibrational spectroscopy and spectroscopy in UV/Vis, nuclear magnetic resonance spectroscopy, electron mapping, X-ray spectroscopy / energy-dispersive X-ray analysis, mass determination and mass spectrometry,

scattering methods, atomic spectroscopy, surface analysis, gas chromatography and high-performance liquid chromatography, rheology. Handling data will be explained with the help of examples.
Students come to grips with further analytical methods and present those to their colleagues.

Intended Learning Outcomes:
At the end of this module, students are able to choose appropriate physico-chemical analysis methods for real-life issues and apply them according to the needs. Students can also evaluate the resulting data on the basis of their knowledge acquired in the module.

Teaching and Learning Methods:
Lectures (given by a lecturer using PowerPoint-media, books and additional witten material), seminar (students individually work out methods common to the field of instrumental analytics, presentation of their knowledge, peer instructions and constructive feedback)

Media:
Presentations, script

Reading List:
R. Winter, F. Noll: Methoden der Biophysikalischen Chemie, Teubner Studienbücher

Responsible for Module:
Cordt Prof. Dr. Zollfrank

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

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

Module Description

CS0026: Advanced Concepts of Bioinformatics | Advanced Concepts of Bioinformatics

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:
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 bioinformatic 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:
Module Biochemistry, WZ1631 Bioinformatics, CS0001 Foundations of Computer Science, Knowledge Linux Command Line Interface, Programming Skills in Python

Content:
In this course state-of-the-art methods in statistical genetics, genome-wide association studies, analysis of complex biological networks, protein-analysis as well as modern machine learning methods for genomic data are investigated and applied on various case-studies.

Intended Learning Outcomes:
The students know state-of-the-art bioinformatics methods and are able to apply them independently on various real-world problems. The students lern to implement custom Python scripts to analyse, visualise and interprete the results of these methods independently.

Teaching and Learning Methods:
Lectures to provide the students with the theoretical and practical concepts of state-of-the-art bioinformatics methods, which they will need to independently apply these methods on real-world data. In the exercises the students will apply these tools on concrete case studies and will implement custom Python scripts to analyze, visualize and interpret the results.

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 bioinformatics tools. Students implement various custom Python scripts (e.g. using Jupyter Notebooks) to analyze, visualize and interpret the results of these tools. Students work on real world problems to implement learnt skills and to gain confidence in applying these different methods independently.

Reading List:
Pevsner, J. (2017). Bioinformatics and functional genomics. Wiley Blackwell.

Responsible for Module:
Dominik Grimm

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

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

Interdisciplinary Electives | Fachübergreifende Wahlmodule

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

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 (Lecture) (Vorlesung, 2 SWS)
Faße A [L], Faße A, Ngassa C

Advanced Development Economics (Tutorial) (Übung, 2 SWS)
Faße A [L], Faße A, Ngassa C
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

SZ0301: German as a Foreign Language A1.1 | Deutsch als Fremdsprache A1.1

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:**
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:
1 schriftlicher End Term Test 90 min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Repeat Examination:

(Recommended) Prerequisites:

Content:
In this module, students acquire basic knowledge of the German language, including intercultural and regional aspects, that will enable them to express themselves in everyday situations, such as shopping, going to a restaurant, public transport etc.
Students learn and practice basic vocabulary on topics such as family, occupation, leisure time, food and living, plural noun forms, personal and demonstrative pronouns and simple forms of negation. They become familiar with numbers, prices and time, learn how to ask and answer simple questions about a person or family, as well as talk about matters of everyday life in simply structured sentences in the simple present.

Students learn different strategies for effective, self-motivated, independent learning. Students acquire teamwork skills through collaborative work in multinational mixed groups.

Intended Learning Outcomes:
The module is based on level A1 of GER.
Upon completion of this module, students are able to express themselves using everyday expressions and simple sentences. They are able to introduce themselves and other people, they can ask and answer simple questions about personal details, describe daily routines in a simple manner and provide information about themselves in writing in simple sentences.
Furthermore, students are able to communicate their wishes, if dialog partners are willing to help and to speak slowly and clearly.

Teaching and Learning Methods:
The module consists of a seminar covering material appropriate to desired learning outcomes and encompassing relevant listening, reading, writing and speaking exercises. These exercises may take the form of individual, partner or group work, implementing a communicative and activity-oriented approach. Students have the opportunity to deepen basic knowledge conveyed in the seminar through independent study and work, using specified (online) materials covering fundamental grammar and communication patterns of the foreign language.
Voluntary homework (preparation and follow-up work) reinforces classroom and structured learning.

Media:
Textbook; multimedia-based teaching and learning materials (black board, overheads, exercise sheets, image, film, etc.) also online

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Deutsch als Fremdsprache A1.1 (Seminar, 4 SWS)
Bakker S, Comparato G, Graf G, Gröbl J, Jennert J, Jokl H, Knappe A, Lechle K, Neumeier M, Pinskaia I, Pletschacher T, Rey-Adell B, Sabel B, Schlüter J, Schmidt-Bender S, Steidten R
For further information in this module, please click campus.tum.de or here.

Module Description

SZ0306: German as a Foreign Language B1.2 | Deutsch als Fremdsprache B1.2

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/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:
1 End Term Test 90 Min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Repeat Examination:

(Recommended) Prerequisites:
Gesicherte Kenntnisse der Stufe B1.1; Einstufungstest mit Ergebnis B1.2.

Content:
In this module, knowledge of German as a foreign language will be further developed, enabling students to express themselves in German independently and confidently in familiar situations, e.g. in the classroom, at work, in free time and with family, on topics of general interest, e.g. films, music, sports, etc, when standard German is spoken. Students develop an expanded spectrum of vocabulary, figures of speech and idioms, discussion patterns, understand and use a basic repertoire of logical main and subordinate clauses (temporal clauses, causal clauses, infinitive clauses, final clauses, consecutive clauses and relative clause), verbs and nouns and expand their use of prepositions. They review and develop elementary aspects of grammar, such as the use of tenses, prepositions, adjective declensions and comparatives. They examine specific features of

culture with regard to festivals and traditions, the educational system, the business world, lifestyles and leisure activities, and obtain insight into contemporary culture in Germany.

Intended Learning Outcomes:
The module refers to level B1 Independent Language Use of the CEFR. Students acquire knowledge of German as a foreign language at the standard language level with a focus on intercultural, cultural and academic aspects. Students obtain team competence through collaborative work in mixed, multinational groups. After completion of this module, students can make themselves understood in most situations likely to occur in the context of work, school and leisure, or while traveling in German-speaking regions. They can report on academic and business careers; describe plans and express hopes and wishes; make, accept or reject invitations; give advice and directions; express and discuss opinions. They can understand and summarize the general content of simple, authentic factual texts, literary texts, and radio and television programs and take part in spontaneous discussions on topics of general interest. Students can compose simple formal letters and longer personal letters and describe personal experiences. They can speak on everyday topics of personal interest in a structured fashion and produce a written text, taking a logically-defensible position on a current issue, when given assistance.

Teaching and Learning Methods:
The module consists of a seminar in which course objectives will be achieved in an activity-oriented, communicative atmosphere through listening, reading, writing and speaking exercises in individual, partner and group work. The fundamental language skills conveyed in the classroom are reinforced through the use of guided self-learning in the form of prepared (and online) materials. The basics of presenting and discussing everyday topics will be conveyed by means of the prescribed criteria and communicative patterns.

Media:
Textbook; multimedia teaching and learning materials (chalk/white board, overheads, worksheets, images, films, etc.) and online resources.

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Deutsch als Fremdsprache B1.2 (Seminar, 4 SWS)
Bauer-Hutz B, Lechle K, Niehaus B, Oelmayer J, Schlüter J, Schmidt-Bender S, Steidten R
For further information in this module, please click campus.tum.de or here.

Module Description

SZ0323: German as a Foreign Language B1.1 plus B1.2 | Deutsch als Fremdsprache B1.1 plus B1.2

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2019/20

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 150	**Contact Hours:** 90

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

Description of Examination Method:
1 End Term Test 90 Min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Repeat Examination:

(Recommended) Prerequisites:
Gesicherte Kenntnisse der Stufe A2.2; Einstufungstest mit Ergebnis B1.2

Content:
In diesem Modul werden Kenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller, landeskundlicher, und studienbezogener Aspekte erarbeitet, die es den Studierenden ermöglichen, sich in vertrauten Situationen, z.B. in Studium, Arbeit, Freizeit und Familie, und zu Themen von allgemeinem Interesse wie Film, Musik, Sport etc. selbständig und sicher in der Zielsprache zu verständigen, wenn Standardsprache verwendet wird.
Es werden Möglichkeiten aufgezeigt, den Lernprozess eigenverantwortlich effektiv zu gestalten und damit die eigene Lernfähigkeit zu verbessern.
Die Studierenden erarbeiten ein erweitertes Spektrum an Vokabular, Redewendungen und Dialogmustern, erfassen und benutzen ein grundlegendes Repertoire an logischen Haupt- und

Nebensatz-Strukturen (z.B. Temporalsatz, Kausalsatz, Infinitiv-Satz, Finalsatz, Konsekutivsatz, Relativsatz). Sie erarbeiten den Gebrauch reflexiver Verben sowie den Gebrauch von Verben und Nomen mit Präpositionalergänzung. Sie lernen/üben die Funktion und den Gebrauch des Konjunktiv II, des Futur I und des Passiv. Sie wiederholen und ergänzen elementare Aspekte der Grammatik wie den Gebrauch der Zeiten, der Präpositionen, der Deklination des Adjektivs und der Komparation.
Die Studierenden beschäftigen sich mit kulturspezifischen Besonderheiten, beispielsweise in Bezug auf Feste und Gebräuche, Ausbildungssysteme, Berufswelt, Lebensformen und Freizeitverhalten und gewinnen Einblicke in die zeitgenössischen Kulturszene Deutschlands.
Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Intended Learning Outcomes:
Das Modul orientiert sich am Niveau B1 des GER.
Nach Abschluss des Moduls sind die Studierenden in der Lage sich in den meisten Situationen, denen man in Studium oder Beruf, Freizeit und auf Reisen im Sprachgebiet begegnet, sicher zu verständigen. Er/Sie kann Aspekte des schulischen und beruflichen Werdegangs referieren, Pläne, Wünsche und Hoffnungen äußern, Einladungen aussprechen, annehmen oder ablehnen, Ratschläge und Anweisungen erteilen, Meinungen äußern und argumentieren.
Er/sie kann wesentliche Inhalte in einfachen, authentischen Sachtexten, Fernseh- oder Radiosendungen und literarischen Texten verstehen und wiedergeben und sich spontan an Gesprächen zu Themen von allgemeinem Interesse beteiligen. Er/Sie kann einfache formelle Briefe und längere persönliche Briefe verfassen und von persönlichen Erfahrungen berichten.
Er /Sie kann strukturiert zu einem alltäglichen Thema von persönlichem Interesse referieren und schriftlich eine logisch begründete Stellungnahme zu einem aktuellen Thema verfassen, wenn Hilfestellung gegeben wird.

Teaching and Learning Methods:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezielten Hör-, Lese-, Schreib- und Sprechübungen erarbeitet werden. Durch die Kombination dieser Übungen in Einzel-, Partner- und Gruppenarbeit wird der kommunikative und handlungsorientierte Ansatz umgesetzt. Durch kontrolliertes Revidieren der Grundgrammatik im Selbststudium mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Inhalte vertieft. Anhand vorgegebener Kriterien und Kommunikationsmuster werden Grundlagen des Referierens und des Diskutierens zu alltäglichen Themen vermittelt.

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

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Deutsch als Fremdsprache B1.1 plus B1.2 (Seminar, 6 SWS)
Hartkopf D, Kraut-Schindlbeck S, Stoephasius J
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

SZ1304: Hebrew A1.1 | Hebräisch A1.1

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 Abschlussklausur (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 Text- bzw. Leseverstehen sowie Aufgaben zur freien Textproduktion. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Repeat Examination:

(Recommended) Prerequisites:
keine

Content:
Der/die Studierende erlangt Grundkenntnisse in der Fremdsprache Hebräisch mit allgemeinsprachlicher Orientierung unter Berücksichtigung kultureller und landeskundlicher Aspekte. Es werden Kenntnisse vermittelt, die es den Studierenden ermöglichen sehr einfache Strukturen wiederzugeben.
Folgende Themen werden behandelt: Gespräche zum Kennenlernen, im Autobus, im Büro, zu Hause, am Telefon. Dazu werden die entsprechenden grammatikalischen Kenntnisse durchgenommen.

Intended Learning Outcomes:
Das Modul orientiert sich am Niveau A1.1 des GER. Nach Abschluss dieses Moduls sind die Studierenden in der Lage die hebräischen Schriftzeichen selbstständig zu lesen, zu schreiben und auszusprechen, hebräische Druck und Schreibschrift zu beherrschen, sehr einfache Fragen zu

vorgegebenen Themen (im Autobus, im Büro) zu beantworten, sehr einfache vorgegebene Sätze zu erkennen und wiederzugeben.

Teaching and Learning Methods:
Einzel-Partner- und Gruppenarbeit; Kontrolliertes Revidieren einzelner Aspekte der Grammatik mit vorgegebenen (online-) Materialien; Referieren und Präsentieren nach vorgegebenen Kriterien; moderierte (Rollen-) Diskussionen. Freiwillige Hausaufgaben zur Vor- und Nachbearbeitung festigen das Gelernte.

Media:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial

Reading List:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (wird in der LV bekannt gegeben)

Responsible for Module:
Christina Thunstedt

Courses (Type of course, Weekly hours per semester), Instructor:
Hebräisch A1.1 (Seminar, 2 SWS)
Ilia Manning I
For further information in this module, please click campus.tum.de or here.

Module Description

SZ1601: Dutch A1 | Niederländisch A1

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: summerterm 2019

Module Level: Bachelor/Master	**Language:** Language taught	**Duration:** one semester	**Frequency:** irregularly
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 Abschlussklausur (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 Text- bzw. Leseverstehen sowie Aufgaben zur freien Textproduktion. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen, die schriftlich beantwortet werden, überprüft.

Repeat Examination:

(Recommended) Prerequisites:
Keine Vorkenntnisse notwendig

Content:
In diesem Modul werden Grundkenntnisse, mündlich und schriftlich, in der Fremdsprache Niederländisch vermittelt, die den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden. Dabei werden interkulturelle und landeskundliche Aspekte berücksichtigt, die den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden. Dabei werden interkulturelle und landeskundliche Aspekte berücksichtigt. Die Studierenden lernen/ üben: z.B. Auskunft über die Wohnsituationen zu geben, den Tagesablauf zu beschreiben, über Gewohnheiten, Freizeit, Ausbildung und Arbeit zu sprechen und Wegbeschreibungen zu verstehen /geben.
Dazu werden u.a. folgende Themen der Grammatik behandelt und geübt: Nomen und Adjektive, Präsens, Perfekt und Präteritum, unregelmäßige Verben und Modalverben.

Es werden Strategien vermittelt, die eine Verständigung trotz noch geringer Sprachkenntnisse (in alltäglichen Grundsituationen) ermöglichen. Außerdem werden Möglichkeiten aufgezeigt, den Lernprozess in der Fremdsprache Niederländisch effektiver zu gestalten und die eigenen Lernfähigkeiten zu verbessern.

Intended Learning Outcomes:
Dieses Modul orientiert sich an Niveau "A1 Elementare Sprachverwendung" des GER. Nach der Teilnahme an der Modulveranstaltung sind die Studierenden in der Lage vertraute, alltägliche Ausdrücke und sehr einfache Sätze zu verstehen und zu verwenden, die auf die Befriedigung konkreter in der Bewältigung des Alltags wesentlicher Bedürfnisse zielen. Er/Sie kann sich und andere vorstellen und anderen Leuten Fragen zu ihrer Person stellen und auf Fragen dieser Art Antwort geben. Der/Die Studierende kann sich auf einfache Art verständigen, wenn die Gesprächspartnerinnen oder Gesprächspartner langsam und deutlich sprechen und bereit sind zu helfen.

Teaching and Learning Methods:
Kommunikatives und handlungsorientiertes Erarbeiten der Inhalte; gezielte Hör-, Lese-, Schreib- und Sprechübungen; Einzel-, Partner- und Gruppenarbeit; Förderung kooperatives Lernens; Kontrolliertes Selbstlernen grundlegender grammatischer Phänomene der Fremdsprache mit vorgegebenen Materialien. Freiwillige Hausaufgaben zur Vor- und Nachbearbeitung festigen das Gelernte.

Media:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Niederländisch A1 (Seminar, 2 SWS)
de Moes E
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

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

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)
Doblinger C [L], Martin C

Einführung in Beratung und Kommunikation (Vorlesung) (Vorlesung, 2 SWS)
Doblinger 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 (Übung) (Übung, 1 SWS)
Fröhling M [L], Potzler A

Angewandte Ethik zu Nachwachsenden Rohstoffen (Vorlesung) (Vorlesung, 1 SWS)
Fröhling M [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)
Goerg S [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

CS0015: Master's Thesis with Master's Colloquium | Master's Thesis with Master's Colloquium

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/summer semester
Credits:* 30	**Total Hours:** 900	**Self-study Hours:** 100	**Contact Hours:** 800

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) and the associated Master's Colloquium (60 minutes oral exam). The final grade consists of 5 parts of the grade of the Master's Thesis and one part of the grade of the Master's Colloquium.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
60 Credits in compulsory and elective mdoules of the master study course Chemical Biotechnology

Content:
consolidation of the knowledge of a specific biotechnological topic 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:
First, the results of the related scientific project planning presented in the Master's Colloquium will be discussed. 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:
Volker Sieber

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

CS0017: Regulation of Microbial Metabolism | Mikrobielle Stoffwechselregulation [MicriobReg]

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:** 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 learning results are to be proved in form of a written test (60 min). The students demonstrate that they know relevant mechanisms of metabolic regulation and that they have understood the basic connections of microbial metabolism and its regulation dealt with in the module and can apply and transfer the methods and techniques.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fundamentals of Microbiology and Molecular Biology from the Bachelor's courses

Content:
Relevant topics of metabolic regulation: i.a. catabolite repression, attenuation, autogenous regulation, endproduct inhibition, 2-component systems, quorum sensing, regulatory RNAs, stringent control, nitrogen regulation, iron homeostasis, phosphate regulation

Intended Learning Outcomes:
Upon successful completion of the module, students will be familiar with the principles and relevant mechanisms metabolic regulation. In addition, students are able to transfer the knowledge they have acquired in order to develop solutions to new problems.

Teaching and Learning Methods:
The contents of the lectures are conveyed by a talk of the lecturer, based on ppt-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. Learning methods: During the follow-up of the lecture, the students intensively deal with the teaching contents of the lecture.

Media:
PowerPoint, whiteboard

Reading List:

Responsible for Module:
Bastian Blombach

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

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

WZ1600: Physics | Physik [Phys]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2015/16

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

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

Description of Examination Method:
Achievement of desired learning objectives shall be verified in a written final exam (90 minutes). In this respect the students demonstrate that they know and understand the concepts of mechanics, thermal engineering, electricity and optics. By using specific physical issues (mainly computational tasks) the students demonstrate that they are able to also use acquired concepts in a solution-oriented way in simple cases.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Good A-level knowledge of mathematics

Content:
The module of physics provides an introduction into classical physics. The module introduces into the math-based approach of physics for nature description. The module outlines the basics of mechanics, thermal engineering, electricity and optics, makes them clear by means of examples and further practices them by self-employed work.

Intended Learning Outcomes:
The module serves to acquire physical basics. The students know and understand the basic concepts of mechanics, thermal engineering, electricity and optics and can apply these concepts in simple cases. So a solid basis is created for the course participants which is necessary to understand the subsequent content of teaching (e.g. thermodynamics, energy technology).

Teaching and Learning Methods:
Lecture (speech by teaching staff including writing on the board, PP media, books and other written material), exercise (self-employed work on exercises related to the topics of the lecture in small groups with tutors) for further practising of the concepts which were presented in the lecture.

Media:
Writing on the board, presentations, slide scripts

Reading List:
U. Harten: Physik, Einführung für Ingenieure und Naturwissenschaftler (Physics, Introduction for Engineers and Scientists), 4th edition 2009, Springer
Paul A. Tipler: Physik (Physics), Spektrum (Panoply), Akademischer Verlag Heidelberg, Berlin, Oxford

Responsible for Module:
Kainz, Josef; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Physik (Übung) (Übung, 2 SWS)
Kainz J [L], Härtl S, Kainz J, Lugauer F

Physik (Vorlesung) (Vorlesung, 2 SWS)
Kainz J [L], Kainz J
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 (Übung) (Übung, 2 SWS)
Grimm D [L], Grimm D

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

Module Description

WZ1611: Statistics | Statistik

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:
Learning outcomes shall be verified in a written test (120 min). Tasks shall be specified by means of which the students are to demonstrate that they know the statistical 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:
Qualification for university entrance: good mathematical knowledge is an advantage.

Content:
Selected statistical methods required for calculations in the scientific, engineering or economic field, especially from the field of descriptive statistics (e.g. Representation and description of distributions, indicators), calculus of probability as well as inductive statistics (e.g. confidence intervals, testing of hypotheses, regression analysis).

Intended Learning Outcomes:
The students know the most important statistical methods required for calculations in the scientific, engineering or economic field. They have understood this method and are able to select and perform suitable statistical procedures for specific case studies. Furthermore the students are able to understand statistics in technical literature (e.g. scientific journals).

Teaching and Learning Methods:
Lecture and associated exercise including independent processing of specific examples. Statistical methods shall be presented during the lecture. Within the scope of the exercise their application shall be practised based on specific case studies.

Media:
Lecture script, exercise sheets

Reading List:
Fahrmeir, Künstler, Pigeot, Tutz: Statistik - Der Weg zur Datenanalyse, Springer Verlag, ISBN: 978-3-642-01938-8; Kauermann, Küchehoff: Stichproben - Methoden und praktische Umsetzung mit R, Springer Verlag, ISBN: 978-3-642-12317-7

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

WZ1631: Bioinformatics | Bioinformatik

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 bioinformatic 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:
WZ1603/WZ1929 Biology
WZ1616/WZ1931 Biochemistry

Content:
Selected bioinformatic methods required for calculations in the scientific field, especially from the area of biological databases (e.g.NCBI, Swissprot), algorithms for sequence alignments (e.g. Needleman-Wunsch, Smith-Waterman, ClustalW, BLAST), phylogenetic reconstruction as well as methods from structural bioinformatics (e.g. Pymol, Docking). Methods shall be presented during the lecture. Within the scope of the exercise their application shall be practised based on specific case studies.

Intended Learning Outcomes:
The students know the most important bioinformatic methods and databases (e.g. NCBI, Swissprot, Needleman-Wunsch, Smith-Waterman, ClustalW, BLAST, Pymol, Docking) required for calculations in the scientific field. They have understood this method and are able to select and perform suitable bioinformatic procedures for specific case studies.

Teaching and Learning Methods:
Lecture and associated exercise including independent processing of specific examples. The contents mediated by the lecture are outlined in the tutorial by means of concrete bioinformatic examples.The bioinformatic methods and algorithms which are presented in the lecture are proved and applied for concrete problems self-contained at the computer.

Media:
The lecture shall mainly be done by using powerpoint presentations. Introduction into bioinformatic software tools shall be done by using the corresponding internet pages. During the exercise the students work at PCs to independently implement skills learnt and gain confidence in working with the corresponding media and programmes.

Reading List:
Selzer, Marhöfer, Rohwer, 2008: Applied Bioinformatics, Springer Verlag

Responsible for Module:
Grimm, Dominik; Prof. Dr.

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

Bioinformatik (Vorlesung) (Vorlesung, 2 SWS)
Grimm D [L], Grimm D
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], Able T, Chia-Leeson O, Hüsing T, Karl R, Laudage T, Riepl H, Urmann C

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

Module Description

WZ1923: Physical Chemistry | Physikalische Chemie [PhysChem]

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 learning results are going to be proved in form of a written test (120 min). The students solve physical/chemical arithmetic problems and answer questions for definitions or physical/chemical relations. They prove that they have understood the basic relations of physical chemistry that are highlighted within the scope of the module and can use the systems of equations. Calculators are allowed additives. Other additives can be permitted by the lecturer as needed.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
A-level student knowledge of mathematics (especially differentiation and integration) and physics

Content:
Basics of chemical thermodynamics: laws of thermodynamics, forms of energy (U, H, G, S), relations of formulas; chemical equilibrium and chemical reactions; properties of gases; phase transition of pure substances and multiphase systems; two component systems; selected boundary surface phenomena; basics of reaction kinetics

Intended Learning Outcomes:
After successful completion of the module the students know the laws of thermodynamics; they are able to make calculations concerning U, H, S and G; they understand phase diagrams of one and two component systems, can create charts and calculate the condition of equilibrium of simple systems; they can calculate with partial molar quantities in multi component systems; they can use ideal and real gas equations; they are able to form and solve equations related to the kinetics of chemical reactions and to determine the order of reactions;

Teaching and Learning Methods:
Teaching methods: in the lecture the teaching content is communicated by a talk of the lecturer, supported by PowerPoint and sketches on the blackboard in which the latter form is chosen to derivate complex relations. To a limited extent this can be completed for selected topics by self-study of the textbook by the students. 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. Learning methods: at the postprocessing of the lecture especially 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 physical-chemical relations and practise the usage of the systems of equations.

Media:
PowerPoint, whiteboard, exercise sheets, textbook, optional: script

Reading List:
Lehrbuch: P.W. Atkins, J. de Paula, Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013

Responsible for Module:
Schieder, Doris; Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Physikalische Chemie (Vorlesung) (Vorlesung, 2 SWS)
Plumeré N [L], Honacker J, Plumeré N, Schieder D

Physikalische Chemie (Übung) (Übung, 2 SWS)
Plumeré N [L], Honacker J, Schieder D
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

WZ1925: Practical Laboratory Course General Chemistry | Praktikum 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:** 60	**Contact Hours:** 90

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

Description of Examination Method:
Perfomance is going to be effected by a written protocol of the conducted lab experiments (for each experiment about 5 pages of protocol). In this protocol the students should prove their understanding of the structure of chemical compounds and aggregation states. In addition they should show that they understand chemical reactions and their thermodynamic and kinetic aspects. Furthermore should the students show that they are able to use lab instruments and equipment correctly for chemical experiments.

Repeat Examination:
End of 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 and experimental essays: Structure of compounds, acid / base equilibria, redox reactions, thermodynamics, reaction kinetics, selected reactions of inorganic chemistry.

Intended Learning Outcomes:
The students will know and understand chemical structures, aggregation states of compounds and the basic principles of chemical reactions. The students will get familiar with the practical work in chemical laboratories. They will be able to perform and formulate correctly chemical reactions, and experimentally determine thermodynamic and kinetic aspects of chemical reactions. The

successful participation in the module will enable the students to participate in the module of basic organic chemistry

Teaching and Learning Methods:
Laboratory experiments and equipment.

Media:
Laboratory equipment.

Reading List:
1) Practical Labor Script; 2) Theodore L., H. Eugene LeMay, Bruce E. Bursten, Chemie Studieren Kompakt, 10. aktualisierte Auflage, Pearson Verlag, München;

Responsible for Module:
Herbert Riepl (h.riepl@wz-straubing.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Labor-Praktikum
Allgemeine und anorganische Chemie
6 SWS
Herbert Riepl
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1926: Practical training in basic organic chemistry | Praktikum Grundlagen Organische Chemie [POC]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:** German	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 90	**Contact Hours:** 90

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

Description of Examination Method:
Attested experimental protocols (for each experiment about 5 pages of protocol). Data obtained from experimental work have to be evaluated and analyzed. If sufficient correlation with experimental results obtained by sample tests is obtained, the gained values are sufficiently analyzed and the experimental setup is correctly described, the respective experimental protocol is attested. In general, the practical training is attested, if 80% of all experimental protocols are approved.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic organic chemistry, inorganic chemistry

Content:
Boiling under reflux, crystalisation, distillation, isolation by succion, extraction with immiscible organic solvents, thin-layer-chromatography, column chromatography

Intended Learning Outcomes:
The students have obtained practical skills to perform reactions of the organic chemistry. By performing simple reactions, typical manual operations have been acquired. After completion of the practical course the students are able to correctly prepare, build up, conduct and document an experiment, to analyze the obtained result and to recognize possible causes of defaults.

Teaching and Learning Methods:
By own guided experimentation of students, use of chemicals and typical equipment is trained. Hereby manual skill and successful experimentation handicraft is obtained. About 10 experiments are conducted.

Media:
student teaching laboratory

Reading List:
H.G. Becker, Organikum, 21. Aufl., Wiley VCH

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

Courses (Type of course, Weekly hours per semester), Instructor:
Praktikum
Organisch chemisches Praktikum
6 SWS
Herbert Riepl
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1927: Instrumental analysis and spectroscopy | Instrumentelle Analytik und Spektroskopie

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:* 8	**Total Hours:** 240	**Self-study Hours:** 135	**Contact Hours:** 105

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

Description of Examination Method:
The module exam consists of two parts, part one is a written test (90 min) to control the knwoledge about the theoretical basics of all treated analysis methods as only a part of these methods is practised. The second part consists of the evalution of the written protocols of the performed laboratory experiments (for each experiment about 5 pages of protocol). In these protocols the students should prove the understanding of the applied analysis methods and the correct handling of the analysis equipment. Furthermore the students prove that they record the laboratory experiments correctly and that they question their results critically and check them for plausibility. It is essential to learn the analysis methods extensively in theory and to apply them partly in practice, therefore two test forms exist in this module.Weighting written test/ protocol evaluation: 2:1.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
In the module the basics of instrumental analysis are communicated. Thereby particular physicochemical characterization methods, basic principles of measurement and the setting of analysis instruments are disscussed in detail. In detail are these: optic/electricl/magnetic measuremnts, adsorption/desorption as basis for chromatopraphic techniques, adsorption/ desorption related to vibrational spectroscopy and UV/Vis spectroscopy, nuclear resonance spectroscopy, mass determination and spectrometry, scatter methods, atomic spectroscopy and

gas and high performance liquid chromatography. The handling of the received measuring results is explained by case studies.

Intended Learning Outcomes:
After visiting the required modul the students are able to select corresponding physicochemical analysis methods for underlying practical problems and to use these methods as needed. On the basis of the gained knowledge the students can analyse the obtained measuring results in a competent way.

Teaching and Learning Methods:
The theoretical basics of the experiments conducted in the practical course will be delivered in the lecture part via ppt-presentations, movies and white board. In the practical course, the students will self-reliantly perform, document and analyse their experiments.

Media:
presentation, script, cases and solutions lab and equipment

Reading List:
script, sample solutions for the exercises

Responsible for Module:
Zollfrank, Cordt; Prof. Dr. rer. silv.

Courses (Type of course, Weekly hours per semester), Instructor:
Instrumentelle Analytik und Spektroskopie (Übung) (Übung, 4 SWS)
Costa Riquelme R, Fernandez Cestau J, Fuenzalida Werner J, Riepl H, Rühmann B, Urmann C

Instrumentelle Analytik und Spektroskopie (Vorlesung) (Vorlesung, 3 SWS)
Zollfrank C [L], Costa Riquelme R, Fernandez Cestau J, Fuenzalida Werner J, Riepl H, Rühmann B, Urmann C
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1928: Advanced organic chemistry | Organische Chemie für Fortgeschrittene [AOC]

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 students are able to demonstrate thier understanding of chemical reactions concerned in this course in a written exam with formula equations (90 min). The students show their understanding of different classes of natural compounds in formula equations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
module basic organic chemistry

Content:
Fossil oil and natural gas as primary source, crack- und steam reforming reactions, technical olefin chemistry, technical aromatic chemistry, polyolefins, nitrogen containing organic intermediates, carboxylic acids and oxygen containing intermediates in polyester production. Chemistry of carbonyl compounds and carbohydrates.

Intended Learning Outcomes:
After successfully managing this module, the students are able to understand the chemical reactions of our fossil based chemical production. They can present product trees, based on side products or associated products. By this knowledge they can identify intermediates up to the ready polymer product. The students can apply typical reactions of different organic compounds.

Teaching and Learning Methods:
Lecture by academic teaching personell with PP-presentations, books, printed matter and others. Visit of production plants of nearby chemical industry to see typical industrial scale of reactions. 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 exspcecially 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 chemical reactions of our fossil based chemical production and practise the presentation of product trees.

Media:
Powerpoint presentations, whiteboard, printed text of teaching

Reading List:
K. Weissermel, H.J.Arpe, Industrial Organic Chemistry, 4. Auflage, VCH Weinheim

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

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

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

Module Description

WZ1929: Cell biology and microbiology | Zell- und Mikrobiologie [MiBi]

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:** 105	**Contact Hours:** 45

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

Description of Examination Method:
The learning results are proved in a written test in which the students are to call up and remember important principles of biology without using additives. In addition the students prove that they are able to recognize and solve a problem in a certain time by answering the comprehension questions on covered basic cell and microbiology processes. Answering questions requires mainly the use of own formulations thereby the correct recall of important technical terms is additionally reviewed. 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. Exam duration: 90 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Basics of cell biology (cellular structure (cell wall, plasma membrane, endomembrane system, nucleus), differences between prokaryotic and eukaryotic organisms, theoretical basics of microscopy, transport processes, genetic flow of informations and basics of molecular genetics (e.g. DNA structure, transcription, translation, DNA duplication), basics of biological taxonomy using the example of selected production organisms (e.g. E.coli, S.cerevisiae, algae, fungi), usage of microorgamisms in industrial biotechnolgy (e.g. ethanol fermentation, ABE fermentation, protein synthesis)

Intended Learning Outcomes:
After having participated in the module units the students possess basic knowledge about the structure and function of biomolecules. They know important elements of pro- and eukaryotic cells and can differentiate between these life forms. They know the basics of the genetic flow of informations and of the most important metabolic pathways and can grade bacteria, fungi and plants to higher-ranking systematic groups. After completion of the module the participants know different microorganisms, can describe their properties and understand basic cellular processes. Furthermore, the students can reflect biological terms, define processes and are able to use their knowledge to solve problems.

Teaching and Learning Methods:
The teaching contents are imparted by a talk of the lecturer, supported by PowerPoint and blackboard sketches.

Media:
PowerPoint, blackboard work

Reading List:
„Allgemeine Mikrobiologie“ von Georg Fuchs von Thieme, Stuttgart (Broschiert - 11. Oktober 2006)
"Brock Mikrobiologie" von Michael T. Madigan und John M. Martinko, Pearson, 11. Auflage (2008)
"Biologie" von Neil A. Campbell und Jane B. Rice, Pearson, 8. Auflage (2011)

Responsible for Module:
Erich Glawischnig (egl@wzw.tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Zell- und Mikrobiologie (Vorlesung, 3 SWS)
Glawischnig E [L], Glawischnig E
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1930: Practical course microbiology | Praktikum Mikrobiologie

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:* 6	**Total Hours:** 180	**Self-study Hours:** 105	**Contact Hours:** 75

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

Description of Examination Method:
The performance is effected by written protocols of the executed laboratory experiments ((for each experiment about 5 pages of protocol). With these protocols the students prove that they are able to unterstand the theoretical background of the experiments, to report their experimental procedure and to evaluate their results. Furthermore, they should show that they can discuss deviations of the expected results and possible reasons.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Module Cell and Microbiology

Content:
Microscopy, methods of colony isolation, colony count, differentiation of bacteria, isolation of microorganisms, identification methods for microorganisms, bacteriophages, growth behaviour of microorganisms

Intended Learning Outcomes:
After module participation the students are familiar with the execution of experiments in microbiological labs and able to use the mediated microbiological working techniques at least in main features. They handle aseptic techniques and can identify microorganisms. In addition, they possess a deeper understanding of the theories which underlie the experiments. Furthermore, the students can report laboratory experiments in a correct way and evaluate and analyse them by means of the theoretical backgrounds under guidance.

Teaching and Learning Methods:
Laboratory experiments in small groups (approx. 10 experiments) under guidance with previous introduction of the theory related to the particular experiments (lecture) as well as analysis of the results by experiment reports. Aspects related to safety issues in the laboratory are also covered in the lectures.

Media:
Practical course script

Reading List:
Practical course script

Responsible for Module:
Erich Glawischnig (egl@wzw.tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
Mikrobiologie
1 SWS

Praktikum
Mikrobiologisches Praktikum
4 SWS
Erich Glawischnig
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1931: Biochemistry | Biochemie [BC]

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:**	**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 proved in form of a written test (90 min exam duration). Based on questions to biochemical metabolic pathways and enzymology the students prove that they know the corresponding technical terms, designations and contents, that they have understand the basic relations and are able to apply their knowledge concerning the reactions taking place within the scope of kinetic and thermodynamic connections. For that purpose concrete computational tasks are assigned.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in the modules "Basic Organic Chemistry", "General Chemistry" and "Cell and Microbiology".

Content:
Enzymology: Within the module the students shall be introduced into basics of enzyme catalysis. In doing so theories relating to the course of enzymatic reactions, special aspects of kinetics and thermodynamics of enzyme-catalysed reactions, inhibition mechanisms as well as possibilities for calculating kinetic parameters shall be treated inter alia. Metabolism: Basic metabolic pathways such as glycolysis, citrate-cycle or gluconeogenesis shall be presented in the lecture. In doing so it is dealt with the general course of reaction cascades, thermodynamic aspects of energy generation as well as mechanisms of modulation of the individual paths.

Intended Learning Outcomes:
After sucessful completion of the module the students are able to describe and explain basic concepts, phenomenons and relations in the field of biochemistry. The students know important properties of proteins,understand the significance of kinetic parameters of enzymatic reactions and will be able to calculate them and apply to new issues (e.g. inhibition). Furthermore the students will be able to specify in detail basic metabolic pathways of the most important classes of substances, understand the particular steps and regulation systems of the respective paths.

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using powerpoint presentations and blackboard sketches. 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:
Presentations, powerpoint, presentation script, exercise sheets

Reading List:
- Voet, D. , Voet, J.G., Biochemistry 4th Edition, Wiley-VCH, 2011;
- Nelson, D.L, Cox, M.M., Lehninger Principles of Biochemistry 5th Edition, WH Freeman, 2008;
- Berg, J.M, Tymoczko, J.L., Stryer, L., Biochemistry 6th Edition, 2006

Responsible for Module:
Josef Sperl (josef.sperl@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Biochemie (Vorlesung) (Vorlesung, 2 SWS)
Al-Shameri A [L], Al-Shameri A

Biochemie (Übung) (Übung, 2 SWS)
Al-Shameri A [L], Al-Shameri A
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1932: Practical course biochemistry | Praktikum Biochemie [Pra BC]

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:* 6	**Total Hours:** 180	**Self-study Hours:** 90	**Contact Hours:** 90

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

Description of Examination Method:
The learning results are reviewed by a oral exam (30 min duration) in which the students show that they unterstand the theoretical background of the experiments. Furthermore they should be able to report and discuss the most important results of their practical experiments and answer corresponding questions. In addition, the students prove by correct execution of all laboratory experiments with correct recording (for each experiment about 5 pages of protocol) that they can use the imparted experimental working techniques and can accordingly document laboratory experiments (not graded course achievement).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Practical course microbiology

Content:
In the practical course commonly required basics for working in biochemical labs as well as special methods for separation and characterisation of molecules (amongst others ion exchange chromatography, size exclusion chromatogrpahie, thin-layer chromatography) are imparted. Furthermore, basic biochemical methods are imparted, especially the isolation of nucleic acids and proteins and their analysis by spectroscopy and gel electrophoresis as well as the analysis of enzyme-catalysed reactions.

Intended Learning Outcomes:
After module participation the students are familiar with the execution of experiments in biochemical labs and able to use the mediated experimental methods at least in main features.

In addition, they possess a deeper understanding of the theories which underlie the experiments. Furthermore, the students can report laboratory experiments in a correct way and evaluate and analyse them by means of the theoretical backgrounds under guidance. They can question their results critically and review them for plausibility.

Teaching and Learning Methods:
Laboratory experiments in small groups under guidance with previous introduction of the theory related to the particular experiments as well as analysis of the results by experiment reports. The students practice in excercises how to document and analyse experiments based on given case studies. The acquired skills are then applied by documenting and analysing own results. The students will conduct approx. 12 experiments.

Media:
Practical course script, PowerPoint presentations, blackboard sketch, lab, lab equipment

Reading List:
Practical course script

Responsible for Module:
Josef Sperl (josef.sperl@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Praktikum Biochemie (Übung) (Übung, 2 SWS)
Beer B, Hupfeld E

Praktikum Biochemie (Praktikum, 4 SWS)
Beer B, Hupfeld E
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1933: Molecular biology and genetics | Molekularbiologie und Gentechnik

TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)

Version of module description: winterterm 2017/18

Module Level: Bachelor	**Language:** German	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 150	**Contact Hours:** 90

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

Description of Examination Method:
The performance of the exam consists of a written test (90 min) in which the students show that they are able to call up and structure their theoretical and practical knowledge and use it on problems. 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. By creating written protocols of the executed laboratory experiments (for each experiment about 5 pages of protocol), the students prove that they can documentate and illustrate theoretical principles as well as the results and the corresponding analysis and assessment of the experiments (not graded course achievement).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Module Biochemistry and module Practical course biochemistry

Content:
molecular structure of DNA, plasmids, bacteriophages, mutagenesis strategies, bacterial genomes, prokarotic gene regulation, transformation of organisms, genetic engineering, genetic engineering regulation, genome editing, cloning of DNA fragments, heterologous gene expression, analysis methods for DNA, RNA and proteins

Intended Learning Outcomes:
After completion of the modul the students possess knowledge about the most important molecular biological methods. They know how to isolate, analyse and manipulate nucleic acids and possess knowledge about the transformation of microorganisms. They understand what a genetically

engineered organism is and can assess the risks and benefits of genetic engineering experiments. The students can perform and analyse molecular biological experiments and name possible sources of error.

Teaching and Learning Methods:
The theoretical basics of the experiments conducted in the practical course will be delivered in the lecture part via ppt-presentations, movies and white board. In the practical course, the students will self-reliantly perform, document and analyse their experiments.

Media:
PowerPoint, blackboard work, practical course script

Reading List:
Molekulare Genetik: Knippers, ISBN: 987-3-13-477009-4, Bioanalytik: Lottspeich, ISBN: 978-3827400413, script

Responsible for Module:
Blombach, Bastian; Prof. Dr. rer. nat.

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

Module Description

WZ1934: Enzymes and their reactions | Enzyme und ihre Reaktionen

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 learning results are proved in form of a written test (90 min exam duration). Based on questions to biochemical metabolic pathways and enzymology the students prove that they know the corresponding technical terms, designations and contents, that they have understand the basic relations and are able to apply their knowledge concerning the reactions taking place within the scope of kinetic and thermodynamic connections. For that purpose concrete computational tasks are assigned.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in the modules "Basic Organic Chemistry", "General Chemistry" and "Cell and Microbiology".

Content:
The course should give a broad overview of enzyme classes (oxidoreductases, isomerases, hydrolases, lyases, transferases and ligases) and of enzyme-catalysed reactions. Thereby different reaction mechanisms are examined from a chemical point of view and hence the usage of enzymes in simple chemical implementations and technical fields is derived and comprehensively illustrated. The role of complex cofactors (radical forming, redox-active, electron switching, ion stabilisating and so on) is introduced and hence the limitations of enzyme reaction are worked out. With data bases of enzyme reactions and thermodynamic dimensions (e.g. from the theory of group contribution methods) target compounds of enzyme reactions especially in the field of renewables utilization are made accessible.

Intended Learning Outcomes:
After sucessful completion of the module the students know and understand enzyme-catalysed chemical reactions. Based on this knowledge the students are able to design single- and multi-stage enzymatic processes and to evaluate them by means of thermodynamic and kinetic reaction data.

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using powerpoint presentations, blackboard sketches and working on data bases. 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:
Presentations, PowerPonit, lecture script, exercise sheets, computer based work and enzyme reaction data bases

Reading List:
Voet, D. , Voet, J.G., Biochemistry 4th Edition, Wiley-VCH, 2011; Perry A. Frey und Adrian D. Hegeman, Enzymatic Reaction Mechanisms, Oxford Univ Press, 2006; Reinhard Renneberg, Darja Süßbier, Biotechnologie für Einsteiger, 3. Auflage, Spektrum Verlag Heidelberg 2010; A. Liese, K. Seelbach, C. Wandrey, Industrial Biotransformations, Wiley-VCH, 2006

Responsible for Module:
Sieber, Volker; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
Enzyme und ihre Reaktionen
2 SWS

Übung
Enzyme und ihre Reaktionen
2 SWS
Volker Sieber
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

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

WZ1939: Practical course Process Engineering | Praktikum Allgemeine Verfahrenstechnik [PVT]

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:** 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 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 and thermal process technology, Technical Thermodynamics, Chemical Thermodynamics and Mass Transport

Content:
Basic operations of process engineering, especially from the chemical, thermal and mechanic range e.g. destillation or particle distribution analysis.The content and the number of experiments are chosen from a of multiplicity of basic operations and rely on the available laboratory equipment.

Intended Learning Outcomes:
After graduation of the practical course, the students know basic processes and principles of process engineering (e.g. destillation, extraction, desiccation or particle distribution analysis and

separation from a gas flow). 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.

Media:
Practical course script, laboratory equipment

Reading List:
Practical course script

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

Courses (Type of course, Weekly hours per semester), Instructor:
Praktikum Verfahrenstechnik I (Praktikum, 5 SWS)
Burger J [L], Baumeister E, Burger J, Göttl Q, Wolf C
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

WZ1941: Practical course Bioprocess Engineering | Praktikum Bioverfahrenstechnik [PCBPE]

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:** 75	**Contact Hours:** 75

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, records of the different experiments have to be handed in (for each experiment about 5 pages of record). Data obtained from experimental work have to be evaluated and analyzed. If sufficient correlation with experimental results obtained by sample tests is obtained, the gained values are sufficiently analyzed and the experimental setup is correctly described, the respective experimental protocol is attested. In general, the practical training is attested, if at least 65% of all experimental protocols are approved.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
The practical course provides deepened insights of the lecture of bioprocess engineering which will be achieved by experimental confirmtion of the theretical content.This includes the analysis of typical parameters such as 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 trasnfer will be conducted. Additionally, basic operation unit design as well as scale-up aspects will be experimental analysed.

Intended Learning Outcomes:
The students acquire detailed and differentiated knowledge about concepts, calculations and the general design of various bioprocesses to optimize the processes. Additionally, they will be able to transfer these results on more complex or specific challenges.

Teaching and Learning Methods:
The practical course is based on defined experiments on the topics of: fermentation, mixing and stirring, oxygen transfer, calculation and characterization of tube flows. Main aim is the evokening of problem oriented thinkinig of the students by encouranging selfemployed working methods. Based on data aquisition the process technological characteristics are calculated and evaluated.

Media:
PowerPoint, short films, scipts, 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

WZ1942: Process Design Project | Anlagenprojektierung

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:** 60	**Contact Hours:** 90

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

Description of Examination Method:
The exam performance consists of a project planning in the group and preparation of a group presentation of the main results of the project treatment in the group that records the assignment of tasks, the detailed course of action of the students and the calculation as well as the beyond obtained results. The presentation shows whether the students have learned all the steps which belong to the design of a technical process. The completion of the project work constitutes of a short presentation (15 min) of the students.Thereby the presentation is performed to the other participants of the module (not graded course achievement).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Chemical and thermal process technology, Technical Thermodynamics, Chemical Thermodynamics and Mass Transport

Content:
The content consists of a project work in basic engineering and the corresponding design of a exemplary process or of parts of the process, the usage of calculation tools (like Excel, Mathcad), the examination of profitability and of the basics of project management in line with the teamwork.

Intended Learning Outcomes:
After completion of the module the students know how to approach the planning of a technical assignment of tasks. They are able to acquire required informations, to dimension the system in a correct way and examinate its profitability. So the students can design technical processes. Thereby the reference to real design is laid and the students are able to apply basic work steps.

Teaching and Learning Methods:
The groups are tackled with a design task which can be solved by a correct information search and execution of sub-steps. The formulation of solution(s) is carried out in groups consisting of 2 to 4 students. The lecturers support this learning process by continuous interaction. Thereby the knowledge is intensified in supervised teamworks whereby the expertise is clearly strengthened.

Media:

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.

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