Module Catalog

M.Sc. Biomass Technology

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 705

Compulsory Modules | Pflichtmodule

Introduction to Renewables Utilization | Einführung in die stoffliche Nutzung

Corresponding Modules BOKU Vienna | Entsprechende Veranstaltungen BOKU Wien

Module Description

CS0156BOK: Chemistry and Technology of Sustainable Resources | Chemistry and Technology of Sustainable Resources

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** English	**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:

(Recommended) Prerequisites:
basic chemistry

Content:
Monosaccharides, Oligosaccharides, Cellulose, Cellulose derivatives, Starch

Lignin: Basic building blocks, Biosynthesis, Analytical methods for Lignin characterization,

Basic concepts of reactivity (carbohydrates and lignin)

Pulping, Bleaching: General Overview, History of paper making

Chlorine based bleaching, Oxygen based bleaching, bleaching technologies and basic reactions of wood components,

alternative bleaching methods (LMS, POM, PAA).

Fiber production: Viscose and Tencel process - basic chemical reactions and technological principles, side reactions.

Cellulose Derivatives: cellulose acetate, carboxymethyl cellulose, methyl cellulose - preparation and application

Aging and Degradation: Basic reactions of cellulose degradation, mass-deacidification methods

Intended Learning Outcomes:
Chemistry and basic technology of sustainable resources, mainly based on wood components are covered.

Teaching and Learning Methods:
multimedia-supported
lectures are via ZOOM online

Media:

Reading List:
Ek et al. (Eds). Pulp and Paper Chemistry and Technology Vol. 1-4, De Gryuter
Fengel and Wegener "Wood",
Klemm et al., Cellulose and cellulose derivatives"
H. Sixta, Handbook of Pulp
Holik, Handbook of Paper and Board
J. Lehmann, Kohlenhydrate

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

CS0189BOK: Post-harvest Technology | Post-harvest Technology

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** English	**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
Due to the corona situation, the exam takes place as an online exam. The mark results from the evaluation of the written exam. The mark of the lecture will be derived from the reached percentage of the points as followed. 90 – 100 % = 1 78 – 89 % = 2 66 – 77 % = 3 55 – 65 % = 4 0 – 54 % = 5 (failed) Duration of the written examination = 60min. The examiner reserves the right to make oral inquiries about the subject of the examination within the four-week assessment period. For the written exam you can bring calculator, ruler, and the formulary supplied on the bokulearn plattform.The use of any other tools and documents during the online exam is not permitted - this also applies to files on your computer! Please only do the online test using a PC! A working web-camera and a working microphone are required to participate!

Repeat Examination:

(Recommended) Prerequisites:

Content:
Importance of post-harvest technology for the food chain

Biological and physical principles of post harvest technology

Selected post harvest technologies in agriculture:

Treatment of seed (drying, cleaning, sieving,?)

Alternative methods of seed treatments (warm-humid, microwave, high frequency energy)

Drying technology (principles and application; Ddying of agricultural products)

Crop conservation with silage making (principles and processes)

Storage of crops (potato, fruit, vegetable,?); Principles and applications

Special post-harvest technologies in horticulture and viticulture

Intended Learning Outcomes:
Understanding of biological and physical properties of harvested crops and their comprehension

Qualification for systematic analyses of post harvest technology

Qualification for planning of post harvest technology

Evaluation of post-harvest technologies on engineering fundamentals as well as ecological and economic aspects.

Teaching and Learning Methods:
interactive lecture

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

WZ9428BOK: Technology of Wood Processing | Technologien der Holzverarbeitung

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 1	**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
oral examination

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Characterization of the raw material Wood (grading etc.) and principles of converting the raw material wood into a material and wood-base products. Principles of slicing, sawing, milling, chipping etc. drying and glueing.

Intended Learning Outcomes:
Understanding of the relationship of wood as a raw material and the wood-based materials and products along the process chain wood and the approbiate technologies. Knowlegde of the most common wood based materials, their properties and potential applications incl. relevant Standards.

Teaching and Learning Methods:
Vorlesung interaktiv mit Studierenden

Media:

Reading List:
Wagenführ, A., Scholz, F., Taschenbuch der Holztechnik. Fachbuchverlag Leipzig, Leipzig 2005
Fellner, J., Teischinger, A., Zschokke, W.: Holzsprektrum. proHolz Austria, Wien 2007

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (1 ECTS)
Technologien der Holzverarbeitung (LV-Nr. 891330)
1 SWS
Alfred Teischinger

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

Compulsory Modules TUM | Pflichtmodule der TUM

Module Description

CS0101: Renewables Utilization | Renewables Utilization

Version of module description: Gültig ab 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:
Rühmann, Broder; Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Renewables Utilization (Exercise) (Übung, 2 SWS)
Rühmann B

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

Module Description

CS0156: Material Application for Renewable Resources | Material Application for Renewable Resources

Version of module description: Gültig ab summerterm 2024

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:
During the seminar, students independently work on a selected topic from the field of biobased materials and give an oral presentation with PowerPoint-handout (min. 10 slides). Group work is compulsory (3 – 5 persons). The students will implement their own online survey and present the findings in the context of the relevant literature in the presentation (each student has to present 5 minutes). The oral presentation shall be assessed according to content of the PowerPoint-handout and rhetoric aspects. The PowerPoint-handout summarizes the relevant literature, data, and key findings. Weighting: PowerPoint-handout 1, oral presentation 1.
The seminar work is not part of the written exam. However, midterm bonus points can be achieved which will have an effect on the individual final grade (-0,3).

Assessment requires a written examination (90 minutes). Students demonstrate their knowledge of physico-chemical properties and possible applications of biobased materials, as well as their environmental impact. Students are able to develop options for chemical synthesis and production processes of biobased plastics. No further tools are allowed in the examination.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in "Basics in chemistry " and “Biogenic Polymers”, as well as knowledge of materials and chemical compounds, or comparable knowledge of chemistry and physics.

Content:
Lectures give an overview the applications for biogenic resources in materials industry. Starting with the chemical composition and physic-chemical properties of the raw materials, the module introduces students to production and processing of biodegradable and non-biodegradable

bioplastics, as well as of natural fibre composites. It also covers material properties, relevant fields of application, their environmental impact, as well as current market trends.
In the seminar, students independently work on research papers and based on that, give a presentation to fellow students.

Intended Learning Outcomes:
After successful participation, students are able to assess opportunities and barriers for the application of biobased plastics, as well as their environmental impact compared to conventional plastics. Above all, they are competent to select suitable feedstocks, classes and types of materials, as well as processes to meet the technical requirements of a specific target product, having lower environmental impact at the same time.

Teaching and Learning Methods:
Lecture (talks using PowerPoint slide media, books and additional written material), seminar (independent work on a selected topic with subsequent presentation, peer instruction and constructive feedback).

Media:
Presentations, slide notes

Reading List:
Endres, H.J., Seibert-Raths, A., Technische Biopolymere, Carl Hanser Verlag, München, 2009
Pickering, K. L. (Hrsg.): Properties and performance of natural-fibre composites, CRC Press, Boca Raton 2008
Lewin, M.(Hrsg.): Handbook of Fibre Chemistry, Marcel Dekker, New York, 1998

Responsible for Module:
Fink, Bettina; Dr. rer. nat.

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

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

Introduction Energy Conversion and Energy Economics | Einführung Energiewandlung & Energiewirtschaft

Corresponding Modules BOKU Vienna | Entsprechende Veranstaltungen BOKU Wien

Module Description

WZ9423BOK: Energy Economics | Energiewirtschaft

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
Written

Repeat Examination:

(Recommended) Prerequisites:

Content:
Overview about the energy ecenomy. General points of view for the treatment of problems of energy economics. General introduction in circle processes for the production of electric energy, power plants for production of heat and electric energy, combustion of fossil and renewable fuels, technology of combustion and vessels, emissions by combustion.

Energy use in industry. Efficient energy conversion and utilization. Optimization of heating and cooling processes. Problems of optimisation in the energy economy. Calculation of costs in the energy-technology. Energy controlling in industry and trade.

Intended Learning Outcomes:
Basic knowledge about facts and contexts in the energy economy should be arranged. Furthermore an introduction is given in methods, that are absolutely necessary to the judgment

of processes of energy economy. In the course some procedures are expounded to estimate the economic conditions of processes in energy technology.

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

WZ9454BOK: Energy Economics and Politics | Energiewirtschaftspolitik

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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:
The assessment consists of three parts. Students have to pass a test, write a seminar paper and review and present the paper of a fellow student. To allow for a trouble free review by other students, a draft version of the seminar paper has to be handed in on a certain deadline announced during the lecture.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Natural and technical basics of energy economics
Energy demand and supply
Energy markets (oil, gas, electricity)
External cost of energy production and the role of renewable energies
Energy policy instruments with special focus on environmental policies (e.g. Pigou tax, emission trading)

Intended Learning Outcomes:
Rising population numbers and increasing living standards boost the worldwide energy demand. Energy producers face the challenge to increase their energy supply and simultaneously reduce negative environmental impacts of energy production. Participants gain a basic understanding of energy demand and supply and of the particularities of energy markets. They will also learn to assess the effects of energy policies on energy markets.

Teaching and Learning Methods:
The first units are dedicated to an introduction to energy economics. In the second part students present the seminar papers of fellow students.

Media:

Reading List:
Erdmann, G., Zweifel, P. (2007) Energieökonomik - Theorie und Anwendungen, Berlin Heidelberg: Springer

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Seminar (3 ECTS)
Energiewirtschaftspolitik (LV-Nr. 731322)
2 SWS
Johannes Schmidt

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

Module Description

WZ9455BOK: Biorefinery and Products from Renewable Resources | Bioraffinerie und Produkte aus nachwachsenden Rohstoffen

Version of module description: Gültig ab 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

Content:
Biorefinery is a concept towards processing biomass to a variety of products. These products may range from materials, base and fine chemicals, to energy such as gasoline, electrical power or heat. In this lecture the broad range of utilizations of renewable resources are demonstrated, also to introduce main focul points of the german-taught master study "Material and energetic use of renewable resources (NAWARO)" (H 066 471).

Intended Learning Outcomes:
Knowledge on major renewable ressources, including oils, fats, proteins, and carbohydrates. Knowledge on major areas taught in the master study "Material and energetic use of renewable resources (NAWARO)" (H 066 471). Be able to report on different material and energetic uses derived from renewable resources. Ability to give definitions and delineations around "renewable resources".

Teaching and Learning Methods:
class lecture
Introductory lectures by persons who are also engaged with the "Material and energetic use of renewable resources" (NAWARO)" study

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Bioraffinerie und Produkte aus nachwachsenden Rohstoffen (LV-Nr. 970308)
1 SWS
Rupert Wimmer, Alexander Bauer, Sabine Baumgartner, Stefan Böhmdorfer, Andreas Gronauer, Georg Gübitz, Miriam Lettner, Markus Neureiter, Christoph Pfeifer, Tobias Pröll

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

Compulsory Modules TUM | Pflichtmodule der TUM

Module Description

CS0260: Energy and Economics | Energy and Economics [EUW]

Version of module description: Gültig ab summerterm 2022

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

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

Description of Examination Method:
The examination will take the form of a written test (60 minutes). The students prove that they can understand and answer questions and the connections between the energy conversion, the conversion of renewable raw materials, the energy supply in general and the current energy-political and economic situation. Group work can be included and be part of the exam.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prior participation and passing of the fundamentals of Thermodynamics module is required for participation in the Energy and Economics module.

Content:
The module deals with the basics of energy sources, climate change and the technology of the heat, electricity and fuel market and the use of renewable raw materials, including an introduction to simple technical systems and current topics on the energy industry. It also deals with electricity trading, CO2 trading and the current situation of various energy technologies.
In exercises small examples are calculated to the economy (production costs of heat and power of plants (e.g. combined heat and power plants).

Intended Learning Outcomes:
By participating in the module, students will be able to understand the energy sources and simple principles of energy conversion into heat and electricity. They can perform simple economic assessments of energy systems and understand related market mechanisms of the electricity and heat market.

Teaching and Learning Methods:
The module consists of a lecture with exercises. The contents of the lecture are conveyed in the lecture and through presentations.

Media:
Presentations, exercise

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

Responsible for Module:
Gaderer, Matthias; 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

WZ1664: Energy Storage | Energy Storage

Version of module description: Gültig ab winterterm 2021/22

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamic, basic but profound knowledge in physics

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

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

Teaching and Learning Methods:
The module consists of a lecture course with integrated practical elements. The lecture's content are mediated by the instructor's presentation and exercise examples. By solving given tasks at

home and if necessary students presentations the acquired knowledge is consodiated. The writing of the term paper is also a means of consolidation.

Media:
Powerpoint, whiteboard, exercise sheets

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

Responsible for Module:
Matthias Gaderer

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

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

Introduction to Economics of Renewable Resources | Einführung in die Ökonomie nachwachsender Rohstoffe

Corresponding Modules BOKU Vienna | Entsprechende Veranstaltungen BOKU Wien

Module Description

WZ9456BOK: Computer Simulation in Energy and Resource Economics | Computer Simulation in Energy and Resource Economics

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer semester
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:
Weekly Assignments (50% of points)
Final oral examination (50% of points)
Extra points in the human-zombie deathmatch

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Bubbles and crashes on energy and resource markets, and complex, non-fully rational human behaviour pose serious problems to traditional economic modeling techniques. This course introduces the students to the concept of complex systems and the method of agent based modeling: both, the concept as well as the method, are highly relevant when trying to explain the above mentioned economic phenomena. This course gives an introduction to complex systems in economics, teaches students how to apply agent based modelling in the context of electricity markets - and tries to shed light on the question how a zombie outbreak may be best survived. Economic agents that show bounded rationality or strategic behavior and markets that are out of equilibrium pose serious problems to traditional economic modeling techniques.

This course introduces the students to the concept of agent based modeling which allows addressing these issues.

After presenting general agent based models in economics, we focus mainly on modeling the design of electricity markets.

Intended Learning Outcomes:
The students learn to understand the concept of complex systems and how the concept may be applied to agent based modeling. They get to know important agent based models from various disciplines (economy, sociology, biology) and learn how to apply them appropriately. Students will also learn how to implement, verify and validate basic agent based models in the programming language NetLogo.

Teaching and Learning Methods:
The course is split into a lecture part which introduces students to the basic theoretical background, a practical part in the computer room, where students learn to program in Netlogo, and weekly assignments for self-study at home.

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Lecture/Seminar (3 ECTS)
Computer simulation in energy and resource economics (LV-Nr. 731369)
2 SWS
Johannes Schmidt

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

Module Description

WZ9457BOK: Modeling of Techno-economical Processes | Modellierung technoökonomischer Prozesse

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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 exam and successful exercise units

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
basic knowledge in computing

Content:
In this course, possibilities for modeling technologically relevant problems within industrial manufacturing processes are elaborated. Multivariate correlations that occur within industrial manufacturing processes, impede the usage of simple analytical software packages. Thus, more sophisticated programs are needed for analyzing increasingly complex problems. In especially, tools for modeling and simulation in MATLAB are presented and applied in the exercising units.

Course structure:
- process analysis (plausibility check of technologically relevant correlations and collected data)
- data acquisition
- data management
- evaluating data quality
- considering time lags (static and dynamic simulation of the material flow)
- model calibration (using multivariate statistical approaches)
- model validation
- model application (prediction of technological properties)
- process adaptation and failure detection

Intended Learning Outcomes:
Students are able to evaluate data quality, detect multivariate correlations, consider time lags using material flows and statistically optimize processes with respect to economically relevant factors.

Teaching and Learning Methods:
Lecture with exercises

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (2 ECTS)
Modellierung Technoökonomischer Prozesse (LV-Nr. 734334)
2 SWS
Martin Riegler

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

Compulsory Modules TUM | Pflichtmodule der TUM

Module Description

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

Version of module description: Gültig ab winterterm 2023/24

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:
End of Semester

(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

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

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

Module Description

WZ1103: Introduction to Economics of Renewable Resources | Einführung in die Ökonomie Nachwachsender Rohstoffe

Version of module description: Gültig ab winterterm 2021/22

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:
Die Prüfungsleistung wird in Form einer schriftlichen Klausur (120 Minuten) erbracht. In dieser soll nachgewiesen werden, dass in begrenzter Zeit und ohne Hilfsmittel ökonomische Zusammenhänge bei der Verwendung Nachwachsender Rohstoffe verstanden worden sind und im Zusammenhang mit einzelbetrieblichen Maßnahmen analysiert und weiterentwickelt werden können. Auch wird mittels der Klausur überprüft, inwieweit die Studierenden die verschiedenen Märkte nachwachsender Rohstoffe charakterisieren und mögliche Lösungswege für die stoffliche und energetische Nutzung aufzeigen können.
Der Teilbereich "Ökonomie Nachwachsender Rohstoffe" geht mit 65 % und der Teilbereich "Märkte Nachwachsender Rohstoffe" mit 35 % in die Gesamtnote ein.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Die Vorlesung gliedert sich in 3 Teilbereiche auf. Diese sind inhaltlich weitgehend voneinander unabhängig, thematisieren aber verschiedene Facetten der Ökonomie von Nachwachsenden Rohstoffen.
1. Vorlesung Ökonomie Nachwachsender Rohstoffe
Einführung in die Grundlagen der Ökonomie anhand ausgewählter Konversionspfade auf der Basis Nachwachsender Rohstoffe von Standortentscheidungen über die Beschaffung und Logistik, Produktion, zwischenbetrieblichen Verbindungen bis zur externen Berichterstattung
2. Übung zur Ökonomie Nachwachsender Rohstoffe

Die fachlichen Inhalte der Vorlesung werden anhand von Fallbeispielen analysiert und kritisch bewertet, so dass die Teilnehmer die Inhalte in ihrer späteren beruflichen Tätigkeit eigenständig weiterentwickeln können.
3. Vorlesung Märkte Nachwachsender Rohstoffe
Darstellung verschiedener Märkte der Nachwachsenden Rohstoffe. Diese sind aufgeteilt in die stoffliche Nutzung (Bioschmierstoffe, Werkstoffe, chemische Grundstoffe und Feinchemikalien) und in die energetische Nutzung (Wärme, Elektrizität und Mobilität)

Intended Learning Outcomes:
Nach der Teilnahme an der Modulveranstaltung können die Studierenden die ökonomischen Grundlagen der Verwendung Nachwachsender Rohstoffe differenziert anwenden und die Wirtschaftlichkeit anhand von einzelbetrieblichen Fallbeispielen analysieren und bewerten. Des Weiteren sind sie in der Lage, die betriebs- und marktwirtschaftlichen Zusammenhänge bei der Verwertung Nachwachsender Rohstoffe kritisch zu beurteilen und aktuelle Entwicklungen dabei einzubeziehen. Darüber hinaus können die Studierenden die verschiedenen Vermarktungsformen und Marktgrößen von Nachwachsenden Rohstoffen einschätzen und vergleichend kombinieren.

Teaching and L o f b] mf

Management of Renewable Resources (Lecture) (Vorlesung, 1,5 SWS)
Röder H [L], Pokholkova M, Röder H
For further information in this module, please click campus.tum.de or here.

Life Cycle Assessment of Renewable Resources | Ökobilanzierung nachwachsender Rohstoffe

Corresponding Modules BOKU Vienna | Entsprechende Veranstaltungen BOKU Wien

Module Description

WZ9460BOK: Life Cycle Assessment of Renewable Resources | Life Cycle Assessment nachwachsender Rohstoffe

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**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 exam (60% of the Mark)
two working assignments (40% of the Mark)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Life cycle analysis
Energy efficiency
Environmental performance concept

Intended Learning Outcomes:
To learn about chances, risks and effects of new technologies

Teaching and Learning Methods:
Lecture
Practice with software

Joint preparation of application examples
Independent processing of simple projects

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (4 ECTS)
Life cycle assessment nachwachsender Rohstoffe (LV-Nr. 915326)
3 SWS
Andreas Gronauer; Martin Kühmaier, Gerhard Piringer, Karl Stampfer

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

Compulsory Modules TUM | Pflichtmodule der TUM

Module Description

CS0184: Advanced Sustainability and Life Cycle Assessment | Advanced Sustainability and Life Cycle Assessment

Version of module description: Gültig ab winterterm 2023/24

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:
Written exam (90 minutes): Students have to solve problems from the thematic field of the module. They have to prove their ability to use the right vocabulary, apply their knowledge on advanced topics in life cycle and systems thinking, sustainability and and life cycle assessment. Learning aids: pocket calculator.

Alternative: For small groups (<15 students) parts of the exam can be held in case studies which have to be solved in a group. Thereby the students have to prove through the solution of an advanced problem that they are capable to apply methods and approaches of sustainability and life cycle assessment to emerging topics from the field. Weighting: 1:1.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
-

Content:
The module contains units covering the following topics:
• Systems and life cycle thinking
• LCA following the ISO 14040/14044 and ILCD standards
• Extension of Life Cycle Assessment to Life Cycle Sustainability Assessments
• Advanced Life Cycle Impact Assessment Methods such as for
- Land use and land use change
- Water use

- Resource use
• Attributional and consequential assessments
• Regionalisation of inventories and impact assessments
• Hybrid approaches
• Uncertainty handling
• Interface with Multi Criteria Decision Analysis
• Presentation and visualisation of results
• Handling of data uncertainty
• Current trends and developments
• Software systems and data bases for material flow analysis and life cycle assessment
• Case studies

Intended Learning Outcomes:
The students use advanced concepts and tools of sustainability and life cycle assessment to assess products, services and processesregarding their environmental impacts. Thus, they are able to gain a deeper understanding of their underlying material and energy flows and how they impact the environment. With these competencies development and improvement of systems, products and services can be supported, decision support delivered and communication with stakeholders aided.

Teaching and Learning Methods:
Format: lecture and (computer-based) exercises to introduce the content, to repeat and deepen the understanding as well as practice individually and in groups.

Teaching / learning methods:
- Media-assisted presentations
- Group work / case studies with presentation
- Individual assignments and presentation
- Computer lab exercises using LCA software systems and Life Cycle Inventory Data bases.

Media:
Digital projector, board, flipchart, online contents, case studies, computer lab

Reading List:
Recommended reading:
• Curran, M.A. (2015): Life Cycle Assessment Student Handbook, Scrivener Publishing:
• Hauschild, M.Z. & Huijbregts, M.A.J. (2015): Life Cycle Impact Assessment (LCA Compendium - The Complete World of Life Cycle Assessment), Springer.
• Klöpffer, W. & Grahl, B. (2014): Life Cycle Assessment (LCA), Wiley-VCH.
• Recent articles from esp. International Journal of Life Cycle Assessment, Journal of Cleaner Production, Journal of Industrial Ecology, Environmental Science and Technology (to be announced in the lecture)

Responsible for Module:
Prof. Magnus Fröhling

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

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

Renewable Resources and Nature Protection | Nachwachsende Rohstoffe und Naturschutz

Corresponding Modules BOKU Vienna | Entsprechende Veranstaltungen BOKU Wien

Module Description

CS0157BOK: Integrated Landscape Management and Nature Conservation | Integrale Landnutzung, Habitatmanagement & Naturschutz

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
presentation and active participation

Repeat Examination:

(Recommended) Prerequisites:

Content:
introduction to nature conservation issues, rational and motivation for the lecture, different historic aspects of landuse management fragmentation, habitat and game management, edge effect, importance of pasture for biodiversity, management of nationalparks (e.g. NP Neusiedler See, NP Donauauen), adaptive management of NP visitors natural reserves network in Austria, concept of near to nature silviculture, Natura 2000, coarse woody debris management, population viability analysis, hemeroby versus naturalness

Intended Learning Outcomes:
There is a need for professional knowledge about goals and definition of nature conservation, silvicultural treatment plans, requirements of deer populations or aspects for conservation of

biodiversity in discussions with NGO's. Students should become aquanted with ecological aspects of several land use practices and habitat management methods to be familar with the basic principles of nature conservation strategies.

Teaching and Learning Methods:
active participation in lecture 45%
content of seminar work 35%
presentation of seminar work 20%

Media:

Reading List:
HAMPIKE, U. 1991: Naturschutz-Ökonomie. UTB 1650. Ulmer, Stuttgart.
JEDICKE, E., 1994: Biotopverbund. Grundlagen und Maßnahmen einer neuen Naturschutzstrategie. 2. Aufl. Ulmer, Stuttgart.
KAULE, G, 1986: Arten- und Biotopschutz. UTB, Große Reihe, Ulmer, Stuttgart.
KIMMINS, H. 1992: Balancing Act: Environmental Issues in Forestry. UBC Press - University of British Columbia, Vancouver.
LEIBUNDGUT, H., 1990: Waldbau als Naturschutz. Haupt, Bern u. Stuttgart.
LEOPOLD, A. , 1992: Am Anfang war die Erde. Plädoyer für Umwelt-Ethik. Knesebeck, München.
MAYER, H. ZUKRIGL, K., SCHREMPF, W., SCHLAGER, G., 1987: Urwaldreste, Naturwaldreservate und schützenswerte Naturwälder in Österreich. Eigenverlag Institut für Waldbau, BOKU.
NOSS, R. F. & COOPERRIDER, A. Y. (1994): Saving Nature´s Legacy. Protecting and Restoring Biodiversity. Island Press. Washington, D.C., Covelo, California.
PLACHTER, H., 1991: Naturschutz. UTB für Wissenschaft: Uni-Taschenbücher; 1563. G. Fischer, Stuttgart.
SCHERZINGER, W. 1996: Naturschutz im Wald : Qualitätsziele einer dynamischen Waldentwicklung. Ulmer, Stuttgart.
SZARO, R. Z. & JOHNSTON, D. W., 1996 (Edit.): Biodiversity in Managed Landscapes. Theory and Practice. Oxford Univesity Press. New York, Oxford.

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.

Compulsory Modules TUM | Pflichtmodule der TUM

Module Description

WZ1020: Renewable Resources and Nature Protection | NAWARO und Naturschutz

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**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:
Assessment is based on an oral examination (20 minutes) on nature conservation in relation to renewable resources in order to show, that students are aware of the effects of renewable resources on nature conservation efforts.On a written seminar paper and its presentation students can show, that they are able to roughly evaluate the compatibility of cultivation systems as well as processing of renewable resources with nature conservation. Both oral examination and the presentation are worth 50 % each.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge of elective subjects Renewable resources and Agroecosystems.

Content:
Compatibility of production and processing of renewable resources with nature conservation: nature conservation and ecological sustainability; guidelines of ecological sustainability, normative and ethical basics of ecological sustainability; determination and difficulties in estimation of risks; operationalization of ecosystem performance through ecosystem-based approach; special aspects of protected goods, such as soil, water, climate/air, species and biotope; effects of production and processing of renewable resources on environment, nature and landscape; options for optimizing ecological sustainability of renewable resources; special topics such as biodigradable waste/ landscape maintenance material as renewable resource.

Intended Learning Outcomes:
After their participation, students are aware of the effects of renewable resources on nature conservation efforts and are able to roughly evaluate the compatibility of cultivation systems as well as processing of renewable resources with nature conservation. They will have the knowledge to understand and analyze reviews and academic work on the issue. The module provides the basis for extension of the students' knowledge in a master thesis followed by expert research on the develpment of ecologically reasonable and sustainable cultivation and processing technologies.

Teaching and Learning Methods:
Lectures will bei given, and students independently work on a seminar paper including its presentation.

Media:
Presentations

Reading List:
Sachverständigenrat für Umweltfragen (SRU) (2007): Klimaschutz durch Biomasse. Berlin, Erich Schmidt. Deutscher Rat für Landespflege (DRL) (Hrsg.) (2006): Die Auswirkungen erneuerbarer Energien auf Natur und Landschaft. Bonn, DRL.

Responsible for Module:
Wolfgang Zehlius-Eckert zehlius@wzw.tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
NAWARO und Naturschutz
2 SWS
Wolfgang Zehlius-Eckert, Harald Albrecht, Norman Siebrecht, Sebastian Wolfrum

Übung
NAWARO und Naturschutz
1 SWS
Wolfgang Zehlius-Eckert, Harald Albrecht, Norman Siebrecht, Sebastian Wolfrum

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

Module Description

WZ1824: System Analysis and Introduction to Ecology | System Analysis and Introduction to Ecology

Version of module description: Gültig ab summerterm 2023

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 a written exam (Klausur, duration 90 min), the students' understanding of important ecological concepts and ecosystem dynamics' patterns is assessed. Moreover, in the same exam, we test their understanding of system analysis methods and their ability to apply them in ecological and other contexts by correctly solving specific problems given in the questions.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
This module combines an introduction to ecology with an introduction to analyzing and modelling dynamic systems. As ecosystems are intrinsically dynamic, i.e. governed by feedback structures, understanding dynamic systems is a key qualification for understanding ecological theory. By examples from ecology but also from other fields (in which cases, however, transfers to ecological applications are always highlighted) formal key methods in structuring system knowledge, building computer models, and learning from such models are taught. An important insight to convey is the interdisciplinarity of dynamic systems and the related methods: Feedback structures found in ecosystems can often as well be found in social science or engineering contexts and vice versa. Parallely, students get basic and advanced insights into fundamental elements of ecological concepts (e.g. modularity, unitarity, speciation, populations, metapopulations, competition, mutualism, ecosystems and their functions) and theory from the level of organisms to populations to species interactions up to the ecosystem level.

Intended Learning Outcomes:
At the end of the module students understand essential elements of ecological theory and concepts. They remember important dynamic patterns and the ecological concepts behind. Moreover, they are able to apply key methods of system analysis to small and intermediate problems in ecology but also in other fields. The latter abilities include using causal loop diagrams and stock-and-flow diagrams for structuring information, understanding the basic mathematics behind dynamic models, being able to build small and intermediate simulation models, and to develop an understanding of the potential and limitations of computer simulations in general.

Teaching and Learning Methods:
Lecture providing theoretical foundations in ecology. Interactive lecture in System Analysis,with an individual workstation being available for each student. In the beginning, the group is closely guided through simple problems in order to develop routine in the methodological and technical basics while understanding fundamental dynamic processes from exponential growth and decay up to nth order delays. Along with their increasing skills, students are given the opportunity to work more independently, with individual guidance upon request, about problems like different approaches to sustainable harvest or overshoot and collapse systems. This concept allows the lecturer to adjust the share of frontal teaching and independent work to the group’s learning progress.

Media:
Reading material provided by lecturers, power point presentations, modelling software VENSIM PLE, example models

Reading List:
Begon, M., C. R. Townsend and J. L. Harper. 2006. Ecology: From Individuals to Ecosystems. Blackwell Publishing, Malden, MA.
H. Bossel: System Zoo 1 Simulation Models – Elementary Systems, Physics, Engineering. Books on Demand, Norderstedt, 2007 (ISBN 978-3-8334-8422-3).
H. Bossel: System Zoo 2 Simulation Models – Climate, Ecosystems, Resources. Books on Demand, Norderstedt, 2007 (ISBN 978-3-8334-8423-0).
H. Bossel: System Zoo 3 Simulation Models – Economy, Society, Development. Books on Demand, Norderstedt, 2007 (ISBN 978-3-8334-8424-7).
Ford, A. Modeling the Environment. Island Press, 1999.
Pruyt, E., 2013. Small System Dynamics Models for Big Issues: Triple Jump towards Real-World Complexity. Delft: TU Delft Library. ISBN/EAN: 978-94-6186-195-5 (Free e-book)
Sterman, J.D., Business Dynamics. McGraw-Hill Education, 2000.
Stiling, P. D. 2014. Ecology: Global Insights and Investigations. McGraw-Hill Education, UK.

Responsible for Module:
Biber, Peter; Dr. rer. silv.

Courses (Type of course, Weekly hours per semester), Instructor:
Systems Analysis (Vorlesung, 2 SWS)
Biber P

Introduction to Ecology (Vorlesung, 2 SWS)
Meyer S [L], Meyer S, Mak B
For further information in this module, please click campus.tum.de or here.

Master Seminar | Masterseminar

Module Description

WZ1959: Master's Thesis Seminar | Masterseminar

Version of module description: Gültig ab summerterm 2017

Module Level:	Language:	Duration:	Frequency:
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:

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:
Englisch - Intensive Thesis Writers' Workshop C2 (Workshop, 2 SWS)
Jacobs R, Ritter J, Wellershausen N

Masterseminar (Biomass Technology) (Seminar, 2 SWS)
Zavrel M [L], Zavrel M
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9463BOK: Master's Thesis Seminar | Masterseminar

Versionocosioeqjeo

Introductory lectures from people who are currently taking part in the "Material and Energetic Exploitation of Renewable Raw Materials (NAWARO)" master programme

Frontal instruction introducing the scientific work
Practical work from the scientific lectures as well as specialist discussion
Training on presentation techniques

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar (2 ECTS)
Masterseminar (LV-Nr. 930300)
2
gesamter Lehrkörper, der am Studiengang beteiligt ist

Barta, Norbert , Bauer, Alexander , Freyer, Bernhard , Friedel, Jürgen Kurt , Fürst-Waltl, Birgit , Gronauer, Andreas , Knaus, Wilhelm Friedrich , Kummer, Susanne , Leeb, Christine , Meszaros, Gabor , Piringer, Gerhard , Quendler, Elisabeth , Schunko, Christoph , Sölkner, Johann , Vogl, Christian R. , Winckler, Christoph , Wurzinger, Maria , Zollitsch, Werner
For further information in this module, please click campus.tum.de or here.

Renewable Resources and Agroecosystems | Nachwachsende Rohstoffe und Agrarökosysteme

Corresponding Modules BOKU Vienna | Entsprechende Veranstaltungen BOKU Wien

Module Description

WZ9458BOK: Silvicultural Strategies for Secondary Conifer Forests | Waldbau in sekundären Nadelwäldern

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	Language: German	Duration: two semesters	Frequency: winter/summer 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 test on lecture content

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
origin of secondary coniferous forests (Norway spruce, Scots pine, Corsican pine), site characteristics, prospects, problems and risks (e.g., storm damage, snow breakage, pests and deseases, climate change), silvicultural strategies for a sustain able management of secondary coniferous forests (incl. conversion and transformation), prioritization for conversion programs, field trips and case studies.

Intended Learning Outcomes:
Students shall be aquainted with (a) problems of secondary coniferous forests, (b) future perspectives, and (c) silvicultural strategies to manage such forests according to principles of sustainable forest management.

Teaching and Learning Methods:
active participation, seminar exercises, round table discussion

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Seminar (2 ECTS)
Waldbau in sekundären Nadelwäldern (LV-Nr. 913319)
1,5 SWS
Manfred Josef Lexer, Eduard Hochbichler

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

Module Description

WZ9459BOK: Regeneration Resources I | Nachwachsende Rohstoffe I

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 4	**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

Content:
Environmental and climatic relevant measures in the production of consider the Newest developments and innovation in the specific sector renewable biomass for different heating systems;
Electricity for all types of consumers;
Renewable biomass as fuel;
Renewable biomass as industrial raw material

Intended Learning Outcomes:
The students will be introduced from the important way to produce renewable biomass in optimizing strategies, which help to fully understand the principle of sustainable agriculture and its positive effects on the environment.

Teaching and Learning Methods:

Media:

Reading List:
„Nachwachsende Rohstoffe", Wulf Diepenbrock . UTB-Ulmer, 2014. „Energie aus Biomasse", Martin Kaltschmitt, Hans Hartmann, Hermann Hofbauer. Springer-Verlag, 2009. „Regenerative Energie in Österreich", Martin Kaltschmitt. 2009.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (4 ECTS)
Nachwachsende Rohstoffe I (LV-Nr. 951329)
3 SWS
Eduard Hochbichler, Wulf Diepenbrock, Hans-Peter Kaul, Bano Mehdi

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

Compulsory Modules TUM | Pflichtmodule TUM

Module Description

CS0183: Energetic Use of Biomass and Residuals | Energetic Use of Biomass and Residuals [EBR]

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics, Energy Process Engineering

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

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

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

Media:
Presentation, script, examples, excursion

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

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

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

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

Module Description

WZ1115: Agroforestry Systems | Agroforstsysteme

Version of module description: Gültig ab 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:
Assessment takes a written form (90 minutes). Students show the extent to which they are able to determine practicable and highly economical alley cropping and apply this knowledge to develop solutions to real-life problems. They are also expected to analyze various ecological aspects such as carbon sequestration and erosion protection with the help of introduced examples. Students demonstrate their understanding of the topic when answering questions on crop processing systems.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in Silviculture WZ1607

Content:
Role and distribution of agroforestry systems in Germany and all over the world. Introduction to special agroforestry systems for production of renewable resources and their importance. Establishment and use of agroforestry systems. Ecological impact of agroforestry systems: interactions between trees and agricultural systems, competitive relationships, carbon sequestration, CO2 avoidance, erosion protection, dynamics of soil moisture, biomass production, economic evaluation and funding options, propagation and harvesting of appropriate plants, potential applications of crops (e.g. in firing systems).

Intended Learning Outcomes:
Students are able to discuss the ecological and economic potential of agroforestry systems for production of renewable resources. They can evaluate the performance of agroforestry systems and apply concepts for agroforestry systems of typical areas (selection of appropriate wood plants and use systems, localisation of forest belts for optimal performance in the ecosystem). Students

can evaluate agroforestry systems and crop use from a basic economical perspective (efficiency analysis, risks, marketing and strategies for their use).

Teaching and Learning Methods:
Lectures introduce basic knowledge; tutorials on identification of appropriate trees and bushes. Excursion to agroforestry systems in active and trial operations, demonstrating possible damages and causes.

Media:
Lectures given as presentations, examples, group work, case studies

Reading List:
Anbau und Nutzung von Bäumen auf landwirtschaftlichen Flächen Gebundene Ausgabe – Wiley-VCH Verlag GmbH & Co. KGaA; Auflage: 1. Auflage 2009
Tatjana Reeg, Albrecht Bemmann, Werner Konold, Dieter Murach, Heinrich Spiecker;
Kurzumtriebsplantagen: Holz vom Acker - So geht's Taschenbuch – DLG-Verlag, 2012
Dirk Landgraf, Frank Setzer;
Aktuelle Veröffentlichen in Fachzeitschriften

Responsible for Module:
Höldrich, Alexander; Dr. agr.

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Übung
Agroforstsysteme
4 SWS

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

Elective Modules | Wahlmodule

Cultivation of Renewable Raw Materials | Nachwachsende Rohstoffe und Anbausysteme

Elective Modules TUM | Wahlmodule der TUM

Module Description

WZ1115: Agroforestry Systems | Agroforstsysteme

Version of module description: Gültig ab 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:
Assessment takes a written form (90 minutes). Students show the extent to which they are able to determine practicable and highly economical alley cropping and apply this knowledge to develop solutions to real-life problems. They are also expected to analyze various ecological aspects such as carbon sequestration and erosion protection with the help of introduced examples. Students demonstrate their understanding of the topic when answering questions on crop processing systems.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in Silviculture WZ1607

Content:
Role and distribution of agroforestry systems in Germany and all over the world. Introduction to special agroforestry systems for production of renewable resources and their importance. Establishment and use of agroforestry systems. Ecological impact of agroforestry systems: interactions between trees and agricultural systems, competitive relationships, carbon sequestration, CO_2 avoidance, erosion protection, dynamics of soil moisture, biomass production, economic evaluation and funding options, propagation and harvesting of appropriate plants, potential applications of crops (e.g. in firing systems).

Intended Learning Outcomes:
Students are able to discuss the ecological and economic potential of agroforestry systems for production of renewable resources. They can evaluate the performance of agroforestry systems and apply concepts for agroforestry systems of typical areas (selection of appropriate wood plants and use systems, localisation of forest belts for optimal performance in the ecosystem). Students can evaluate agroforestry systems and crop use from a basic economical perspective (efficiency analysis, risks, marketing and strategies for their use).

Teaching and Learning Methods:
Lectures introduce basic knowledge; tutorials on identification of appropriate trees and bushes. Excursion to agroforestry systems in active and trial operations, demonstrating possible damages and causes.

Media:
Lectures given as presentations, examples, group work, case studies

Reading List:
Anbau und Nutzung von Bäumen auf landwirtschaftlichen Flächen Gebundene Ausgabe – Wiley-VCH Verlag GmbH & Co. KGaA; Auflage: 1. Auflage 2009
Tatjana Reeg, Albrecht Bemmann, Werner Konold, Dieter Murach, Heinrich Spiecker;
Kurzumtriebsplantagen: Holz vom Acker - So geht's Taschenbuch – DLG-Verlag, 2012
Dirk Landgraf, Frank Setzer;
Aktuelle Veröffentlichen in Fachzeitschriften

Responsible for Module:
Höldrich, Alexander; Dr. agr.

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Übung
Agroforstsysteme
4 SWS

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

Module Description

WZ1120: Medicinal and Spice Plants | Heil- und Gewürzpflanzen

Version of module description: Gültig ab 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

WZ1193: Biogas Technology | Biogastechnologie [BiGA]

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Students take a written examination (90 minutes) to demonstrate their knowledge of microbial breakdown processes in the biogas process, as well as their ability to assess influencing factors. They also demonstrate their knowledge of various technologies for using biogas and can explain their respective advantages and disadvantages. Additionally, they demonstrate that they have understood the legal and economic framework conditions of biogas technology and are able to translate these to case examples. Students also show that they can develop basic concepts of biogas plants.They will answer questions on the topic in their own wording and explain case examples or work out calculations. Multiple-choice questions are also possible.

Repeat Examination:
Next semester

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

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

Intended Learning Outcomes:
After successful completion of the module, students are able to develop concepts for biogas generation and recovery in a specific context. Students are aware of microbial breakdown

processes in biogas plants and can differentiate between various influencing factors. They are also aware of various processes for the use of biogas and understand their advantages and disadvantages. Students recognize the meaning of biogas technology for sustainable energy supply. Students have a good knowledge of legal and economic framework conditions in the field of biogas generation and they are able to conceptualize basic biogas plants.

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

Media:
PowerPoint presentation, slide notes, exercise sheets

Reading List:
D. Deublein, A. Steinhauser, Biogas from Waste and Renewable Resources - An Introduction, Wiley-VCH, 2010, ISBN-13: 978-3-527-32798-0, ISBN-10: 3-527-32798-3

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

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

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

Module Description

WZ1824: System Analysis and Introduction to Ecology | System Analysis and Introduction to Ecology

Version of module description: Gültig ab summerterm 2023

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 a written exam (Klausur, duration 90 min), the students' understanding of important ecological concepts and ecosystem dynamics' patterns is assessed. Moreover, in the same exam, we test their understanding of system analysis methods and their ability to apply them in ecological and other contexts by correctly solving specific problems given in the questions.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
This module combines an introduction to ecology with an introduction to analyzing and modelling dynamic systems. As ecosystems are intrinsically dynamic, i.e. governed by feedback structures, understanding dynamic systems is a key qualification for understanding ecological theory. By examples from ecology but also from other fields (in which cases, however, transfers to ecological applications are always highlighted) formal key methods in structuring system knowledge, building computer models, and learning from such models are taught. An important insight to convey is the interdisciplinarity of dynamic systems and the related methods: Feedback structures found in ecosystems can often as well be found in social science or engineering contexts and vice versa. Parallely, students get basic and advanced insights into fundamental elements of ecological concepts (e.g. modularity, unitarity, speciation, populations, metapopulations, competition, mutualism, ecosystems and their functions) and theory from the level of organisms to populations to species interactions up to the ecosystem level.

Intended Learning Outcomes:
At the end of the module students understand essential elements of ecological theory and concepts. They remember important dynamic patterns and the ecological concepts behind. Moreover, they are able to apply key methods of system analysis to small and intermediate problems in ecology but also in other fields. The latter abilities include using causal loop diagrams and stock-and-flow diagrams for structuring information, understanding the basic mathematics behind dynamic models, being able to build small and intermediate simulation models, and to develop an understanding of the potential and limitations of computer simulations in general.

Teaching and Learning Methods:
Lecture providing theoretical foundations in ecology. Interactive lecture in System Analysis,with an individual workstation being available for each student. In the beginning, the group is closely guided through simple problems in order to develop routine in the methodological and technical basics while understanding fundamental dynamic processes from exponential growth and decay up to nth order delays. Along with their increasing skills, students are given the opportunity to work more independently, with individual guidance upon request, about problems like different approaches to sustainable harvest or overshoot and collapse systems. This concept allows the lecturer to adjust the share of frontal teaching and independent work to the group’s learning progress.

Media:
Reading material provided by lecturers, power point presentations, modelling software VENSIM PLE, example models

Reading List:
Begon, M., C. R. Townsend and J. L. Harper. 2006. Ecology: From Individuals to Ecosystems. Blackwell Publishing, Malden, MA.
H. Bossel: System Zoo 1 Simulation Models – Elementary Systems, Physics, Engineering. Books on Demand, Norderstedt, 2007 (ISBN 978-3-8334-8422-3).
H. Bossel: System Zoo 2 Simulation Models – Climate, Ecosystems, Resources. Books on Demand, Norderstedt, 2007 (ISBN 978-3-8334-8423-0).
H. Bossel: System Zoo 3 Simulation Models – Economy, Society, Development. Books on Demand, Norderstedt, 2007 (ISBN 978-3-8334-8424-7).
Ford, A. Modeling the Environment. Island Press, 1999.
Pruyt, E., 2013. Small System Dynamics Models for Big Issues: Triple Jump towards Real-World Complexity. Delft: TU Delft Library. ISBN/EAN: 978-94-6186-195-5 (Free e-book)
Sterman, J.D., Business Dynamics. McGraw-Hill Education, 2000.
Stiling, P. D. 2014. Ecology: Global Insights and Investigations. McGraw-Hill Education, UK.

Responsible for Module:
Biber, Peter; Dr. rer. silv.

Courses (Type of course, Weekly hours per semester), Instructor:
Systems Analysis (Vorlesung, 2 SWS)
Biber P

Introduction to Ecology (Vorlesung, 2 SWS)
Meyer S [L], Meyer S, Mak B
For further information in this module, please click campus.tum.de or here.

Research Internship (max. 10 ECTS) | Research Internship (max. 10 ECTS)

Module Description

CS0294: Research Internship Master 5 ECTS | Research Internship Master 5 ECTS

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration are evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Background knowledge of the respective focus to which the project topics of the research internships are assigned. In this case, having a background in Python or SuperPro Designer and experience in the laboratory is often recommended.

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 120 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an

internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

Intended Learning Outcomes:
After participation in the module, students understand the principles of approach to (research)projects in addition to the subject-specific knowledge and working methods taught in the research internship projects, the planning of project work and the critical evaluation of the project results and can apply them to new project tasks. Furthermore, they are able to document, interpret and summarise project work and results in written form.

Teaching and Learning Methods:
Depending on the focus and topic, for example, experiments in laboratories, guided or independent literature and data research, concept studies, simulations, methods for project and experimental design or test evaluation

Media:
Depending on the focus and topic, e.g., experimental equipment (laboratory), databases, libraries, specialized software, programming software, simulation software, project and experimental design software

Reading List:
technical literature;
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

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

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Master 5 ECTS (Praktikum, 5 SWS)
Blombach B, Glawischnig E, Hädrich M, Vital S

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Costa Riquelme R [L], Costa Riquelme R

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Sieber V [L], Abbas Nia A, Al-Shameri A, Arana Pena S, Dsouza Z, Fornoni E, Friedrichs J, Fuchs A, Giustino A, Grundheber J, Hofer N, Hörnschemeyer K, Hupfeld E, Kampl L, Köllen T, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Rau M, Romeis D, Rühmann B, Scheerer J, Schieder D, Schulz M, Sieber V, Siebert D, Skopp A

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Zavrel M [L], Beerhalter D, Borger J, Dsouza V, Geisler N, Marino Jara J, Oktay I, Stegemeyer U, van der Walt H, Zavrel M

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

Module Description

CS0297: Research Internship Master 10 ECTS | Research Internship Master 10 ECTS

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 60	**Contact Hours:** 240

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration are evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Background knowledge of the respective focus to which the project topics of the research internships are assigned. In this case, having a background in Python or SuperPro Designer and experience in the laboratory is often recommended.

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 360 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

Intended Learning Outcomes:
After participation in the module, students understand the principles of approach to (research)projects in addition to the subject-specific knowledge and working methods taught in the research internship projects, the planning of project work and the critical evaluation of the project results and can apply them to new project tasks. Furthermore, they are able to document, interpret and summarise project work and results in written form.

Teaching and Learning Methods:
Depending on the focus and topic, for example, experiments in laboratories, guided or independent literature and data research, concept studies, simulations, methods for project and experimental design or test evaluation

Media:
Depending on the focus and topic, e.g., experimental equipment (laboratory), databases, libraries, specialized software, programming software, simulation software, project and experimental design software

Reading List:
technical literature;
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

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

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Master 10 ECTS (Forschungspraktikum, 10 SWS)
Banlaki I, Crean E, Gaizauskaite A, Kalkowski J, Li Y, Niederholtmeyer H

Research Internship Master 10 ECTS (RES) (Praktikum, 10 SWS)
Gaderer M [L], Huber B, Putra L

Research Internship Master 10 ECTS (Sieber) (Forschungspraktikum, 10 SWS)
Sieber V [L], Abbas Nia A, Al-Shameri A, Arana Pena S, Dsouza Z, Fornoni E, Friedrichs J, Fuchs A, Giustino A, Grundheber J, Hofer N, Hörnschemeyer K, Hupfeld E, Kampl L, Köllen T, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Romeis D, Rühmann B, Scheerer J, Schulz M, Sieber V, Siebert D, Skopp A
For further information in this module, please click campus.tum.de or here.

Elective Modules BOKU | Wahlmodule der BOKU

Module Description

CS0019BOK: BOKU: Forest Soil Biology | BOKU: Forest Soil Biology

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 45	**Contact Hours:** 30

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

Description of Examination Method:
The course is exam-immanent. Criteria are regular participation (at least 75%), commitment to practical work, evaluation and presentation of the results and active participation/discussion in the lectures

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
(1) Introduction to forest soil biology with a focus on biodiversity, litter degradation, humus formation and measurement methods for soil biological investigations.

(2) Excursions and method demonstration:
- Test area with automated greenhouse gas measurements as well as C, N and water balance
- Federal Research and Training Centre for Forests.

(3) Lectures: Degradation processes, influencing factors, important forest-soil organisms and their function, consequences of climate change for forest soils, online research and presentations on selected topics.

Intended Learning Outcomes:
Understanding the forest floor as a habitat for microorganisms, soil animals and plant roots. Insight into the interactions and activities of these organisms, their function and their dependence on the environment.

Teaching and Learning Methods:
Lecture with integrated exercises

Media:

Reading List:
Soil Biodiversity Atlas (freier Download unter: https://esdac.jrc.ec.europa.eu/content/atlas-soil-biodiversity)

Responsible for Module:
Andreas Schindlbacher Andreas.schindlbacher@boku.ac.at

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

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

Module Description

CS0032BOK: Small scale forestry | Kleinwaldwirtschaft

Version of module description: Gültig ab winterterm 2018/19

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer 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:

(Recommended) Prerequisites:

Content:
Position of the small-scale forests in the forestry of Austria and the EU; Condition and management of the small-scale forests; Significance of the branche of business forestry for the small-scale forest owners; Education and further training, advice, support, project management; Organization of the cooperation.

Intended Learning Outcomes:
Arrangement of knowledge about the management of the small-scale forests, the education and further training, advice, support and cooperation of the small-scale forest owners.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Werner Löffler

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

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

Module Description

CS0063BOK: BOKU: Crop Production | BOKU: Crop Production

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 52	**Contact Hours:** 23

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

Description of Examination Method:
Written and oral
There is a written exam shortly after the end of the course. It takes roughly half an hour and consists of about 15 questions in multiple choice mode or requiring very short written answers. Each question allows for an indicated number of points, which are given according to the correctness of the answer. A minimum of 50% of the points are necessary to pass. Marks are given relative to the number of marks exceeding that minimum.
Students who are not able to attend that exam are offered oral exams based on individual appointments. The questions will be selected from the previous written exam and the affiliation of marks is again related to the correctness of answers.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic knowledge in (plant) biology and physics on Matura level

Content:
Block A: Introduction to agronomy
1. Introduction
- Definition of course contents and objectives
- Arable crops and grassland as elements of agro-ecosystems
2. Historical view
3. Effects of environmental factors on field crops
4. Germination and crop establishment
5. Growth, development and yield formation
6. Crop husbandry
7. Environmental impacts of field crops

8. Systems of crop production - conventional/integrated/ecological agriculture

Block B: Fodder crops and catch/cover crops, grain crops rich in carbohydrates (cereals)
1. Botanical classification
2. Environmental needs
3. Definition, assessment and production of yield and quality
4. Crop husbandry

Block C: Grain crops rich in protein or oil; root and tuber crops; renewable resources
1. Botanical classification
2. Environmental needs
3. Definition, assessment and production of yield and quality
4. Crop husbandry

Intended Learning Outcomes:
Students acquire knowledge about field crop production with emphasis on the underlying physical, chemical and biological processes, also with view to environmental claims

Students can draw conclusions on suitable crop management practices

Students acquire detailed knowledge about environmental needs, yield, product quality and crop husbandry of important arable crop species in temperate climate zones

Teaching and Learning Methods:
Classroom lecture, assisted by moodle

Media:
course material available at BOKUlearn (Moodle)

Reading List:

Responsible for Module:
Hans-Peter Kaul (BOKU)

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

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

Module Description

CS0114BOK: Post-harvest Technology | Post-harvest Technology [CS0114BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**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:
Written
The mark results from the evaluation of the written exam. The mark of the lecture will be derived from the reached percentage of the points as followed. 90 – 100 % = 1 78 – 89 % = 2 66 – 77 % = 3 55 – 65 % = 4 0 – 54 % = 5 (failed) Duration of the written examination = 60min. For the written exam you can bring calculator, ruler, german/englisch dictionary and the formulary supplied on the bokulearn plattform.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Importance of post-harvest technology for the food chain

Biological and physical principles of post harvest technology

Selected post harvest technologies in agriculture:

Treatment of seed (drying, cleaning, sieving,?)

Alternative methods of seed treatments (warm-humid, microwave, high frequency energy)

Drying technology (principles and application; Ddying of agricultural products)

Crop conservation with silage making (principles and processes)

Storage of crops (potato, fruit, vegetable,?); Principles and applications

Special post-harvest technologies in horticulture and viticulture

Intended Learning Outcomes:
Understanding of biological and physical properties of harvested crops and their comprehension

Qualification for systematic analyses of post harvest technology

Qualification for planning of post harvest technology

Evaluation of post-harvest technologies on engineering fundamentals as well as ecological and economic aspects.

Teaching and Learning Methods:
interactive lecture

Media:

Reading List:

Responsible for Module:
BOKU Pejakovic Vladimir, Gronauer Andreas Institut für Landtechnik

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

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

Module Description

CS0125BOK: Dendrology | Dendrologie [CS0125BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Written
To pass the exam successfully 56 points out of a maximum of 110 points have to be achieved. Open questions on the topics of the lecture are asked. 110-97 = 1 96-83 = 2 82-69 = 3 68-56 = 4

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Biologie/Botanik Maturaniveau

Content:
Importance of woody plants for ecosystems and landscape; origin and differentiation of gymnosperms and angiosperms; the ice age as the cause of the depauperation of Europe in woody species; general features of spermatophyta; the gymnosperms and their Central European representatives; the dicots and their woody representatives

Intended Learning Outcomes:
Understanding the evolution of woody plants from the most primitive gymnosperms to the most evolved angiosperms; recognition of Central European woody species and some important exotics by means of conspicuous characteristics; sites, geographic distribution and commercial use of the species

Teaching and Learning Methods:
multimedia-supported

Media:

Reading List:

Responsible for Module:
BOKU Hesse Benjamin Daniel Institut für Botanik

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

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

Module Description

WZ9178BOK: Medicinal and Aromatic Plants | Medicinal and Aromatic Plants

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
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:
oral
Verbal examination

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
After informing on definitions, main cultivation areas and economic aspects the specific tasks of medicinal and aromatic plants (MAP) production will be discussed. Special regard will be paid to quality and quality management including the respective factors: genetics and breeding, morpho- and ontogenetic as well as environmental variability, influences by cultivation practices, harvest and post harvest technology. Guidelines for Good Agricultural Practice in MAP production and domestication of wild plants are further focal points. The most important species will be discussed in detail.

Intended Learning Outcomes:
MAPs (medicinal and aromatic plants) are typical specialist minor crops with increasing importance. The aim of the subject is to import knowledge on the diversity of this group of useful plants including their secondary products and their significance as renewable natural resources. Furthermore the frame conditions of MAP production should get known as also the most important species and their specific requirements.

Teaching and Learning Methods:
Examination dates based on personal arrangements.
The topic of the essay will be mutually agreed. The content of the essay will be verbally discussed.

Media:

Reading List:

Responsible for Module:

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

Vorlesung (3 ECTS)
Medicinal and aromatic plants (in Eng.); (LV-Nr. 951316)
2 SWS
Johannes Novak
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9343BOK: Plant and Environment | Plant and Environment

Version of module description: Gültig ab winterterm 2012/13

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:
written and oral exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
B.Sc.

Content:
Introduction - stress, temperature - energy balance, light - quality and quantity, water and drought, flooding and oxygen deficiency, salt, heavy metals and phytoremediation, nitrogen and the N cycle, CO_2 and the global carbon cycle; herbivores, pathogenes and defence; genetically modified crops; invasive plants, ecosystem services

Intended Learning Outcomes:
Understanding interactions between plants and their abiotic and biotic environment. The effect of natural and anthropogenic stress and the reaction of plants and the importance of plants for the human environment

Teaching and Learning Methods:
Lecture

Media:

Reading List:
Handed out during the course Schulze et al. Plant Ecology, Springer 2005

Larcher: Physiological Plant Ecology, Springer 2002

Responsible for Module:
Peter Hietz

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

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

Module Description

WZ9418BOK: Field Crop Production and Products | Spezieller Pflanzenbau

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**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, based on individual appointments (no announcements in BOKUonline)

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Bachelor level in agricultural sciences, especially in the field of plant production/crop sciences

Content:
Production of fodder crops
(environmental preconditions, product quality, crop establishment, crop husbandry, harvest technology and yield processing)

Production of grain crops rich in carbohydrates, protein or fat
(environmental preconditions, product quality, crop establishment, crop husbandry, harvest technology and yield processing)

Production of root and tuber crops
(environmental preconditions, product quality, crop establishment, crop husbandry, harvest technology and yield processing)

Production of industrial crops for fibre, energy or chemical compound use
(environmental preconditions, product quality, crop establishment, crop husbandry, harvest technology and yield processing)

Intended Learning Outcomes:
The students acquire detailed knowledge about most important crops, their product quality requirements and their crop husbandry, mainly for field crops in temperate climates

Teaching and Learning Methods:

Media:

Reading List:
Presentation files are available via BOKUlearn (Moodle), there you find also textbook recommendations

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
VS
Spezieller Pflanzenbau (LV-Nr. 951330)
3 SWS
Hans-Peter Kaul

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

Module Description

WZ9420BOK: Supply of Wood Fuels | Energieholzbereitstellungssysteme

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
Assessment is based on written working assignments (20 %), a seminar paper (30 %) and a written test (50 %). All parts have to be passed positively (> 50 % of maximum points).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge of forestry is advantageous but not compulsory.

Content:
• Energy balance, demands and potential in Austria
• Timber as energy source, energy content, standards and qualities of fuels
• Supply of forest chips, chipper types, transport systems, logistics, costs
• Management of short-rotation forest areas
• Energy balance of supply systems
• Multicriteria evaluation of supply systems

Intended Learning Outcomes:
• Gain basic knowledge about wood biomass on technical, economical and ecological aspects
• Gain insight about appropriate operations and machines
• Planning of wood biomass supply operations with regard to technical, economical and ecological aspects

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Seminar (3 ECTS)
Energieholzbereitstellungssysteme (LV.-Nr 915332)
2 SWS
Gernot Erber, Christian Kanzian

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

Module Description

WZ9421BOK: Aspects of Product Quality in Plant Production | Aspects of Product Quality in Plant Production

Module Description

WZ9422BOK: Technology Manure Utilisation | Technik der Biomasse und Wirtschaftsdüngernutzung

Version of module description: Gültig ab winterterm 2018/19

Module Level: Master	Language: German	Duration: one semester	Frequency: winter semester
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:
Assessment criteria:
active participation in the course (active participation in discussions, exercises, excursion)
Assessment: written examination

Repeat Examination:

(Recommended) Prerequisites:

Content:
1 Ecological fundamentals 1.1 Environmentally relevant elements and compounds 1.2 Circulation of substances 1.3 Nutrient and pollutant balances 2 Legal regulations, environmental protection measures 3 Biogenic emissions from agriculture (odours, NH3, CH4, N2O) 3.1 Mechanism of formation, sources, mitigation strategies 3.2 Guidelines on assessment of ambient air from animal husbandry 4 Agricultural manures 4.1 Farmyard manure 4.1.1 Methods of farmyard manure removal 4.1.2 Methods of farmyard manure storage 4.1.3 Methods of farmyard manure treatment 4.1.4 Methods of farmyard manure spreading 4.2 Liquid manure 4.2.1 Liquid manure properties 4.2.2 Methods of liquid manure removal 4.2.3 Methods of liquid manure storage 4.2.4 Methods of liquid manure treatment 4.2.4.1 Mixing and pumping 4.2.4.2 Aeration 4.2.4.3 Separation 4.2.4.4 Liquid manure additives 4.2.5 Methods of liquid manure spreading 4.2.5.1 Tankers and spreading equipment 5. Energy production from biomass 5.1 Biogas production 5.1.1 Potential (manures, organic wastes, energy plants) 5.1.2 Anaerobical, biochemical degradation 5.1.3 Types of biogas plants 5.1.4 Energy efficiency of biogas plants 5.1.5 Energy conversion, electricity and heat from biomass (FC, HPC, MGT) 5.2 Solid fuels 5.2.1 Harvesting and conditioning 5.2.2 Firing systems 5.3 Fuels 5.3.1 Vegetable oils 5.3.2 Ethyl alcohol

Intended Learning Outcomes:
To know areas of problems and conflicts in protection of environment and climate in agriculture, to point out causes of and solutions to problems and conflicts. To know and evaluate the broad range of methods of manure storage, treatment and spreading. To develop methods of manure management with low nutrient losses, high nutrient efficiency and low environmental impact. To apply guidelines on assessment of emissions from animal husbandry. To describe methods of energy production from energy plants and biomass (biogas production, solid fuels, fuels).

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

WZ9428BOK: Technology of Wood Processing | Technologien der Holzverarbeitung

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 1	**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
oral examination

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Characterization of the raw material Wood (grading etc.) and principles of converting the raw material wood into a material and wood-base products. Principles of slicing, sawing, milling, chipping etc. drying and glueing.

Intended Learning Outcomes:
Understanding of the relationship of wood as a raw material and the wood-based materials and products along the process chain wood and the approbiate technologies. Knowlegde of the most common wood based materials, their properties and potential applications incl. relevant Standards.

Teaching and Learning Methods:
Vorlesung interaktiv mit Studierenden

Media:

Reading List:

Wagenführ, A., Scholz, F., Taschenbuch der Holztechnik. Fachbuchverlag Leipzig, Leipzig 2005
Fellner, J., Teischinger, A., Zschokke, W.: Holzsprektrum. proHolz Austria, Wien 2007

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (1 ECTS)
Technologien der Holzverarbeitung (LV-Nr. 891330)
1 SWS
Alfred Teischinger

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

Module Description

WZ9466BOK: Soil Protection | Soil Protection

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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:
written and oral
The overall grade is composed of the following components:
Written exam (multiple & single choice) 40%
Homework - Case Study (written) 50%
Participation in the Peer Review Workshop 10%

Grading scheme:
>=90 Excellent (1)
>=80 Good (2)
>=70 Fair / Average (3)
>60 Passed (4)
<=60 Failed (5)
Note: the course certficate can only be issued after all examination parts are passed with at least 50% of the maximum attainable scores.

The blended learning components (homework, peer review workshop) are handled through BOKU Learn.
The written exam (multiple/single choice mode) comprises a total of 10 questions.
Grading will only be issued if all assessment components are passed with at least 50% of the maximum scores attainable.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Fundamentals of soil science (at least bachelor level, ideally the level after passing the exam of 911.306 - Soil Science Refresher); Proficient English

Content:
Introduction
- Global issues and drivers of soil less and degradation (theory/lecture)
-Major soil threats at global, European and national level (theory/lecture)
-Case studies covering different aspects of soil degradation and soil management (blended learning component: homework, peer review workshop)

Intended Learning Outcomes:
Overall aim: Provide an overview on major problems of soil protection and sustainable land use at global, European and national (Austrian) level.
Objectives:
- make you familiar with the main soil threats at global, european and national level
- make you familiar with (sources of) information on the current state of soil
- give you an appreciation of instruments of soil protection and their application to specific problems
- encourage critical evaluation and challenging of current concepts of soil protection
- provide guidance for informed use of soil information and decision making
- enable you to develop possible solutions for better protection of soil
Expected learning outcomes:
- Know and comprehend fundamental soil threats
- Recall the main soil threats
- Know about major drivers and causes of soil degradation
- Put them into context of natural, societal and economic conditions
- Rank their relative importance at national, European and global level
- Know about the state of soil (degradation)
- Recall major pattern of soil degradation at national and European scale
- Know about sources of soil information and their application
- Recall important sources of soil information in Austria, Europe and at global level
- Make informed use of soil information
- Know about instruments / measures of soil protection
-Apply your knowledge to a case study

Teaching and Learning Methods:
Interactive lecture
Interactive lecture (theory part) combined with blended learning components (Homework, peer review workshop) handled through BOKU Learn.

Media:

Reading List:
The course materials will be made available chapter by chapter during the semester through BOKULearn.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Soil protection (in Eng.); (LV-Nr. 911301)
2 SWS
Walter Wenzel

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

Module Description

WZ9467BOK: Mountain Forest Silviculture | Gebirgswaldbau

Version of module description: Gültig ab winterterm 2017/18

Module Level:	Language:	Duration:	Frequency:
Master	German/English	two semesters	winter/summer 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
written test on lecture contents

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic silvicultural know how as it is taught in the Bachelor class of Silviculture

Content:
Forests are one of the key vegetation forms in Mountainous areas and forest coverage is required to ensure the protection function within this multi-functional environment. Forests fulfill a protection- production- welfare and recreational function and thus help to guarantee the settlement areas in mountainous regions. For example, it is expected that within the State of Tirol only 15 % may be considered as potential settlement area and without forests this area would be much smaller. We have 22% of Mountain forests which grow under extreme conditions (e.g. climate, soil, shortage of the vegetation period, etc.). Thus maintaining forests for ensuring its multifunctional role within Mountainous areas is a key element within silviculture This also underlines that regeneration is extremely important and that potential threats for forest regeneration such as browsing, grazing and entomological risks, etc., need to be avoided. These threats lead to a substantial decline in forest regeneration and thus in a long run to unstable and fragile forests. Forests in mountainous areas require special silvicultural techniques and have to ensure a continuous coverage of the forested area.
This requires an assessment of the risk potential followed by a short, medium and long term planning of silvicultural treatments.

Intended Learning Outcomes:
General understanding of forests in mountainous areas including their role for ensuing the multifunctional demands, required planning activities and silvicultural activities. Why are forests important and what would happen if we would have no forests.

Teaching and Learning Methods:
Lecture in the classroom. Background material will be distributed during the course.

Media:

Reading List:
Hasenauer H.: Skriptum Waldbau; Mayer, H.: Waldbau auf soziologisch-ökologischer Grundlage; Mayer, H. - Pitterle, A.: Osttiroler Gebirgswaldbau

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Gebirgswaldbau (LV-Nr. 913328)
2 SWS
Hubert Hasenauer, Rupert Seidl

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

Module Description

WZ9468BOK: Forest Soil Biology | Waldbodenbiologie

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	Language: German/English	Duration: two semesters	Frequency: winter/summer semester
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:
The participants in these lectures and exercises are constantly evaluated. Criteria for evaluation are regular attendance, quality of contributions, input to discussions and presentation of results.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
(1) Soil sampling for microbial analysis and gas measurement

(2) Lectures on microbial decomposition in the forests, factors of influence, soil organisms, effects of soil warming

Intended Learning Outcomes:
Understanding of the forest soil as a habitat for microorganisms, soil animals and plant roots. View of the reciprocal effects and activities of these organisms, their function and their dependence on the environment.

Teaching and Learning Methods:
lecture with exercises

Media:

Reading List:
Haider K. (1996) Biochemie des Bodens. Ferdinand Enke Verlag, Stuttgart, 174 pp.
Killham K. (1994) Soil Ecology, Cambridge University Press, Cambridge, 141 pp.
Paul, EA, Clark, FE (1996) Soil Microbiology and Biochemistry. Academic Press, New York, 340 pp.
Schlegel, HG (1992) Allgemeine Mikrobiologie. 7. Aufl. Thieme verlag, Stuttgart, 634 pp.
Sylvia D.M., Fuhrmann J.J., Hartel P.G., Zuberer D.A. (1999) Principles and Applications of Soil Microbiology. Prentice Hall, Upper Saddle River, New Jersey, 550 pp.
- A script will be available

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (3 ECTS)
Waldbodenbiologie (in Eng.); (LV-Nr. 911348)
2 SWS
Sophie Zechmeister-Boltenstern

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

Module Description

WZ9469BOK: Aspects of Nature Conservation in Forest Protection | Naturschutzaspekte des Waldschutzes

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 1	**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:
no

Content:
Possibilities to implement forest protection measures in accordance with nature conservation. Evaluation of forest protection risks in general and of forest protection risks in connection with total retraction from any forest protection measures. Problems related with dying and with dead trees. Modus operandi in special cases: diagnosis of pests and their natural enemies, risk assessment and determination of site predisposition and of stand predisposition.

Intended Learning Outcomes:
Relaying of problem-oriented knowledge for risk assessment in case of execution or of omission of forest protection measures.

Teaching and Learning Methods:
interactive lecture

Media:

Reading List:
Scherzinger W. (1996): Naturschutz im Wald. E. Ulmer

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (1 ECTS)
Naturschutzaspekte des Waldschutzes (LV-Nr. 916327)
1 SWS
Rudolf Wegensteiner

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

Module Description

WZ9473BOK: Actual and Future-oriented Themes of Silviculture | Aktuelle und zukunftsorientierte Themen des Waldbaus

Version of module description: Gültig ab 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

Content:
Presentation and discussion of current and future oriented forest management questions/problems (increasing demand of wood; climate change; continuous cover forestry; etc.); evaluation of possibilites/alternatives, chances and risks of silvicultural concepts and procedures considering changing general conditions/challenges

Intended Learning Outcomes:
Extending of silvicultural knowledges; adaption of competences for developing silvicultural strategies and deducing of objective oriented and situational treatment programmes

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Exkursion (2 ECTS)
Aktuelle und zukunftsorientierte Themen des Waldbaus (LV-Nr. 913009)
2 SWS
Eduard Hochbichler

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

Module Description

WZ9474BOK: Agricultural Engineering in Plant Productionseminar | Agricultural Engineering in Plant Productionseminar

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:**
Credits:* 4	**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:
The overall course grade is compiled from evaluations in the following three areas:
1. Evaluation of active participation during course meetings with mandatory attendance (15 points)
2. Evaluation of the final paper (40 points)
3. Evaluation of the final presentation (45 points)

Grades:
The grades for the course will be calculated according to the number of points achieved and based on the following grading scale:
90 – 100 Points = very good (1)
78 – 89 Points = good (2)
66 – 77 Points = satisfactory (3)
55 – 65 Points = adequate (4)
0 – 54 Points = inadequate (5)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
The prerequisite for participation in the course is a solid foundation in agricultural engineering and agricultural production, as well as in plant production.

Content:
The course focuses on special topics in the field of agricultural engineering in plant production. This course builds upon the content of the courses "Fundamentals of Agricultural Engineering" (931.103), "Agricultural Engineering in Plant Production" (931.100) as well as „Agricultural Engineering in Plant Production - practical course" (931.101). Students will delve

into various aspects of agricultural engineering by researching and writing literature comparison papers. One focus of the course is to work with scientific literature in English and correctly use English technical terms.

The course is designed to be interdisciplinary and covers process engineering (through the detailed examination of process engineering aspects of agricultural engineering), plant production aspects (by conveying the technical requirements based on plant production conditions), as well as sustainability aspects (by evaluating the environmental effects, future viability). The course's primary aim is not simply to communicate detailed information on agricultural engineering, but rather to contribute to a critical evaluation of processes and innovations in the course's areas of focus, as well as to determine problems and challenges in the selected fields of application.

Intended Learning Outcomes:
Upon positive completion of the course, students will be able to:
• Give an overview of special topics in the field of agricultural engineering
• Confidently use scientific literature (search, use and correctly cite literature)
• Critically evaluate scientific literature
• Participate in discussions based on the analysis of scientific literature and determine development potential, risks and open research areas

Teaching and Learning Methods:
The topic of the course paper can be chosen from a pool of topics, however each topic may only be researched once. The topic will be presented and clarified during the last course units.

The content of the course paper will be a critical examination of one technology. The final paper should be structured as follows:
1. A short summary of the technology and its current state of development (ca. 500 words)
2. A summary of the technologies/innovations as described in the literature (ca. 1,000 words)
3. A critical evaluation of innovations (benefits, drawbacks, practical applicability), discussion supported by literature data (ca. 1,000 words)
4. A conclusion (max. 100 words)

The course paper will be written about the individual technologies in 3-person groups. The course paper should be as short and concisely written as possible (no comprehensive "summary" of the literature); the suggested length of the paper is approximately 5-6 pages (2,600 words not counting the bibliography). The course papers should be based on the content of at least 10 scientific publications written in English.

Results of the course paper will be presented visually in the concise format of a poster. Course leaders will make a template for the poster available to all course participants. Upon positive evaluation, posters will be approved for printing.

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar mit Exkursion (4 ECTS)
Agricultural engineering in plant production - seminar (LV Nr. 931300)
3 SWS
Alexander Bauer, Norbert Barta, Andreas Gronauer, Gerhard Piringer, Helmut Wagentristl

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

Renewable Raw Materials for Material Use | Chemisch-werkstoffliche Nutzung von Biomasse

Elective Modules TUM | Wahlmodule der TUM

Module Description

AR30317: Lecture Series TUM.wood | Ringvorlesung TUM.wood
[TUM.wood]

From tree to architecture – the value chain of wood

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** one-time
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 written exam is implemented at the end of the semester.
Answerings questions regarding the content of the lectures is the main aspect of the exam. There ´s a possibility that it contains tasks, which require independant thinking and development of the gained knowledge. Drawing scetches, answering multipe-choice questions and verbalizing your own resolution can be part of the exam.

Length: 90 min.
Tools: dictionary

Repeat Examination:

(Recommended) Prerequisites:
Es werden rudimentäre Grundkenntnisse im allgemeinen Themenkomplex Wald, Holz, Bauwesen empfohlen.

Content:
The lecture series should offer an overview about the relations in the whole value chain of wood and forestry. A holistic approach beyond the limits of the faculties should deepen the

understanding for the ecologic, economic, socio-cultural and technical aspects of the topic ‘building with timber’.

Intended Learning Outcomes:
After having participated the course the students will be able to:

- understand the important aspects, challenges and strategies of modern silviculture in central Europe
- analyze the ecologic and economic relations between silviculture, wood processing and implementation in the building construction sector
- understand the state of the art in the production of solid timber and timber products
- gain an insight in the development of biogenic polymers
- gain an overview of the engineers topics of structural design, fire safety and building physics in timber construction
- gain an overview of the implementation fields of timber in building construction (multi storey buildings, timber engineering, construction in existing contexts…)
- understand the most important parameters at construction and design of timber buildings

Teaching and Learning Methods:
The interdisciplinary approach of TUM.wood is reflected by its teaching proposition. The aligned programme of the associated departments invites the students of the involved faculties to gain knowledge of the other areas of study. This comprehensive knowledge is presented within a series of lectures given by the different TUM.wood-partners. Referenced projects may show the complexity and conjunction of the diverse topics and relate therory and practice.
The content of the lectures shall be documented by the students themselves. These notes and the slides of the lecutres build the foundation for the exam. The main learning aspect is to understand the imparted knowledge and conncetion the coherences between the presented interdisciplinar topics. Suggestions for advanced literature will be given during the lessons.

Media:
Presentations of the lectures will be provided for the exam prepartions.

Reading List:
Kaufmann, H. und Nerdinger, W. (2011) Bauen mit Holz - Wege in die Zukunft. Ausstellungskatalog Pinakothek der Moderne. Prestel, München
Kaufmann, H. mit Krötsch, S. und Winter, S. (2021) Atlas Mehrgeschossiger Holzbau. Detail Verlag, München

www.dataholz.eu
www.informationsdienst-holz.de

Weitere projektbezogene Literaturempfehlungen werden zu Beginn der jeweiligen Veranstaltung mitgeteilt.
Je nach Themenschwerpunkt wird ein Handapparat zur Verfügung gestellt.

Responsible for Module:
Birk, Stephan; Prof. Dipl.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
TUM.wood Lecture Series: Exploring the Wood Value Chain (Vorlesung, 2 SWS)
Schuster S [L], Schuster S, Seidl R, Annighöfer P, Ludwig F, Dörfler K, Weber-Blaschke G, van de Kuilen J, Zollfrank C, Benz J, Winter S, Birk S, Nagler F
For further information in this module, please click campus.tum.de or here.

Module Description

CS0008: Enzyme Engineering | Enzyme Engineering [EE]

Version of module description: Gültig ab summerterm 2022

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:
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 written seminar report must be created.The total grade consists of the written exam grade (67%) and the grade of the seminar report (33%).

Repeat Examination:
Next 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 seminar aims to convey basic bioinformatical tools used in rational enzyme design such as ligand docking, energy minimization and rational introduction of mutations. These methods will be practiced on real enzymes and used to generate improved enzyme variants for a specific engineering target.

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 these improvements and they own the theoretical ability to put these improvements into practice. After having participated in the seminar the students are able to use different bioinformatical tools for rational enzyme design and are able to evaluate the results of the generated informatical predictions.

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. In the seminar, the students will be guided through the single steps of a rational enzyme engineering approach with the help of a script. The results of these steps will be summarized in a written report to put the single steps into a larger context.

Media:
PowerPoint, lecture script, scientific publications

Reading List:
Recommendations:
"Directed Enzyme Evolution: Screening and Selection Methods” (Methods in Molecular Biology) and “Directed Evolution Library Creation: Methods and Protocols” (Methods in Molecular Biology), both Frances H. Arnold, George Georgiou (publisher), Springer, Berlin
“Protein Engineering Protocols” (Methods in Molecular Biology), Katja M. Arndt and Kristian M. Muller (publisher), Springer, Berlin.

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

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

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

Module Description

CS0009: Enzymatic Biotransformations | Enzymatic Biotransformations [IBT]

Version of module description: Gültig ab winterterm 2023/24

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 students should be able to understand and describe possibilities and limitations of established industrial enzymatic processes. This understanding and its application 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). As a voluntary mid-term effort, the students can take part in three online test within the Moodle course of the exercise. If they achieve at least 65% of the points in these tests, a bonus of 0.3 will be credited on the grade of the written examination (however, an improvement of the grade from 4.3 to 4.0 is not possible).

Repeat Examination:
Next 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 or online questions

Reading List:

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

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

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

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

Version of module description: Gültig ab summerterm 2024

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 module examination takes the form of a presentation followed by discussion. The learning outcomes are verified by a group project (3-4 students per group). The presentation of the developed code and the results of the project will be done together as a group, with each group member presenting one part. The presentation should be equally divided among the group members. After the presentation, each group member is asked individual questions about the project. The final grade will be based on the presentation and results of the project (duration of presentation and questions: approx. 30 min depending on group size; approx. 8-10 minutes per student). As a voluntary mid-term effort, the students can take part in a multiple-choice test (duration: 10 minutes). If they achieve at least 65% of the points in this test, a bonus of 0.3 will be credited on the grade of the presantation (however, an improvement of the grade from 4.3 to 4.0 is not possible).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Mathematical Skills in Linear Algebra and Statistics as well as Programming Skills in Python are expected

Content:
Technologies that generate analyses or predictions based on data can be found in almost all areas of our daily life (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, predicting 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 to various real-world problems.

The following contents will be treated exemplarily:
- Similarity and Distance Metrics
- Data Preprocessing and Visualization
- Dimensionality Reduction (e.g., Principal Component Analysis)
- Classification (Nearest-Neighbor, Logistic Regression, Decision Trees, Support Vector Machines (SVM))
- Model Selection and Hyperparameter Optimization (Confusion Matrix and Evaluation Measures, Cross-Validation, Hyperparameter tuning techniques, Common problems such as Over- vs. Underfitting)
- Clustering (K-Means, Hierarchical Clustering)
- Regression Models (Linear Regression, Support Vector Regression)

AI-based technologies have the potential to support many areas of biotechnology and sustainability, e.g. by guiding downstream research with data-driven predictions or supporting decision-making with demand forecasts. In this course, we will look at suitable practical examples and demonstrate their potential.

Intended Learning Outcomes:
The students know the fundamental and most important artificial 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. Students will understand how artificial intelligence can support areas of biotechnology and sustainability and are able to assess the potential of AI-based approaches in sustainability projects.

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:
Grimm, Dominik; Prof. Dr.

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

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

Module Description

CS0024: Electrobiotechnology | Electrobiotechnology [EBT]

Version of module description: Gültig ab winterterm 2023/24

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 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:
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:
Plumeré, Nicolas; Prof. Dr. rer. nat.

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

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

Module Description

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

Version of module description: Gültig ab summerterm 2023

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:
Examination: A 60-minute written examination in which students demonstrate their ability to solve analytical problems using a combination of experimental and theoretical methods. No aids are allowed in the examination. Participation in the examination is subject to a 90% attendance in the lecture and seminar.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prerequisite for this module is the successful completion of a course in Instrumental Analytics including GC/MS and LC/MS. Proof (module description, transcript of grades) must be sent to corinna.urmann@tum.de before the start of the module. If you have obtained your Bachelor degree in Chemical Biotechnology at the TUM Campus Straubing, you do not need to send the module description, as we know the content of the lecture. If the requirements are met, you will be admitted to the module with a maximum of 10 students. An insurance for damages in the laboratory is necessary.

Content:
The module deals with chromatographic methods such as GC and LC (sampling, sample preparation, sample separation) in combination with different detection options such as MS, MS/MS (e.g. high resolution). In addition, different evaluation methods (practical and theoretical) for structure determination or compound identification are covered.

Intended Learning Outcomes:
After successful participation in the module, students will be able to recognise the potential applications of the methods as well as their limitations. Understand and confidently discuss

the methods and techniques presented, as well as terms and abbreviations. Apply evaluation procedures and principles of documentation and reporting correctly. Independently formulate challenging analytical questions, identify appropriate analytical techniques and combine experimental and theoretical methods to solve the problems.

Teaching and Learning Methods:
The teaching methods used are the lecture with PowerPoint support, as well as teaching videos, open source software and additional material. In the seminar, students will work on practical examples and present their results to their colleagues.

Media:

Reading List:

Responsible for Module:
Dr. Corinna Urmann

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

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

Module Description

CS0100: Microbial and Plant Biotechnology | Microbial and Plant Biotechnology [MPBioTech]

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
In order to check whether students have understood and are able to apply the principles and relevant methods and techniques of biotechnological production processes, the students answer questions about production processes and fermentation strategies, as well as on important methods and applications in plant biotechnology in a written exam (90 min) and prove that they have understood the correlations of metabolism. Allowed tools are calculators.

Repeat Examination:
Next semester

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

Content:
In the lecture microbial biotechnology relevant topics and techniques of microbial biotechnology are presented. This includes the quantitative description of the metabolic performance of microorganisms, industrially relevant substrate sources, metabolic engineering strategies as well as examples of industrial production processes (e.g.: alcohols, amino and organic acids).
In the lecture plant biotechnology the most important model and crop plants in biotechnology are presented, classified and their morphological and physiological properties are emphasized. Major questions, methods and solutions will be discussed with thier pros and cons. Some of the topics to be discussed: legal framework, major appilcation of current plant genetic engineering, the Arabidopsis model system, snovel concepts for yield and quality improvement. One focus is on the challenges for agriculture caused by climate change and sustainable solutions.

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

Teaching and Learning Methods:
The contents of the lectures are conveyed by a talk of the lecturer, based on PowerPoint presentations. The blackboard might additionally be used to explain more complex relationships. To a limited extent, this can be supplemented by self-study of the literature mentioned in the lecture.

Media:
PowerPoint, whiteboard

Reading List:
Microbiology – an evolving science, J. L. Slonczewski, J. W. Foster, W W Norton & Co Inc, 4th edition, ISBN: 978-0-393-61403-9 (available in the library)
Molecular Biology of the Gene, I. D. Watson, T. A. Baker, A. Gann, M. Levine, Losick, Pearson, 7th edition, ISBN-13: 978-0321762436 (available in the library)
Biotechnology, R. D. Schmid, C. Schmidt-Dannert, Wiley-VCH, 1st edition, ISBN: 978-3-527-33515-2 (available in the library, eBook)
Industrial Microbiology, D. B. Wilson, H. Sahm, K.-P. Stahmann, M. Koffas, Wiley-VCH, 1st edition, ISBN: 978-3-527-34035-4 (available in the library)
Industrial Biotechnology – Products and Processes, C. Wittmann, J. Liao, Wiley-VCH, volume 4, ISBN: 978-3-527-34181-8 (available in the library, eBook)
Industrial Biotechnology – Microorganisms, C. Wittmann, J. Liao, Wiley-VCH, volume 4, ISBN: 978-3-527-34179-5 (available in the library, eBook)
Campbell Biology N. A. Campbell, L. A. Urry, M. L. Cain, S. A. Wasserman, P. V. Minorsky, J. B. Reece, Pearson, 11th edition (2018) (available in the library)

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

Courses (Type of course, Weekly hours per semester), Instructor:
Microbial Biotechnology (Vorlesung, 2 SWS)
Blombach B [L], Blombach B

Applied Microbiology and Metabolic Engineering (Lecture) (Vorlesung, 2 SWS)
Blombach B [L], Blombach B, Glawischnig E

Plant Biotechnology (Lecture) (Vorlesung, 2 SWS)
Glawischnig E [L], Glawischnig E
For further information in this module, please click campus.tum.de or here.

Module Description

CS0104: Biogenic Polymers | Biogenic Polymers [Bioplar]

Version of module description: Gültig ab 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:
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" 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:
Zollfrank, Cordt; Prof. Dr. rer. silv.

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

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

CS0108: Catalysis | Catalysis

Version of module description: Gültig ab summerterm 2022

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:
Results will be assessed by a written exam (90min), whereby the students explain important facts of technical catalysis chemistry, mechanistic aspects of catalysts how catalysts work, what is their typical composition and show practical applications by using examples.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic organic and inorganic chemistry

Content:
transition metal compounds, homogenous/heterogenous catalysis, mechanistic details of activation of organic and inorganic molecules at transition metal compounds, surface chemistry, characterisation of catalysts, heat/mass transfer at catalyst grains, reactor designs

Intended Learning Outcomes:
Students can show important chemical aspects of the phenomenon of catalysis with simple examples. They can show the implication of a catalyst in an overall reaction and can quantify it mathematically by using typical measurable values.

Teaching and Learning Methods:
Using lectures, basic principles of catalysts and catalysis will be transmitted.

Media:
Power point presentation, table, oral teaching, discussion

Reading List:
Dirk Steinborn, Grundlagen der metallorganischen Komplexkatalyse, Vieweg und Teubner Verlag, 2. Auflage 2009 (434 Seiten, 41 €).

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

Courses (Type of course, Weekly hours per semester), Instructor:
Catalysis (Lecture) (Vorlesung, 3 SWS)
Riepl H [L], Riepl H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0109: Sustainable Energy Materials | Sustainable Energy Materials [SEM]

From the basics to the application

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
The learning outcomes will be checked through a written exam (90 minutes) in which the students have to reproduce essential aspects of sustainable energy materials and their applications through examples. In addition, mathematical problems will be given to show that the students are able to quantify simple examples.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge of basic electrochemistry/physical chemistry is beneficial, but not required.

Content:
Sustainable energy management is an important issue to minimize environmental impact and climate change. Electrochemical devices such as fuel cells and batteries can help use Renewable In this course, you will learn about the basics of electrochemistry and various important devices used in current and future energy systems, such as fuel cells, batteries, and electrochemical water splitting. The lectures will cover the working principles, components, materials, applications, and future potential of these devices in the energy economy.
Using catalysts in chemical reactions can increase their speed and selectivity, leading to significant energy savings. One section of the course will focus on fuel cell catalysis, and other ideas such as using catalysts in chlorine electrolysis will be introduced to demonstrate how choosing the right counter reaction can result in energy efficiency. The topic of water splitting to obtain hydrogen will be covered later in the course.
We will examine the use of different materials in energy-related devices and how their electronic and ionic properties affect their performance.

Batteries play a crucial role in electromobility by efficiently storing and releasing electrical energy. One part of the course will cover Li-ion batteries, starting with an overview of their fundamentals and the most common cell types. In addition to discussing the characteristics of typical Li-ion electrode materials and electrolytes, the course will show how key performance characteristics such as energy density, power density, and lifespan are influenced by the cell chemistry. The course will also introduce concepts for the next generation of batteries, such as all-solid-state batteries.

Intended Learning Outcomes:
Upon successful completion of this course, students will be able to:
1. Understand and Explain Key Concepts in Electrochemistry:
o Remember and describe the fundamental principles of electrochemistry, including thermodynamics, kinetics, Pourbaix diagrams, and the Butler-Volmer equation.
o Explain the significance of electrochemical processes in energy conversion and storage technologies.
2. Analyze Electrochemical Systems:
o Interpret Pourbaix diagrams to determine the stability of materials in various pH and potential conditions.
o Apply the Butler-Volmer equation to analyze the kinetics of electrochemical reactions in different energy systems.
o Evaluate the thermodynamic feasibility of electrochemical reactions in sustainable energy applications.
3. Comprehend and Apply Battery Fundamentals:
o Understand the working principles of batteries, including charge/discharge processes, energy density, and power density.
o Differentiate between various battery types (e.g., lithium-ion, sodium-ion, solid-state, flow batteries) based on their materials, design, and application potential.
o Apply knowledge of battery chemistry to assess the performance and suitability of different battery types for specific sustainable energy applications.
4. Develop and Evaluate Sustainable Battery Solutions:
o Develop strategies for improving the efficiency, lifespan, and environmental impact of existing battery technologies.
o Critically evaluate the potential of emerging battery materials and technologies for future energy storage solutions.
5. Understand and Analyze Hydrogen Fuel Cells:
o Explain the principles of hydrogen fuel cells, including the role of catalysts, membrane technology, and the overall electrochemical process.
o Analyze the efficiency and challenges associated with hydrogen fuel cells in comparison to other energy conversion technologies.
o Evaluate the environmental and economic implications of hydrogen fuel cell deployment in various sectors.
6. Comprehend and Apply Knowledge of Electrolyzers:
o Understand the operation of electrolyzers, particularly in the context of hydrogen production from renewable energy sources.

7. Integrate Knowledge to Develop Sustainable Energy Solutions:
o Synthesize knowledge from electrochemistry, battery technology, and hydrogen energy systems to propose innovative solutions for sustainable energy storage and conversion.
o Critically evaluate the trade-offs between different energy materials and technologies, considering factors such as cost, scalability, environmental impact, and performance.
These learning outcomes are designed to ensure that students not only grasp the theoretical concepts of sustainable energy materials but also apply and evaluate these concepts in practical, real-world contexts.

Teaching and Learning Methods:
The module consists of a lecture with integrated exercises. The learning content is conveyed through lectures. In the integrated exercises, students work on individual questions and present their solutions.

1) Lectures:
- Purpose: Lectures provide the essential theoretical foundation in sustainable energy materials, covering key topics like basic electrochemistry, battery fundamentals, and hydrogen fuel cells.
- Approach: Interactive and structured with clear explanations, visual aids, and real-world examples, lectures often include brief in-class exercises to reinforce understanding.
- Outcome Alignment: Lectures support learning outcomes related to understanding and explaining core concepts, while integrated exercises help students begin to apply and analyze these ideas.

2) Exercises and Problem-Solving Sessions:
- Purpose: These sessions reinforce lecture material, allowing students to practice problem-solving, apply theory to real-world scenarios, and deepen their understanding.
- Approach: A mix of individual and collaborative exercises, including problem sets, with guidance from instructors to support learning.
- Outcome Alignment: Exercises align with outcomes related to applying, analyzing, and evaluating knowledge, preparing students for advanced tasks in projects and labs.

Media:
1) Presentation Slides:
• Purpose: Presentation slides will be the primary medium for delivering content during lectures. They will be designed to visually complement the spoken content, providing clear and concise explanations of key concepts, diagrams, equations, and real-world examples.
• Usage: Slides will be used to illustrate complex ideas in electrochemistry, battery technology, and hydrogen systems, helping students to follow along and understand the material more effectively. Key points, equations (e.g., Butler-Volmer equation), and visual aids (e.g., Pourbaix diagrams) will be highlighted to enhance comprehension.
• Accessibility: All slides will be made available to students before or after the lectures via the course's online platform, allowing for review and study at their own pace.
2) Online Learning Platform:

• Purpose: The online learning platform (e.g., Moodle, Blackboard) will serve as the central hub for course materials, communications, and assessments. It will facilitate a blended learning approach, integrating various media forms into a cohesive learning experience.
• Usage: The platform will host lecture slides, videos, reading materials, quizzes, and assignments. It will also be used for discussion forums where students can ask questions and engage in peer learning. This platform supports continuous access to resources and enables students to manage their learning effectively.
• Interactivity: Features such as quizzes, polls, and discussion boards will allow students to interact with the material and with each other, enhancing engagement and reinforcing learning.
3) Textbooks and Research Articles:
• Purpose: Textbooks and scholarly articles provide in-depth coverage of theoretical concepts and the latest research developments in the field. These resources are essential for supporting lecture content and offering additional perspectives on topics covered in the course.
• Usage: Core textbooks will be recommended for fundamental concepts, such as basic electrochemistry and battery technology. Research articles will be assigned to provide insights into recent advancements and emerging trends in sustainable energy materials. These readings will complement lecture content and form the basis for exercises and discussions.
• Depth: By engaging with these texts, students will deepen their understanding of the material and develop critical thinking skills, particularly in evaluating new research and technological developments.

Reading List:
Handbook of fuel cells, Wolf Vielstich, Hubert A. Gasteiger, Arnold Lamm, 2010
Electrochemical Systems, Karen Thomas-Alyea, John E. Newman, 2021

Responsible for Module:
Ledendecker, Marc; Prof. Dr. rer. nat.

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

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

Module Description

CS0149: Renewable Resources in Medicine | Renewable Resources in Medicine

Version [overlapping text] ereoe

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:
Zollfrank, Cordt; Prof. Dr. rer. silv.

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

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

Module Description

CS0156: Material Application for Renewable Resources | Material Application for Renewable Resources

Version of module description: Gültig ab summerterm 2024

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:
During the seminar, students independently work on a selected topic from the field of biobased materials and give an oral presentation with PowerPoint-handout (min. 10 slides). Group work is compulsory (3 – 5 persons). The students will implement their own online survey and present the findings in the context of the relevant literature in the presentation (each student has to present 5 minutes). The oral presentation shall be assessed according to content of the PowerPoint-handout and rhetoric aspects. The PowerPoint-handout summarizes the relevant literature, data, and key findings. Weighting: PowerPoint-handout 1, oral presentation 1.
The seminar work is not part of the written exam. However, midterm bonus points can be achieved which will have an effect on the individual final grade (-0,3).

Assessment requires a written examination (90 minutes). Students demonstrate their knowledge of physico-chemical properties and possible applications of biobased materials, as well as their environmental impact. Students are able to develop options for chemical synthesis and production processes of biobased plastics. No further tools are allowed in the examination.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Successful participation in "Basics in chemistry " and “Biogenic Polymers”, as well as knowledge of materials and chemical compounds, or comparable knowledge of chemistry and physics.

Content:
Lectures give an overview the applications for biogenic resources in materials industry. Starting with the chemical composition and physic-chemical properties of the raw materials, the module introduces students to production and processing of biodegradable and non-biodegradable

bioplastics, as well as of natural fibre composites. It also covers material properties, relevant fields of application, their environmental impact, as well as current market trends.
In the seminar, students independently work on research papers and based on that, give a presentation to fellow students.

Intended Learning Outcomes:
After successful participation, students are able to assess opportunities and barriers for the application of biobased plastics, as well as their environmental impact compared to conventional plastics. Above all, they are competent to select suitable feedstocks, classes and types of materials, as well as processes to meet the technical requirements of a specific target product, having lower environmental impact at the same time.

Teaching and Learning Methods:
Lecture (talks using PowerPoint slide media, books and additional written material), seminar (independent work on a selected topic with subsequent presentation, peer instruction and constructive feedback).

Media:
Presentations, slide notes

Reading List:
Endres, H.J., Seibert-Raths, A., Technische Biopolymere, Carl Hanser Verlag, München, 2009
Pickering, K. L. (Hrsg.): Properties and performance of natural-fibre composites, CRC Press, Boca Raton 2008
Lewin, M.(Hrsg.): Handbook of Fibre Chemistry, Marcel Dekker, New York, 1998

Responsible for Module:
Fink, Bettina; Dr. rer. nat.

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

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

Module Description

CS0181: Advanced Electrochemistry | Advanced Electrochemistry

Version of module description: Gültig ab winterterm 2023/24

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) at the end of the semester. During the semester four online test to each of the main topics of this module are offered as voluntary mid-terms. The online tests are opened in the week after a main topic was concluded and remain open for five days. Up to 10% of the total number of points of the final examination can be credited as bonus points. The results of the online tests, which are held during the semester, determine the amount of bonus points. At least 65% of the points in the online test must be achieved in order to receive bonus points. This means the online test are not graded, the points reached in the online test only determine if and how many bonus points a student gets for their final examination. It is not possible to raise the grade from 4.3 or worse to 4.0. This should encourage students to continuously participate in the lectures and exercises which are very important to them. Based on questions to electrochemical aspects the students prove that they know the corresponding technical terms, designations and contents, that they 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:
End of Semester

(Recommended) Prerequisites:
Participation in the Modules “Allgemeine Chemie” and “Physikalische Chemie”, “Mathematik” und “Physik” or similar courses. In general the student should have a basic knowledge of the reaction kinetics and thermodynamics.

Content:
- Fundamentals of Electrochemistry: Thermodynamics (electrochemical potential, electrode potential, Nernst equation), 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.
- 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 acquire knowledge of advanced concepts of electrochemistry. They master the most important analytical techniques for investigating and evaluating electrochemical systems and know how to control them. In particular, they understand where and when certain measurement techniques are used and what knowledge they gain from them. Based on this, they are able to investigate the same system under different limiting conditions. Furthermore, the students are familiar with the electrochemical processes relevant in industry, such as the conversion of renewable energies, green electrosynthesis and sustainable energy generation and storage, and can apply their theoretical knowledge to these processes. Furthermore, they know concrete application examples from research and industry and how these can be designed and optimised.

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using text documents, 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, Moodle course with online tests, exercise sheets, question cataloge, PowerPoint, script

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

Responsible for Module:
Plumeré, Nicolas; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Electrochemistry (Übung, 1 SWS)
Plumeré N [L], Moore Y

Advanced Electrochemistry (Vorlesung, 2 SWS)
Plumeré N [L], Plumeré N
For further information in this module, please click campus.tum.de or here.

Module Description

CS0219: Protein-based Materials for Technology | Protein-based Materials for Technology

Version of module description: Gültig ab summerterm 2023

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 performance test will be in the form of a written examination. The students should demonstrate an understanding of the lecture content and its applications to problems related to proteins-based materials in the exam. No auxiliary means are allowed in the exam. 120 min examination time.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
This course will intend to consolidate concepts in Physics, Mechanics, Physical Chemistry, Biology, Engineering, and Chemistry having the focus on articles describing protein-based materials and their used in technological platforms. As such, knowledge in Physics, Chemistry, Mechanics, and Biology is required.

Content:
The module aims to provide in-depth knowledge to the students in physical chemistry, spectroscopy, thermodynamic, protein structure, and optoelectronics applied to protein-based materials. The module will study scientific articles that describe protein-based materials. The first focus will be on extracting information about the structure-functionally relationship of proteins and their interaction with other molecules and macromolecules and the different techniques used for that purpose. The second focus will be on studying how protein-based materials can have applications outside the typical biology range.
The course will study at least one scientific article per session to cover protein-based materials with applications in optoelectronics, medicine, and chemistry.
Each topic will be addressed, refreshing the most important physicochemical principles and more useful techniques followed by their relevance in these materials' structural and functional aspects and their application.

Intended Learning Outcomes:
At the end of the module, the students will be able i) to critically evaluate the information in scientific articles relating to novel protein-based materials for technology; ii) to analyze protein-based materials using a physicochemical perspective; iii) to describe the different ways protein interact with other molecules or macromolecules to form functional materials; iv) to describe the main role and characteristics of protein-based materials in technological platforms. They will be able to examine the structure of proteins and other molecules and macromolecules and the forces that define their functionality. They will be able to apply these concepts in bio-based and bio-inspired technologies.

Teaching and Learning Methods:
This course attendance includes lectures and seminars. For this purpose, powerpoint presentations, practical training materials, and open discussion seminars will be used.

Media:
The following forms of media apply: script, powerpoint, films, and blackboard

Reading List:
1. Physical Chemistry for the Biological Sciences, 2nd Edition Gordon G. Hammes, Sharon Hammes-Schiffer, Wiley, 2015, ISBN: 978-1-118-85900-1
2. Physical Chemistry for the Life Sciences, 2ndEdition Peter Atkins and Julio De Paula Oxford University Press ISBN: 978-0-19-956428-6
3. Introduction to Biophotonics Paras N. Prasad Wiley 2003, ISBN: 0-471-28770-9.
4. Introduction to Biomechanics Duane Knudson Springer 2007 ISBN: 978-0-387-49311-4

Responsible for Module:
Costa Riquelme, Rubén Dario; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Protein-based materials for technology (Exercise) (Übung, 2 SWS)
Costa Riquelme R [L], Costa Riquelme R, Atoini Y, Banda Vazquez J

Protein-based materials for technology (Vorlesung, 2 SWS)
Costa Riquelme R [L], Costa Riquelme R, Atoini Y, Banda Vazquez J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0245: Advanced Electronic Spectroscopy | Advanced Electronic Spectroscopy

Version of module description: Gültig ab summerterm 2022

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 performance test will be in the form of a written examination. The students should demonstrate in the exam the understanding of the different techniques taught during the module.
No auxiliary means are allowed in the exam. 120 min examination time

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
This course will intend to consolidate concepts in Physics, Chemistry, and Instrumentation having the focus on articles utilizing the different techniques. As such, knowledge in Physics, Chemistry, and Instrumentation is required.

Content:
The module aims to provide in-depth knowledge to the students in electronic spectroscopy and its applications.
The module will critically evaluate optical spectroscopy techniques such as fluorescence, Uv-Vis absorption, Circular dichroism, photoacoustic spectroscopy, and circularly polarized luminescence focusing on their fundamental strength and weakness. Every method will be described following three main focuses: theory, material description, and applications.
Application examples will be from literature and journal articles.
The module will also continuously reinforce the theoretical background of the interaction between electromagnetic radiation and matter.

Intended Learning Outcomes:
At the end of the module, the students will have developed the ability to analyze advanced problems in electronic spectroscopy and associated phenomena. They will learn to evaluate

critically information regarding techniques such as fluorescence, Uv-Vis absorption, Circular dichroism, photoacoustic spectroscopy, and circularly polarized luminescence.

Teaching and Learning Methods:
This course attendance includes lectures and exercises. Additionally, in the module's final weeks, the student will be encouraged to create a presentation consisting of their critical analysis of a journal article. For this purpose, PowerPoint presentations, practical training materials, and open discussion seminars will be used.

Media:
The following forms of media apply Script, PowerPoint, films, and blackboards.

Reading List:
1. Physical Chemistry for the Life Sciences, 2ndEdition Peter Atkins and Julio De Paula Oxford University Press ISBN: 978-0-19-956428-6
2. Introduction to Biophotonics Paras N. Prasad Wiley 2003, ISBN: 0-471-28770-9.
3. Principles of fluorescence spectroscopy , Lakowicz, Joseph R., ed. . Springer science & business media, 2013.

Responsible for Module:
Costa Riquelme, Rubén Dario; Prof. Dr.

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

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

Module Description

CS0261: Phytopharmaceuticals and Natural Products | Phytopharmaceuticals and Natural Products [Phytopharm]

Version of module description: Gültig ab summerterm 2022

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:
Knowledge of the covered topics of phytopharmaceuticals and natural products compounds is assessed in a written examination (90 minutes). In addition, students are required to explain the medicinal effects of medicinal plants in the examination using examples.

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

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.

Teaching and Learning Methods:
The lecture takes the form of oral presentation given by teaching staff with the help of PowerPoint media, books and other written material.

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:
Riepl, Herbert; Prof. Dr.

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

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

Module Description

CS0264: Polymer Processing | Polymer Processing [PolyProc]

Processing of polymers intro plastic parts

Version of module description: Gültig ab summerterm 2024

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 content and learning objectives of the lecture are examined at the end of the semester in a written test (90 min). An oral pre-test containing safety relevant laboratory work issues must be carried out before the individual pratical course. A written report on the practical course consisting of approximately five pages must be submitted. The written report is an ungraded student achievement.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Polymer chemistry, polymer physics, rheology fluid mechanics, Biogenic Polymers

Content:
The lecture deals with unit operations, basic techniques and processes of plastic material processing, e.g. compounding, extrusion, injection molding, plastic part forming processes and also typical applications. In addition, methods for characterizing thermal and mechanical properties are presented. One focus here is the connection between the processing parameters and the end-use properties. The acquired knowledge is deepened in the accompanying practical course. Injection molding and extrusion tests are carried out and the test specimens are then characterized with regard to their thermal, optical and mechanical properties. Additional foci will be laid on the chemistry, structure and classification of polymers and plastic parts. The lecture also deals with the physical properties of polymers and plastic materials involving materials science. Characterization of the mechanical and thermal properties and their effects on processing, viscosity, viscoelastic behavio will be discussed

Intended Learning Outcomes:
In addition to the chemical-physical basics of polymeric materials, this module imparts the methodical knowledge about classic and modern innovative processing methods of polymeric materials. The students are able to sensibly classify plastic materials, their manufacture and use them for specific applications. The basics for the production technology of plastic materials are acquired. After successfully completing the module, students are able to select and use methods for processing plastic. They will be able to assess sustainability aspects of the polymer production process in terms energy consumption and materials use. Through practical work, the competence for the meaningful use of testing and characterization methods of polymer materials is acquired.

Teaching and Learning Methods:
Lecture (lecture by teaching staff with Power Point slide media, books and other written material), laboratory practical course (experimentation of the students under supervision)

Media:
Power Point slide presentations; Drawing and writing on a black board; Laboratory equipment for experimentation

Reading List:
Polymer Engineering; Technologien und Praxis; Peter Eyerer, Peter Elsner, Thomas Hirth
Polymer Extrusion; Chris Rauwendaal
Extrusion: The Definitive Processing Guide and Handbook; Harold F. Giles, Jr.
Einführung in die Kunsstoffverarbeitung; Michaeli, W.
Werkstoffkunde der Kunststoffe; Menges, G.

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

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

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

Module Description

CS0265: Biorefinery | Biorefinery [BioRaff]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Students answer questions in a written examination (60 minutes) that will be graded. They thereby show that they have understood, can explain and are able to assess the various steps and processes involved in biorefinery. In an additional voluntary coursework (Mid-term), 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" and a short presentation (5 min). Bonus points (up 10/60 depending on the quality) will be awarded for the coursework on the written exam.

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; role of biorefineries for the development of a sustainable biobased economy; presentation and analysis of different biorefinery systems (e.g. green biorefinery, lignocellulose biorefinery);
selected procedures for the extraction of resources (focused on lignocellulose);
selected biogenic compounds 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 biorefineries. The understand the importance of biorefineries for a future sustainable biobased economy. 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:
Schieder, Doris; Dr. rer. nat.

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

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

Module Description

CS0266: Sustainable Chemistry | Sustainable Chemistry

Version of module description: Gültig ab summerterm 2024

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:
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. This presentation is 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:
Zollfrank, Cordt; Prof. Dr. rer. silv.

Courses (Type of course, Weekly hours per semester), Instructor:
Sustainable Chemistry (Seminar) (Seminar, 1 SWS)
Zollfrank C [L], Helberg J, Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0267: Biological Materials | Biological Materials

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor/Master	**Language:** English	**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:
Understanding of the course contents and their application will be tested in a written exam of 90 minutes duration. In detail, the students are required to describe the physical and chemical foundations of the formation, as well as relations between the hierarchical structure and properties, of typical biological materials. Further, the transfer of this knowledge to technological applications and to the design of novel biologically inspired materials, as covered in the course, is a test subject. Lecture notes are not permitted.

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:
After 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:
Van Opdenbosch, Daniel; Dr. rer. nat.

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

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

Module Description

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

Version of module description: Gültig ab summerterm 2013

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:
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:

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

Module Description

WZ1162: Practical Course Renewable Raw Materials | Praktikum Nachwachsende Rohstoffe

Version of module description: Gültig ab winterterm 2015/16

Module Level: Master	**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:
"Eine Studienleistung wird durch die korrekte Durchführung aller Laborexperimente mit korrekter Protokollierung erbracht. Damit weisen die Studierenden nach, dass sie die vermittelten experimentellen und analytischen Arbeitstechniken anwenden und Laborexperimente ordnungsgemäß dokumentieren können. Optional können vor Versuchsbeginn schriftliche oder mündliche Antestate zu den Versuchsbeschreibungen im Praktikumsskript als weitere Studienleistung eingefordert werden, um die angemessene Praktikumsvorbereitung der Studierenden zu zeigen.
Nach Ende des Praktikums findet eine mündliche Prüfung statt, in der die Studierenden nachweisen sollen, dass sie die den Versuchen zugrundeliegenden Prozesse und Reaktionen sowie die Hintergründe der eingesetzten experimentellen Arbeitsschritte verstanden haben. "

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Erforderlich: Vorlesung "Einführung in die stoffliche Nutzung" sowie gegebenfalls Angleichungsmodule "Grundlagen Chemie" und "Grundlagen Biologie" oder vergleichbares Vorwissen.

Content:
In Laborexperimenten werden zentrale Schritte ausgewählter chemischer und bio(techno)logischer Prozesse zur Herstellung von Chemikalien, Werkstoffen und Energieträgern aus nachwachsenden Rohstoffen nachvollzogen. Weiterhin werden allgemein notwendige Grundlagen für das Arbeiten in chemischen und mikrobiologischen Labors sowie spezielle analytische Methoden vermittelt, um Substrate und Produkte zu charakterisieren (u.a. Enzymassays,

Dünnschichtchromatographie, Kapillarviskosimetrie, HPLC, Infrarotspektroskopie, spezielle Methoden zur Polymercharakterisierung).

Intended Learning Outcomes:
Nach Praktikumsteilnahme besitzen die Studierenden ein vertieftes Verständnis für die ausgewählten Beispielprozesse und die zugrundeliegenden Reaktionen. Sie sind mit dem Arbeiten in chemischen und mikrobiologischen Labors in den Grundzügen vertraut und in der Lage, die vermittelten speziellen experimentellen und analytischen Methoden mindestens in den Grundzügen anzuwenden und Laborexperimente korrekt zu protokollieren.

Teaching and Learning Methods:
Laborexperimente in Kleingruppen unter Anleitung mit vorheriger Einführung in die Theorie zu den einzelnen Experimenten, sowie Auswertung der Ergebnisse in Form von Versuchsprotokollen

Media:
Praktikumsskript, ppt-Präsentationen, Tafelanschrift, Labor, Laborgeräte

Reading List:
Praktikumsskript

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

Courses (Type of course, Weekly hours per semester), Instructor:
Praktikum
Praktikum Nachwachsende Rohstoffe
6 SWS

Doris Schieder (doris.schieder@tum.de)

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

Module Description

WZ1164: Advanced Practical Course Chemistry | Chemisches Praktikum [ChemP]

Version of module description: Gültig ab winterterm 2015/16

Module Level: Master	**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:
During the course, experiments are supplemented by assessed oral examinations. Questions are based on the theoretical parts of the script, the practical experiments and related safety issues. This serves to examine acquired knowledge and contributes towards critical thinking in relation to potential risks.
At the end of the course, students will submit a report on each experiment carried out which contribute 50% to the overall assessment.
In the examinations and reports, students demonstrate their ability to apply acquired experimental and analytical techniques and correctly document laboratory experiments.
There is a written examination (60 minutes) at the end of the course. Here, students show that they have understood the chemical reactions underlying the experiments in addition to the background to the experiment procedure. The written examination and the completed reports both contribute 50% to the final grade.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Experience in safe handling of chemicals. Recommended: Participation in module "Basics of chemistry" and "Introduction to material use" or comparable knowledge.

Content:
Preparatory seminar including security advices. The contents include the explanation of practical methods and basics of data analysis. Practical experiments to extend the students' knowledge: renewable resources, vegetable fats and oils, terpenes, amino acids and proteins, sugar and polysaccharides, chemical technologies for the conversion of materials, polymers, sustainable

chemistry, catalysis, isolation of naturally ocurring substances, current synthesis methods, analytics.

Intended Learning Outcomes:
After participation students know basic steps in laboratory work, e.g. to weigh out, instrument setting and operation, dosing, extaction, destillation and chromatography. They are also aware of various reaction types and analysis methods relevant to material use of renewable resources and can apply them to laboratory experiments.

Teaching and Learning Methods:
A preparatory course includes security advices and explanations of practial methods and basics for the analysis of experiments. Afterwards, students work individually on laboratoy experiments and document their results in reports. Experiments are supplemented by assessed oral examinations.

Media:
Script, laboratory equipement

Reading List:
Practical course script

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.

Research Internship (max. 10 ECTS) | Research Internship (max. 10 ECTS)

Module Description

CS0294: Research Internship Master 5 ECTS | Research Internship Master 5 ECTS

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration are evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Background knowledge of the respective focus to which the project topics of the research internships are assigned. In this case, having a background in Python or SuperPro Designer and experience in the laboratory is often recommended.

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 120 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an

internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

Intended Learning Outcomes:
After participation in the module, students understand the principles of approach to (research)projects in addition to the subject-specific knowledge and working methods taught in the research internship projects, the planning of project work and the critical evaluation of the project results and can apply them to new project tasks. Furthermore, they are able to document, interpret and summarise project work and results in written form.

Teaching and Learning Methods:
Depending on the focus and topic, for example, experiments in laboratories, guided or independent literature and data research, concept studies, simulations, methods for project and experimental design or test evaluation

Media:
Depending on the focus and topic, e.g., experimental equipment (laboratory), databases, libraries, specialized software, programming software, simulation software, project and experimental design software

Reading List:
technical literature;
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

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

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Master 5 ECTS (Praktikum, 5 SWS)
Blombach B, Glawischnig E, Hädrich M, Vital S

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Costa Riquelme R [L], Costa Riquelme R

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Sieber V [L], Abbas Nia A, Al-Shameri A, Arana Pena S, Dsouza Z, Fornoni E, Friedrichs J, Fuchs A, Giustino A, Grundheber J, Hofer N, Hörnschemeyer K, Hupfeld E, Kampl L, Köllen T, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Rau M, Romeis D, Rühmann B, Scheerer J, Schieder D, Schulz M, Sieber V, Siebert D, Skopp A

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Zavrel M [L], Beerhalter D, Borger J, Dsouza V, Geisler N, Marino Jara J, Oktay I, Stegemeyer U, van der Walt H, Zavrel M

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

Module Description

CS0297: Research Internship Master 10 ECTS | Research Internship Master 10 ECTS

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 60	**Contact Hours:** 240

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration are evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Background knowledge of the respective focus to which the project topics of the research internships are assigned. In this case, having a background in Python or SuperPro Designer and experience in the laboratory is often recommended.

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 360 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

Intended Learning Outcomes:
After participation in the module, students understand the principles of approach to (research)projects in addition to the subject-specific knowledge and working methods taught in the research internship projects, the planning of project work and the critical evaluation of the project results and can apply them to new project tasks. Furthermore, they are able to document, interpret and summarise project work and results in written form.

Teaching and Learning Methods:
Depending on the focus and topic, for example, experiments in laboratories, guided or independent literature and data research, concept studies, simulations, methods for project and experimental design or test evaluation

Media:
Depending on the focus and topic, e.g., experimental equipment (laboratory), databases, libraries, specialized software, programming software, simulation software, project and experimental design software

Reading List:
technical literature;
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

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

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Master 10 ECTS (Forschungspraktikum, 10 SWS)
Banlaki I, Crean E, Gaizauskaite A, Kalkowski J, Li Y, Niederholtmeyer H

Research Internship Master 10 ECTS (RES) (Praktikum, 10 SWS)
Gaderer M [L], Huber B, Putra L

Research Internship Master 10 ECTS (Sieber) (Forschungspraktikum, 10 SWS)
Sieber V [L], Abbas Nia A, Al-Shameri A, Arana Pena S, Dsouza Z, Fornoni E, Friedrichs J, Fuchs A, Giustino A, Grundheber J, Hofer N, Hörnschemeyer K, Hupfeld E, Kampl L, Köllen T, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Romeis D, Rühmann B, Scheerer J, Schulz M, Sieber V, Siebert D, Skopp A
For further information in this module, please click campus.tum.de or here.

Elective Modules BOKU | Wahlmodule der BOKU

Module Description

CS0001BOK: Technologies of Wood Processing Lecture | Technologien der Holzverarbeitung VL

Version of module description: Gültig ab winterterm 2021/22

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 1	**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

CS0059BOK: BOKU: Applied Biocatalysis | BOKU: Applied Biocatalysis

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 50	**Contact Hours:** 25

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

Description of Examination Method:
Oral exam.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Knowledge of enzymatic reactions, engineering and (bio-)chemistry.

Content:
Applied biocatalysis" is an advanced lecture within the specialisation of “Protein engineering and technology”; in the master study programme Biotechnology H418. This course is based on the knowledge and concepts provided in engineering, chemistry, biochemistry, and molecular biology courses. The lecture starts with a general overview on enzymatic reactions, screening and engineering of enzymes for industrial applications, followed by the basics of biochemical reaction engineering (reaction and process engineering) and general criteria for industrial enzymatic processes. In the main part of the lecture specific examples of biocatalytic synthetic reactions of oxidoreductases, transferases, hydrolases, lyases, isomerases, and ligases in the various industrial sectors are introduced, analysed and probable improvements are discussed. Finally, general rules to establish a biocatalytic process will be the drawn and the strengths and weaknesses of biocatalytic reactions will be assessed.

Intended Learning Outcomes:
After successful attendance of this lecture the participants can recall the application of enzymes for the synthesis of bulk chemicals, fine chemicals and specialities. They can differentiate between different biocatalysts and know their cosubstrate requirements and necessary auxiliary reactions. They can evaluate the usefulness and performance of equilibrium reactions, enantiomeric reactions, hydrolytic reactions, reductive reactions, oxidation reactions, oxygenation reactions,

peroxidation reactions, Bayer-Villiger reactions, formation of C-C bonds, and de-/halogenation reactions. They can identify critical mechanistic limitations of reactions and rate limiting steps, and are competent to optimise reaction conditions. Finally, participants will be able to plan biocatalytic processes based on existing industrial processes and calculate performance numbers for the comparison of processes

Teaching and Learning Methods:
class lecture
Lectures equal to 1.2 ECTS will be accompanied by the idividual study of scientific articles and review materials (0.8 ECTS). For learning and the preparation to the oral exam 1 ECTS is designated.

Media:

Reading List:

Responsible for Module:
Dietmar Haltrich (BOKU)

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

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

Module Description

CS0062BOK: BOKU: Biomaterials | BOKU: Biomaterials

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 29	**Contact Hours:** 21

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

Description of Examination Method:
Written exam

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Elements of biomaterials · The making of – self-assembly and growth · Mechanical concepts in biomaterials · High-performance fibers: spider silk, keratin, collagen · Soft tissue – skin, cartilage, glue · Engineering with fibers: biological composite materials · Bioceramics – teeth, nacre · Art of hierarchical design 1: bone · Art of hierarchical design 2: wood · Intelligent materials – adaptive growth · Biomimetic and bio-inspired materials

Smart materials design may still be a challenge for us today, but Nature has been using it on a regular basis already ages ago. In spite of strictly limited resources and limitations imposed by environmental conditions, sophisticated biomaterials have evolved. They are specially adapted to fulfill specific tasks and are mechanically optimized. Even today, some of them still surpass artificially produced materials in many respects. In this course, selected biomaterials will be presented and their structure, mechanical properties and design strategies explained. A brief overview of experimental investigation methods and possibilities to use design principles from Nature shall be given as well.

Intended Learning Outcomes:
Students graduating from this course have basic knowledge about the design principles and properties of biological materials. They are able to describe structure and function of selected

example materials in detail, recognize common principles and draw conclusions for potential transfer of natural materials design to technical materials.

Teaching and Learning Methods:
Class lecture

Media:

Reading List:

Responsible for Module:
Helga Lichtenegger (BOKU)

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

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

Module Description

CS0064BOK: BOKU: Biotechnology for Sustainable Processes and Environmental Protection | BOKU: Biotechnology for Sustainable Processes and Environmental Protection

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**Total Hours:** 100	**Self-study Hours:** 74	**Contact Hours:** 26

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

Description of Examination Method:
Written exam

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Sustainable processes based on biotechnology
Biotechnology for valorization of biomass and energy production
Enzymatic degradation and processing of lignocellulose
Enzymatic functionalization of natural and synthetic polymers
Mechanisms of enzyme catalyzed degradation of xenobiotics
Enzyme catalysed reactions in soil and water
Enzyme-remediation
Biomarkers
Biotechnological processes with photo-autotrophic microorganisms

Intended Learning Outcomes:
Knowledge about biotechnology based strategies in sustainable processes.
Understanding of the basic principles in enzyme based degradation of xenobiotics and biomass degradation in nature.
Facts about biotechnology for valorization of biomass and about bioenergy production.

Students will be familiar with general principles of biotechnological processes with photo-autotrophic microorganisms and will understand typical advantages and disadvantages.

Teaching and Learning Methods:
Classroom lecture, self-study

Media:

Reading List:

Responsible for Module:
Georg Gübitz (BOKU)

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

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

Module Description

CS0109BOK: Practical Course Biobased and Biodegradable Plastics | Praktikum Biobasierte und biologisch abbaubare Kunststoffe

Version of module description: Gültig ab winterterm 2018/19

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**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:
continuous assessment
The following criteria equally contribute to the assessment of the performance:
1. Preparation:
Elaboration of the topic between preparatory meeting and start of the practical work
2. Commitment:
Participation in practical work, keeping of a protocol
3. Presentation of the results as group effort and individual involvement in the discussion and answering of questions

Repeat Examination:

(Recommended) Prerequisites:

- Practical experience in a chemical and/or microbiological lab
- Awareness about hazards & risks and safety requirements in a lab
- Participants should be familiar with the contents of the lecture 970304 Biobased and biodegradable plastics, which is the theoretical foundation of the practical experiments.

Content:
Students engage in practical work for the biotechnological production of polyhydroxybutyrate (P3HB), a biobased and biodegradable plastic. They experience basic principles of bioprocess technology, including tasks for up- and downstream processing and simple process analytics. The students are divided into two groups and work on one of two practical examples:

Example 1: Photoautotrophic production of PHB with cyanobacteria

- Setup, preparation and media preparation for a photobioreactor (airlift-external loop) at laboratory scale
- Inoculum preparation, inoculation, process control, operation of a batch fermentation process, sampling
- Concentration of an intracellular product (centrifugation)
- Analysis and evaluation of the results

Example 2: Heterotrophic production of PHB with a bacterial strain
- Setup, preparation and media preparation, sterilization of a bioreactor
- Inoculum preparation, inoculation, process control, operation of a fed-batch fermentation process, sampling
- Concentration of an intracellular product via microfiltration
- Analysis and evaluation of the results

The practical work and the results will be elaborated and assessed within the group. There will be a presentation day, where results and experiences of each are presented and discussed with all participants.

Intended Learning Outcomes:
The students are familiar with the practical work required for the operation of a biotechnological production process for biobased and biodegradable plastics and have conducted at least partially some of these operations in person.

The students are able to relate the theoretical knowledge from lectures with practical experiences and may also have experienced that practical processes can deviate from theoretically expected behavior.

The students have the ability to elaborate their own results and present them to a larger audience. They have sufficient insight on the topic to spontaneously engage in a discussion and to answer detailed questions related to their practical work and results.

Teaching and Learning Methods:
- Basic theoretical principles from the course 970304 or self-study from the provided course material

- Performing practical experiments and analyses in the laboratory or pilot plant under supervision. Practical work ranges over a period of approx. 3 weeks. With the exception of certain days (inoculation, harvest, etc.) permanent presence is not required. A working schedule will be prepared within the group. Total presence for the practical work will be approx. 40 hours.

- Elaboration of the results as teamwork. Presentation of the conducted work and the results; the groups present their work to each other. Presentations will be discussed in a plenary session. Each participant is obliged to participate in the discussion and to ask and answer questions.

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

CS0126BOK: Basics of Wood Science | Holzwissenschaftliche Grundlagen [CS0126BOK]

Wood based panels - survey

Intended Learning Outcomes:
Basics of wood science an technology as a base for othe lectures in the field of wood technology in the second part of the curriculum for students of forestry as well as students of forest producs

Teaching and Learning Methods:

Media:

Reading List:
Empfohlene Fachliteratur
Bosshard H H (1984) Holzkunde. Zur Biologie, Physik und Chemie des Holzes, Bd. 1-3, Birkhäuser, Basel

Grammel R (1989) Forstbenutzung. Technologie, Verwertung und Verwendung des Holzes. Verlag Paul Parey, Hamburg

Teischinger A, Fellner J (2000) Nutzhölzer. In: Pierer H (Hrsg.): Holzbauhandbuch. Österreichischer Agrarverlag, Leopoldsdorf

Download über boku learn, bzw. bei den Vortragenden

Responsible for Module:
BOKU Grabner Michael, Wimmer Rupert Institut für Holztechnologie und Nachwachsende Rohstoffe

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

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

Module Description

CS0140BOK: Technology of wood processing (Exercise course) | Technologien der Holzverarbeitung (Übung)

Version of module description: Gültig ab winterterm 2018/19

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 examination, written test (laboratory part)

Repeat Examination:

(Recommended) Prerequisites:

Content:
Characterization of the raw material wood and principles of converting the raw material wood into a material and products. Principles of slicing, sawing, milling, chipping etc. drying and glueing.

Laboratory exercises to the address issues.

Intended Learning Outcomes:
Understanding of the relationship of wood as a raw material and the process chain wood and the approbiate technologies. Knowlegde of the most common wood based materials, their properties and potential applications.

Teaching and Learning Methods:
laboratory

Media:

Reading List:
Secetariat Institute of Wood Science and Technology, script for the lab-units is handed out.
Wagenführ, A., Scholz, F., Taschenbuch der Holztechnik. Fachbuchverlag Leipzig, Leipzig 2005
Fellner, J., Teischinger, A., Zschokke, W.: Holzspektrum. proHolz Austria, Wien 2006

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

WZ9389BOK: Technology and Properties of Natural Raw Materials | Naturstofftechnologien und Eigenschaften

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	Language: German	Duration: one semester	Frequency: winter semester
Credits:* 4	**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:
Part 1:
Commitment during the practical work (30%)
Quality of the protocol (30%)
Evaluation, discussion and presentation of the results (40%)

Part 2:
Preparation of the practical course / experiments (30%)
Quality of the lab minutes (30%)
Evaluation and discussion of the results (40%)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Part 1:
Commitment during the practical work (30%)
Quality of the protocol (30%)
Evaluation, discussion and presentation of the results (40%)

Part 2:
Preparation of the practical course / experiments (30%)
Quality of the lab minutes (30%)
Evaluation and discussion of the results (40%)

Content:
PART 1:

Content:
Plastics, bioplastics and moulding technologies
Overview Wood Plastic Composites
Examples of products

Introduction to the exercises:
Properties of the materials used
Drying, mixing ratios
Machine parameters and protocols (compounding, extrusion)
Storage, mechanical testing (tensile strength, impact, density, swelling)
Interpretation and report of results
Presentation

PART 2
Extractives, chromatographic separation of extractive mixtures
1) Extraction of pine wood, qualitative analysis of mono- and triterpenes using GC/MS
2) Separation of a pigment mixture obtained by solvent extraction of carots using thin-layer chromatography

Solubility of biopolymers
Studies of the dissolving behaviour of cellulose, starch, and lignin (H_2O, HCl, NaOH, Hexane, DMSO, 72% H_2SO_4, conc. H_2SO_4, DMAc/LiCl). Discussion of the obtained results referring to structural differences

Preparation of down-stream chemicals from renewable sources
Preparation of furfural from bran
Two examples for a commercial use of furfural
a) Extraction of dienes from hydrocarbon mixtures (petrochemical refining)
b) Polymerization

Intended Learning Outcomes:
Part 1: Attendance of the VO "Biobased and biodegradable plastics" is recommended. Basic knowledge about the disciplined and attentive handling of raw materials and machines.

Part 2: Principles of extraction and chromatographic techniques. Responsible handling of chemicals.

Teaching and Learning Methods:
Laboratory
Part 1:
Lecture for the general explanation of the topics
Specification of the responsibilities during the course
Instructions for the machines
Independent operation of the machines

Part 2:
Initial test (basic knowledge, preparatio of the experiments)
Lecture on the planned experiments (supervisor)
Conducting and recording experiments (scholars)
Independent evaluation of chromatograms (after joint evaluation of one chromatogram)
daily evaluation and discussion of the conducted experiments

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Praktikum (4 ECTS)
Naturstofftechnologien und Eigenschaften (LV-Nr. 970302)
3 SWS
Norbert Mundiger, Anje Potthast, Falk Liebner

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

Module Description

WZ9427BOK: BOKU: Chemicals from Biomass | BOKU: Chemikalien aus Biomasse

Version of module description: Gültig ab 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.

Module Description

WZ9431BOK: Biobased and Biodegradable Plastics | Biobasierte und biologisch abbaubare Kunststoffe

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer 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
12 questions from all subject areas.
Duration: 60 min

5 points for each completely and correctly answered question (maximum: 60 points).

54 points and more: Sehr gut (1)
48 points and more: Gut (2)
42 points and more: Befriedigend (3)
36 points and more: Genügend (4)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
~Terminology; overview regarding the market situation

~Biotechnological processes for the production of biobased materials and/or their monomeric precursors:
Feedstocks for fermentation and their availability; background in microbiology and process engineering; biotechnological production of selected materials (PHAs, lactic acid and PLA, succinate/butandiol and PBS, 1,2 propanediol and PTT, biopolyethylene, ...)

~Processing and forming
Chemical derivatisation/synthesis; moulding (especially thermoplastic moulding); examples for applied moulding processes

~Characterisation of material properties:
Structures and microstructure; mechanical properties and corresponding analytics and measuring techniques (thermal resistance; deformation resistance, ...)

~Biodegradability and disposal
Material properties with respect to degradability; degradation, certification and labelling; analytics; ecology; legal background (approval, registration, technologies for disposal

Intended Learning Outcomes:
The students are able to distiguish between the terms "biobased", "biodegradable" and "compostable" and they are able to relate materals to the appropriate terms.
They are able to name the most important biobased and biodegradable plastics and can describe their production processes and properties. In addition they are able to critically assess current developments and discussions on biobased materials. They know the most important processing technologies and methods for the characterisation of material properties. The students are familiar with chemical, biological, technical, ecological and legal aspects of biodegradation and are able to apply this knowledge in practice.

Teaching and Learning Methods:
Mixed lecture and discussion

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Biobasierte und biologisch abbaubare Kunststoffe (LV-Nr. 970304)
2 SWS
Markus Neureiter, Ines Fritz, Norbert Mundigler, Rupert Wimmer

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

Module Description

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

Version of module description: Gültig ab 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.

Module Description

WZ9484BOK: Separation Processes for Renewable Resources | Verfahrenstechnik für Nawaros

Version of module description: Gültig ab 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:
Knowledge of Flow Mechanics, Thermodynamics and Heat and Mass Transfer are needed for this course, as they are taught in the lecture "Introduction to Process Engineering"(893.142) of the Bachelor "Wood and Fibre Technology".

Content:
This course gives an introduction to separation processes as destillation, cristallization, drying and extraction.

Intended Learning Outcomes:
Renewable resources are best utilized in a cascade like manner. This means, that first valuable contents as drugs are separated. Than other contents are utilized as products or basic chemicals, materials or fibres and the rest is converted to energy. Separation processes are needed for this need a lot of energy. This course gives an introduction to separation processes as destillation, cristallization, drying and extraction.

Teaching and Learning Methods:
Interactive lecture

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Verfahrenstechnik für NAWAROs (LV-Nr. 893313)
2 SWS
Martin Wendland

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

Module Description

WZ9486BOK: Wood and Fibre Quality | Wood and Fibre Quality

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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 and oral
written exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
1st lector: Functional cambium and wood formation
1 st lector: Wood, paper and fibre properties of interest, Advanced methods for wood and fibre characterisation
2 nd lector: Within-tree variability, conceptual models
2 nd lector: Wood structure-property relationships
3 rd lector: Links between wood / fibre / paper properties and environmental factors
3 rd lector: Improvement of wood quality, plantation forestry, Wood and fibre quality for wood composites

Intended Learning Outcomes:
Wood and fibres are products of the cambium and it they are based on cells that have passed through various phases of development. This biological process is related to wood and fibre quality, the latter being the arbitrary evaluation of an isolated piece of wood, tree part, piece of paper or any other wood derivative for a certain use. In this respect wood formation is the process, wood and fibre quality and related products are results.

The lecture introduces to basic relationships and that are important to wood and fibres originating from fast-grown plantation, regular managed forests but also from high-elevation sites. The ultimate goal is to understand biological and environmental factors that affect wood and fibre quality as well as advanced wood materials, and how to control property variability.

Teaching and Learning Methods:
multimedia-supported
Powerpoint-based lecture, group discussions, content flexibility depending on interest and interaction dynamics

Media:

Reading List:
Wimmer, R., Downes, G.M., Evans, R., French, J. (2008): Effects of site on fibre, pulp and handsheet properties of Eucalyptus globulus. Annals of Forest Science 65 (6)
Wimmer, R. (2002): Wood anatomical features in tree-rings as indicators of environmental change - a review. Dendrochronologia 20(1-2): 21-36.
Downes, G.M., Wimmer, R., Evans, R. (2002): Understanding wood formation: Gains to commercial forestry through tree-ring research. Dendrochronologia 20(1-2): 37-51.
More literature is discussed during the first lecture

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Wood and fibre quality (in Eng.); (LV-Nr. 891338)
2 SWS
Rupert Wimmer

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

Module Description

WZ9487BOK: Natural-fibre Raw Materials | Naturfaserrohstoffe

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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

Content:
Plant-based fibre materials (wood, annual plants, by-products and waste materials from food industry, agriculture, and bioenergy)
Fibre isolation and production technologies
Fibre structure and properties
Introduction to polymeric matrices and fibre-polymer interactions
Fundamentals of fibre-reinforced polymers

Intended Learning Outcomes:
Knowledge of the most relevant natural fibre raw materials and theri advantages and disadvantages in comparison to non bio-based fibres

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Naturfaserrohstoffe (LV-Nr. 891352)
2 SWS
Wolfgang Gindl-Altmutter

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

Module Description

WZ9488BOK: Chemistry and Technology of Polymers | Polymerchemie und Technologie

Version of module description: Gültig ab winterterm 2017/18

Module Level:	**Language:** German/English	**Duration:** one semester	**Frequen**

General structure, terminology and classification of polymers
Main types of polymerisation reactions – Part 1: Step-growth polymerisation
Polycondensation
Silicic acid and polysiloxanes
Polyaddition (e.g., epoxy resins, polyurethanes)
Main types of polymerisation reactions – Part 2: Chain growth polymerisation
Radical polymerisation
Ionic polymerisations
Coordination polymerisation
Ring opening polymerisations
Nomenclature of polymers
Processing and shaping of polymers
Polymer morphology
Design of polymers with regard to high-temperature stability, resistance towards chemicals, and fire resistance
Ageing of polymers (by chemical, thermal, and photolytic processes, X-ray or electron irradiation)
Stabilization of polymers (primary and secondary antioxidants, UV stabilizers)
Polymer recycling

Intended Learning Outcomes:
This lecture imparts ready-to-use knowledge in the areas of organic chemistry, permanently repeated throughout the entire lecture which always makes the connections between the basic principles of organic chemistry and the synthesis of complex polymers. This lecture furthermore imparts the participant solid knowledge of the impact of the macromolecular architecture of main technical polymers on their properties and the interrelation between structure and nomenclature of polymeric compounds. The participants get in-depth knowledge about current trends of polymer application, types and properties of mass and special plastics, basic principles of the synthesis and processing of technically important thermoplastic and thermo-set plastics, as well as basic knowledge of the application-oriented design of synthetic polymers on the molecular level. Topics, such as oxidative or light-induced ageing of plastics, stabilization of plastics towards ageing through addition of additives or recycling of plastics will be discussed in a similar way. The participants of this lecture will be furthermore qualified to recognize independently important interrelationships between structure and nomenclature of polymers, and between structure and properties of polymers.

Teaching and Learning Methods:
Interactive lecture

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Polymerchemie und Technologie (LV-Nr. 774327)
2 SWS
Falk Liebner

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

Module Description

WZ9489BOK: Chemistry and Technology of Sustainable Resources | Chemie und Technologie nachwachsender Rohstoffe

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**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 and oral
written (4-5 questions, 60% are required to pass), followed by an oral exam (10 min)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic courses in chemistry

Content:
Monosaccharides, Oligosaccharides, Cellulose, Cellulose derivatives, Starch

Lignin: Basic building blocks, Biosynthesis, Analytical methods for Lignin characterization,

Basic concepts of reactivity (carbohydrates and lignin)

Pulping, Bleaching: General Overview, History of paper making

Chlorine based bleaching, Oxygen based bleaching, bleaching technologies and basic reactions of wood components,

Alternative bleaching methods (LMS, POM, PAA).

Fiber production: Viscose and Tencel process - basic chemical reactions and technological principles, side reactions.

Cellulose Derivatives: cellulose acetate, carboxymethyl cellulose, methyl cellulose - preparation and application

Aging and Degradation: Basic reactions of cellulose degradation, mass-deacidification methods

Intended Learning Outcomes:
Chemistry and basic technology of sustainable resources, mainly based on wood components are covered.

Teaching and Learning Methods:
Class lecture

Media:

Reading List:
Ek et al. (Eds). Pulp and Paper Chemistry and Technology Vol. 1-4, De Gryuter
Fengel and Wegener "Wood"
Klemm et al., "Cellulose and cellulose derivatives"
H. Sixta, Handbook of Pulp
Holik, Handbook of Paper and Board
J. Lehmann, Kohlenhydrate

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Chemie und Technologie nachwachsender Rohstoffe (in Eng.); (LV-Nr. 774301)
2 SWS
Antje Potthast, Thomas Rosenau

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

Module Description

WZ9490BOK: Processes in Enzyme Technology | Processes in Enzyme Technology

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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:
no

Content:
The course will provide an overview of the key enzymes currently used in industrial processes. An overview of the technical use of enzymes and the possibilities to change and improve enzyme performance for adaptation to technical applications including enzyme optimization through enzyme discovery and engineering will be presented. A number of case studies highlighting the use of enzymes in industries e.g., starch conversion, food production, textile, wood fiber processing, biofuel production etc. will be explored.

Intended Learning Outcomes:
After passing the course, the students should be able to:
- understand the fundamentals of catalytic principles, enzyme kinetics and reaction mechanisms,
- explain the key structural factors which give rise to increased enzyme stability important for industrial applications,
- describe methods for selection and optimisation of industrial enzymes using genetic and biochemical techniques,
- describe and evaluate methods for enzyme immobilization and for characterization of the properties of immobilized enzymes

- describe a contemporary application of enzyme technology and present in a well-structured oral presentation.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Processes in enzyme technology (in Eng.); (LV-Nr. 752332)
2 SWS
Thu Ha Nguyen

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

Module Description

WZ9491BOK: Biochemical Technology | Biochemical Technology

Version of module description: Gültig ab winterterm 2017/18

Module Level:	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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 and oral
oral exam dates can be arranged individually
alternative, students can hand in a term paper (approx. length should be 15 pages) on a topic of biochemical technology which must be based on original literature and cover microbiological, biochemical and technological aspects of the production of selected chemicals / industrial products. These topics for the term paper can be selected individually

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in microbiology and biochemistry (main metabolic pathways in micro-organisms) as well as in biotechnology (cultivation of micro-organisms, fermentation technology)

Content:
1. The lecture on 'biochemical Engineering' will give details about the production processes of some of the most important substrates used for fermentative processes or further transformations, starch, sucrose and plant oils. Alternative production of oil through fermentation by yeasts, fungi and algae.
2. Introduction to enzymes, enzyme catalysis and enzymatic processes; use of enzymes to produce glucose syrup from starch; enzymatic systems involved in the degradation of lignocellulose and conversion of lignocellulosic polysaccharides to fermentable sugars, enzymatic esterification in the production of biodiesel
3. fermentation processes to produce ethanol and other alcohols; lactic acid, succinic acid and other building blocks for the chemical industry; use of metabolic engineering to improve these fermentation processes
4. biocatalysis, definition, challenges and major examples

Intended Learning Outcomes:
After completing the course on 'Biochemical Technology' students will have a profound knowledge of important sources for fermentable sugars, enzymatic conversion of various polysaccharides to fermentable sugars, and the production of major chemical building blocks through fermentation and biocatalysis

Teaching and Learning Methods:
multimedia-supported
both the handouts of the course and relevant review articles can be downloaded from the BOKU Learn system after log-in

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Lecture (2 ECTS)
Biochemical technology (LV-Nr. 752340)
2 SWS
Dietmar Haltrich

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

Module Description

WZ9492BOK: Wood Biotechnology | Holzbiotechnologie

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer 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 exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Wood Biotechnology explains the interactions between enzymes and chemistry / ultrastructure of the wood and leads in biotechnology, which is currently in the timber loading and processing used. In addition to the biotechnological development of basic skills will include differents? fungal process? (Biopulping, bioremediation, Biocontrol, improving impregnability wood, fungal cultivation) and? Enzymatic processes? (Grafting, ethanol form wood waste, removal of resin, pulp bleaching, deinking, recycling) discussed

Intended Learning Outcomes:
Consolidated understanding of biotechnological methods for industrial woodworking questions are relevant

Teaching and Learning Methods:
multimedia-supported
both the handouts of the course and relevant review articles can be downloaded from the BOKU Learn system after log-in

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Seminar (2 ECTS)
Holzbiotechnologie (LV-Nr. 891339)
2 SWS
Clemens Karl Peterbauer, Erhard Halmschlager, Johannes Tintner

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

Module Description

WZ9494BOK: Microbiology | Mikrobiologie

Version of module description: Gültig ab 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

Content:
1. INTRODUCTION
History
The microbial cell

2. PHYSIOLOGY AND GROWTH
Nutrients
Catabolism
Anabolism
Growth
Cell division
Growth kinetics
3. INTRODUCTION TO MOLECULAR BIOLOGY
4. GENETIC ENGINEERING
5A. METABOLISM
5B. BIOACTIVE MOLECULES
5C. BIOENERGY
6. MICROBIAL DIVERSITY
7. MICROBIAL ECOLOGY,BIODEGRADATION AND BIOREMEDIATION

8. SELECTED TOPICS
9. MICROBIOLOGY & RENEWABLE RESOURCES
10. SUMMARY

Intended Learning Outcomes:
Knowledge about basics of microbiology together with technical applications with regard to processing of renewable resources

Teaching and Learning Methods:
Class lecture

Media:

Reading List:
Brock Biology of Microorganisms, 13th Edition

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Mikrobiologie (LV-Nr. 970307)
2 SWS
Georg Gübitz

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

Module Description

WZ9495BOK: Mechanical and Thermal Process Technology II | Mechanical and Thermal Process Technology II

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
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:
written and oral

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Lecture in Mechanical and Thermal Process Technology I (LVA 893.122)

Content:
Part A: Modern Separation Processes
1 Modern Extraction Processes
2 Supercritical Fluid Processes (SFE, SFC, RESS, GAS, etc.)
3 Membrane Processes
4 Process Chromatography ´ Preparative Chromatography

Part B: Reaction Technology
5 Chemical Equilibria
6 Reaction Kinetics
7 Chemical Reactors
8 Residence Time

Part C. Process Integration
9 Design of Plants, Flow Sheets, Environmental Aspects, and Economy

Intended Learning Outcomes:
Based on the lecture Mechanical and Thermal Process Technology II (LVA 893.300), modern seperation processes which are of increasing importance for food and biotechnology are treated more thoroughly. Additionally, the very important subject of chemical reaction technology is treated systematically starting from basic knowledge of reaction equilibria and kinetics and moving to the design of reactors. Finally, it is shown how the knowledge of single unit operations can be integrated to full processes.

Teaching and Learning Methods:
Lecture with exercises

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (3 ECTS)
Mechanical and thermal process technology II (in Eng.); (LV-Nr. 893303)
3 SWS
Senad Novalin, Martin Wendland, Rafat Al Afif

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

Module Description

WZ9496BOK: Wood-Industrial Processes: Wood- and Fibre-based Materials | Wood-Industrial Processes: Wood- and Fibre-based Materials

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** English	**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:
Wood-based composites (Holzwerkstoffe); first lecture will be a recapitulation.

Content:
Current Topics in Development of wood-based composites materials
Recovered Wood in wood-based composites materials
Recycling of wood-based composites materials
Testing of wood-based composites materials

1 Introduction, wood-based composites overview, trends
2 Special wood-based materials: hardboards
3 Special wood-based materials: particle-based materials
4 Hydrolysation of adhesives / bonding agents
5 Binderless boards
6 Alternative raw materials
7 Alternative raw materials
8 Wood plastic composites - trends and materials
9 Wood quality, species and species mixtures in WBC
10 Biorefinery
11 Process analysis
12 Process analysis

13 Reserve
14 Exam

Intended Learning Outcomes:
Familiarity with techniques and processes relevant in wood industrial manufacturing. Acquaintance with the processing and installation engineering to lead to solid wood products and wood-based composite materials. Get to know factors that affect manufacuring processes and product performance.

Teaching and Learning Methods:
multimedia-supported
powerpoint slides, hand-on samples

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Wood-industrial processes: wood- and fibre-based materials (in Eng.); (LV-Nr. 891327)
2 SWS
Rupert Wimmer

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

Module Description

WZ9497BOK: Engineered Wood Products | Engineered Wood Products

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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 and oral
oral exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Material engineering
Material properties of wood composite components
Beam elements (GLT, LVL, LSL, PSL, I-Joist)
Structural plate elements (OSB, Flakeboard, Plywood)
Non-structural plate elements (Particleboard, MDF, Hardboards)
Wood composite materials

Intended Learning Outcomes:
Students have basic knowledge of the properties of materials used for wood composites
Students know to manipulate or engineer the properties of engineered materials
Students have an overview of existing engineered wood products and their properties, the origin of these properties as well as their main application fields.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Engineered wood products (in Eng.); (LV-Nr.891334)
2 SWS
Johannes Konnerth

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

Module Description

WZ9498BOK: Composite | Composite

Version of module description: Gültig ab winterterm 2017/18

Module Level:	Language:	Duration:	Frequency:
Master	German/English	two semesters	winter/summer semester
Credits:*	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**
2			

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:
It is expected that students intending to take the exam in this lecture are familiar with the lectures 'Naturfasern', 'Holzphysik', and 'Naturfaserwerkstoffe und Technologien'.

Content:
Introduction to composite materials, with a strong focus on mechanical properties at micro and macro scale, and the behaviour of lignocellulosic fibres as reinforcements in polymers will be addressed.

Intended Learning Outcomes:
The lecture aims to provide a basic understanding of composite materials and the peculiar properties of bio-based composites.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Composite (in Eng.) (LV-Nr. 891333)
2 SWS
Wolfgang Gindl-Altmutter

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

Module Description

WZ9499BOK: Wood and Fibre Material Performance | Charakterisierung von Holz und Faserwerkstoffen

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** two semesters	**Frequency:** summer 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 and written

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Compounding, physico-mechanical characterisation, thermoanalysis, berst measurements, rheology

Intended Learning Outcomes:
Get acquainted with chemical, thermal, physical and mechanical methods to characterize natural fibres, natural-fibre materials, wood plastic composites, and polymer materials. Discussion of the theoretical background of different methods, and performing practical exercises and tests using actual materials.

Lectures and some practicals take place in the Schwackhöferhaus, Institut für Holzforschung, Besprechungsraum.

Labs take place at IFA Tulln, Institut für Naturstofftechnik; TU Wien, Inst. für Mechanik der Werkstoffe und Strukturen; and Institut für Holzforschung.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (2 ECTS)
Charakterisierung von Holz- und Faserwerkstoffen (LV-Nr. 891337)
2 SWS
Johannes Konnerth, Notburga Gierlinger, Gerhard Sinn

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

Module Description

WZ9500BOK: Wood Cutting, Milling, Moulding | Zerspanungs- und Formgebungstechnik

Version of module description: Gültig ab 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

Content:
Basics of wood machining, Wood plastic composites, compounding, extrusion technology, injection molding etc.

Part Sinn:
Fundamentals of machining, cutting materials and cutting optimization of cutting tools.
Chipless forming techniques of wood. Wood-plastic compounds and methods, extrusion and injection molding techniques

Part Müller:
In the lecture part molding technique, in the industry commonly used manufacturing processes for molding technique (excl. Cutting shaping and Formgebund by injection molding and extrusion) will be presented. The idea of the manufacturing process follows the classification featured in the DIN. Also methods outside wood and fobre technologies will be discussed (primarly metalworking).
For the Wood and Fibre technology manufacturing process for the original forms (press technology), the deformation (compression, bending, upsetting) and joining (laminating, layer glueing, etc.) will be discussed.

The three groups of potential shaping of wood and natural fiber materials will be discussed from a technological and material science point of view.

Part Mundigler:
- Introduction: definitions, reasons for use, overview of the market situation
- Biotechnological processes for the production of bio-based polymer materials or bio-based monomers as starting materials: Fermentation raw materials and their availability, microbiological and procedural foundations; biotechnological production of selected products (PHAs, lactic acid and PLA, succinate / PBS and butanediol, 1,3 propanediol and PTT, Biopolyethylen, ...)
- Processing and shaping: Chemical derivatization / synthesis; Shaping (particularly thermoplastic shaping processes); Examples of processing processes in practice
- Characterization of the material properties: structures and microstructure; mechanical properties and related analytical and measurement methods (heat resistance, dimensional stability, ...)
- Biodegradation and disposal: Material properties regarding degradability; Reduction; Certification and labeling; Analytics; Ecology; Legal framework (recognition, approval, disposal technologies)

Intended Learning Outcomes:
Based on the knowledge of wood machining and tools and wood technologies, basic knowlegde on the wood machining process is provided. The second part of the lecuture deals with formgiving technologies derived from plastic industries such as extrusion an injection molding.

Teaching and Learning Methods:
Powerpoint-based lecture, group discussions, content flexibility depending on interest and interaction dynamics

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Zerspanungs- und Formgebungstechnik (LV-Nr. 891328)
2 SWS
Gerhard Sinn, Ulrich Müller, Norbert Mudigler

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

Renewable Raw Materials for Energetic Use | Energetische Nutzung von Biomasse

Elective Modules TUM | Wahlmodule der TUM

Module Description

CS0003: Production of Renewable Fuels | Production of Renewable Fuels

Version of module description: Gültig ab winterterm 2023/24

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 a written exam of 90 Minutes. Along the problem set, it is checked whether the student is able to understand, improve and assess industrial processes for the production of renewable fuels. No aids permitted.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in chemistry, Fundamentals in Thermodynamics (e.g., Grundlagen der Thermodynamik), Fundamentals in Process Engineering (e.g., Introduction to Process Engineering)

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, legislation of fuels.

Intended Learning Outcomes:
This module aims at making the students familiar with the industrial processes to produce renewable fuels. They are able to set up material and energy balances of these processes and

assess their sustainability. Limitations with respect 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:
Hybrid live lectures & asynchronous mini-videos allowing distance learning, lecture Script and exercises via online platform, excursions to fuel production plants

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,SpringerVieweg (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 renewable fuels (Tutorial, Straubing) (Übung, 2 SWS)
Burger J [L], Burger J, Groh D, Rosen N

Production of renewable fuels (Tutorial, Garching) (Übung, 2 SWS)
Burger J [L], Burger J, Groh D, Staudt J

Production of renewable fuels (Lecture, Straubing) (Vorlesung, 2 SWS)
Burger J [L], Burger J, Staudt J

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

Module Description

CS0058: CFD - Simulation for Energy Systems | CFD - Simulation for Energy Systems [A-CFD]

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**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:
In modern CFD programs, complex mathematical models are made accessible to the user in a simple form. Nevertheless, it is crucial for the correct application of these models to know the basic, theoretical background. The examination performance therefore is a project report. The students prove that they can answer questions about the theory of CFD in writing and solve small computational problems. The students thus show that they are capable of implementing a flow simulation in CFD programs and interpreting the results obtained.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prerequisites for the successful participation is knowledge about
Fluid Dynamics

Content:
The course provides basic knowledge about the underlying theory of CFD simulation to enable students to conduct simple workflows within the CFD simulation software. Simplifications and models for solving the conversion equations of fluid dynamics - mass, impulse and energy - is shown. Furthermore, meshing and setting up useful boundary conditions for solving the flow equations is presented. After solving the CFD problem, validation and presentation of the results by means of flow profiles and animations will be done. The setup of a CFD model including geometric preparation of a model, meshing, pre-processing, solving, and post-processing will be demonstrated and carried out in the CFD software.

Intended Learning Outcomes:
After successful participation within this course, students are capable of carrying out simple workflows within the CFD simulation software (e. g. OpenFOAM, Ansys), including the preparation of a CAD model, meshing, pre-processing, solving, and post-processing. Furthermore, they gained a basic understanding of the relevant theory behind a CFD simulation software.

Teaching and Learning Methods:
The course is set up of a lecture and practical part. The lecture provides the aforementioned relevant theory underlying a CFD simulation software. The practical part includes a guided setup of a CFD model within the CFD software and an independently conducted project at the end of the semester.

Media:
Lecture, blackboard, computer/laptop

Reading List:
Ferziger, J.H.; Peric, M.: Numerische Strömungsmechanik, 1. Auflage, Springer, eBook ISBN 978-3-540-68228-8, 2008
Gersten, K.: Einführung in die Strömungsmechanik, 2. Auflage, Springer, eBook ISBN 978-3-663-14151-8, 1981
Laurien, E.; Oertel jr., H.: Numerische Strömungsmechanik, 3. Auflage, Springer, eBook ISBN 978-3-658-03145-9, 2013
Ferziger, J.H.; Peric, M.; Street, R.L.: Computational Methods for Fluid Dynamics, 4. Auflage, Springer, eBook ISBN 978-3-319-99693-6, 2019

Responsible for Module:
Matthias Gaderer gaderer@tum.de Bernhard Huber b.huber@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

CS0092: Wind Power | Windkraft [Wind]

Version of module description: Gültig ab summerterm 2024

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

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

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

Repeat Examination:
Next semester

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

Content:
This module teaches in-depth knowledge about energy generation from wind power. The technology is described using the following points:
- Physical basics
- Designs and system components
- Planning, construction and operation
- Power output and energy supply
In addition to the technical characteristics of the plants, the module also focuses on their effects on the environment, legal framework conditions and economic

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

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

Media:
PowerPoint, blackboard, publications

Reading List:
Peter Schaffarczyk, Wind Power Technology, Springer, 2023, ISSN 1865-3529, ISSN 1865-3537 (electronic)

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

Courses (Type of course, Weekly hours per semester), Instructor:
Windkraft Vorlesung (Vorlesung, 1,5 SWS)
Schieder D [L], Schieder D, Widmann A

Windkraft Übung (Übung, 1 SWS)
Schieder D [L], Schieder D, Widmann A
For further information in this module, please click campus.tum.de or here.

Module Description

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

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
End of Semester

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

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

Intended Learning Outcomes:
After attending the course the participants understand basic methods for creating models, simulation and optimization. In addition, they are able to apply these methods by creating appropriate program code in Matlab. Furthermore, the participants acquire Matlab programming experience.

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

Media:
PP presentation, whiteboard, demonstration of programs

Reading List:
S. R. Otto & J.P. Denier, An Introduction to Programming and Numerical Methods in MATLAB, Springer, London, 2005
O. Nelles, Nonlinear System Identification, Springer, Berlin, 2010

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

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

Module Description

CS0132: Energy Process Engineering | Energy Process Engineering [EPE]

Energy Processes Engineering

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics

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

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

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

Media:
Lecture, blackbboard, presentation

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

Responsible for Module:
Gaderer, Matthias; Prof. Dr.-Ing.

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

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

Module Description

CS0133: Mechanical Process Engineering | Mechanical Process Engineering [MVT]

Version of module description: Gültig ab 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:
Gaderer, Matthias; Prof. Dr.-Ing.

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

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

Module Description

CS0134: Conceptual Process Design | Conceptual Process Design

Version of module description: Gültig ab summerterm 2024

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:
End of Semester

(Recommended) Prerequisites:
Knowleadge of thermodynamics and apparatusses used for fluid sparations processes. It is recommended to visit at least the course "Introduction of Process Engineering" first.

Content:
Basics of cenceptual design of 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 processes and fluid separation courses 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:
Moulijn et al. (2013). Chemical Process Technology. – John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom.
Biegler et al. (1997). Systematic Methods of Chemical Process Design. – Prentice Hall.
Doherty, M.F., Malone, M.F. (2001). Conceptual design of distillation systems. – Boston: McGraw-Hill.
Gmehling, J., Kolbe, B., Kleiber, M., Rarey, J. (2012). Chemical Thermodynamics for Process Simulation. 1. Auflage. Weinheim: Wiley – VCH
Grassmann, P., Widmer, F., Sinn, H. (1997). Einführung in die Thermische Verfahrenstechnik. 3. vollst. überarb. Auflage. Berlin: de Gruyter.
Stichlmair, J.G., Fair, J.R. (1998). Distillation: Principles and Practice. – New York: Wiley – VCH.

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

Courses (Type of course, Weekly hours per semester), Instructor:
Conceptual Process Design (Lecture) (Vorlesung, 2 SWS)
Burger J [L], Burger J, Ibanez M, Staudt J

Conceptual Process Design (Exercise) (Übung, 2 SWS)
Burger J, Rosen N, Wolf A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0136: Energetic Use of Biomass and Residuals | Energetic Use of Biomass and Residuals [EBR]

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics, Energy Process Engineering

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

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

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

Media:
Presentation, script, examples, excursion

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

Responsible for Module:
Gaderer, Matthias; 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

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

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:

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

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

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

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

Media:
Presentations, slide scripts, program exercises

Reading List:

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

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

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

Module Description

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

Version of module description: Gültig ab winterterm 2022/23

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

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

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

Repeat Examination:
Next semester

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

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

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

construction products, to apply system-related hazard and safety analyzes and safety-related solutions - for example by control technology Aspects - to be included in a plant design.

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

Media:
Presentations, scripts, exercises

Reading List:

Responsible for Module:
Matthias Gaderer gaderer@tum.de

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

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

Module Description

CS0143: Hydropower | Wasserkraft [HyPo]

Version of module description: Gültig ab winterterm 2023/24

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 basics of energy generation from hydropower are assessed in a written examination (60 minutes).

Repeat Examination:
End of Semester

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

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

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

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

Media:
PowerPoint
Blackboard

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

Responsible for Module:
Prof. Josef Kainz

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

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

Module Description

CS0147: Energy Efficient Buildings | Energy Efficient Buildings [EEB]

Version of module description: Gültig ab winterterm 2022/23

Module Level:	Language:	Duration:	Frequency:
Master	English	one semester	summer 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:
Students demonstrate their knowledge and understanding of the differenct aspects of energy efficient buildings in form of a written examination (90 minutes). Students deliver definitions, describe and outline relevant processes, mechanisms and requirements of energy efficient buildings. Furthermore, students calculate different technical specifications and parameters based on provided practice-oriented examples.

Repeat Examination:
Next semester

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

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

Intended Learning Outcomes:
"After successful completion of the module, students acquire in-depth understanding of factors determining the energy efficiency of buildings and relevant legal requirements. Students can

evaluate the sustainability of actions to enhance the energy efficiency of (existing) buildings. In addition, students can understand as well as evaluate and explain advantages and disadvantages of systems for heat and warm water provision based on renewable energies in regards to building and usage type.

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

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

Media:
PowerPoint, blackboard, videos

Reading List:
Bauer, M., Mösle, P., Schwarz, M. (201.): Green Building: Leitfaden für nachhaltiges Bauen. Springer Vieweg. Daten von Fachagenturen: BINE Informationsdienst, vom Bundesumweltministerium bzw. entsprechenden Landesministerien und anderen internationalen Organisationen.

Responsible for Module:
Vienken, Thomas; Prof. Dr.

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

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

Module Description

CS0148: Measurement, Testing, Modeling | Measurement, Testing, Modeling

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Examination in form of a final presentations (25% of the total grade) of the task of the individual groups and a written documentation report (75% of the total grade) of the group work. The report will have 4 to 5 pages per student. Students will prove their understanding and autonomous application of the teaching content (formulation and testing of hypotheses).

Repeat Examination:

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

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

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

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

Media:

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

Responsible for Module:
Prof. Thomas Vienken

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

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

Module Description

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

Version of module description: Gültig ab winterterm 2023/24

Module Level:	Language:	Duration:	Frequency:
Master	English	one semester	

Engu s

to implement different solutions and discern how appropriate to the problem they are. In simple cases, they are also able to evaluate their results in terms of plausibility and accuracy.

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

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

Reading List:

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

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

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

Module Description

CS0228: Technology and Management of Renewable Energies in a Global Context | Technology and Management of Renewable Energies in a Global Context [REAE]

Version of module description: Gültig ab summerterm 2024

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:
The exam will be in form of an oral presentation of the students (20+10 minutes; 75% of the grade) and a short report of the students' project work (max. 5 pages, not counting front page and cited literature; 25% of the grade).

In this students' project, the students demonstrate understanding of specific questions related to a defined topic concerning the technology and management of renewable energies in a global context. Students have to show in their presentation that they can analyse, solve and answer defined problems and questions related to this topic. Participants of the course show that they have done appropriate research work and are able to present their results. By answering follow-up questions related to their presentation they show that they have learned to put their research outcome into the relevant technical or country context. The presentation slides and the short report will be handed over to the lecturers and will be included in the grading.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic know-how related to specific techniques of renewable energies (e.g. solar energy, wind energy, hydropower, biomass conversion technology, geothermal energy) as well as management of energy systems either on a company or on state level.

Content:
A) Technical aspects of different forms of renewable energies (e.g. current state of technology, technical options for the future, technical bottlenecks, scale-up possibilities)
- Wind power

- Hydropower
- Photovoltaics, solarpower
- Geothermal energy
- Biomass use for energy purposes
- Biofuels, electric vehicles, E-fuels
- Hydrogen
- Other forms of renewable energies

B) Economic aspects related to defined renewable energies (e.g. cost of use/production, cost structure and development in the past, learning curves, innovation and diffusion of renewable energies)
C) Influencing factors for adoption and use of renewable energies (e.g. natural/local conditions, availability of renewable resources, technical infrastructure, user structure of energy, cost and economic factors, financing, political and regulatory issues, social acceptance, behaviour of stakeholders and people)
D) Situation and development in a specific (country) context (e.g. governance, policy goals and activities, competing factors and interests (e.g. by fossil energy use or related companies/ stakeholders), legal and regulatory stability)

Intended Learning Outcomes:
At the end of the module, students will be able to analyse and elaborate solutions for existing problems related to the technology and management of renewable energies and apply such solutions to the specific context of selected countries worldwide. They consider both the technical side as well as the economic and management dimension in order to develop integrated solutions for a specific question related to renewable energies. Additionally they take the specific context and situation (e.g. technical infrastructure and know-how, maintenance, electrical or other grids, political and regulatory rules, economic framework, company and user structure) in one or several countries or regions into account when analysing and elaborating solutions for the question on-hand. They are able to apply their knowledge to create an oral presentation and a written summary of their findings. Presented results are discussed with the audience so that students are able to defend their solution and put it in an appropriate context.

Teaching and Learning Methods:
The module is a seminar, where course participants form (preferably international) teams that investigate a given topic by autonomously doing research work and discussing results within the team. During regular meetings with the lecturers questions can be discussed, next steps are defined and (interim) results are presented. Lecturers will provide basic and background material for the students as well as actual information for the given topics that are elaborated by the student teams.

Learning activities: Literature/document research, student group project

Media:
Presentation slides, online discussion forum (all lecture materials are available via Moodle)

Reading List:
Specific literature and documents will be provided to the topics that are worked on in the student projects

Responsible for Module:
Menrad, Klaus; Prof. Dr.sc.agr.

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

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

Module Description

CS0255: Current Topics in Machine Learning and Bioinformatics | Current Topics in Machine Learning and Bioinformatics [CTMLBI]

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/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 outcomes are tested by a graded seminar presentation with a duration of approximately 45 minutes including a discussion with the audience. The seminar allows the students to assess the extent to which they can summarize a complex scientific work in the field of Machine Learning or Bioinformatics correctly and present it to an audience in a comprehensible and convincing way. Furthermore, to assess the skill to quickly understand, review and critically discuss recent research in these fields, the active participation and discussions of the other seminar presentations will be considered as well.

Repeat Examination:

(Recommended) Prerequisites:
Knowledge in Machine Learning and Bioinformatics (e.g. Bioinformatics (WZ1631) and Artificial Intelligence for Biotechnology (CS0012)) is expected

Content:
At the beginning of this course, introductory lectures about current topics in Machine Learning and Bioinformatics will be given. The following topics are treated exemplarily:
- Ensemble learners
- Neural Networks (Basic concept, Feedforward neural networks, Recurrent Neural Networks, Convolutional Neural Networks, Generative Models)
- Green Artificial Intelligence
- Genome-wide Association Studies
- Phenotype Prediction
- Protein-Protein Interaction Network Analysis
- Protein Prediction

- Data Driven Biotechnology

In this course, we will also talk about recent Machine Learning and Bioinformatics research and how it can support sustainability, e.g., by guiding downstream research with data-driven approaches. Furthermore, we will also look at Green Artificial Intelligence, a research direction that aims to make resource-intense AI development more sustainable. After introductory lectures, each student will analyze a recent scientific paper in these research areas in self-study and present it to the course. Active participation and discussions in all the other presentations is expected.

Intended Learning Outcomes:
After successful participation in this module, students will be able to understand and present recent research in Machine Learning or Bioinformatics. They are enabled to analyze recent scientific publications in one of the two fields. Based on this knowledge, they can summarize and present a scientific paper in a concise and understandable way as well as to discuss recent research in Machine Learning or Bioinformatics. Furthermore, students know about current research directions in these scientific fields and know how current Machine Learning and Bioinformatics research supports sustainability.

Teaching and Learning Methods:
At the beginning of this course, introductory lectures to current Machine Learning and Bioinformatics topics will provide additional and necessary fundamentals to understand recent scientific publications. Furthermore, each student will analyze a recent research paper in one of the two fields in self-study and present it to the course to train the ability to understand advanced concepts. Beyond that, for further training of these skills, the paper presentations will be discussed in the course.

Media:
Slide presentation, blackboard, discussion forums in e-learning platforms

Reading List:
Pattern Recognition and Machine Learning, Christopher M. Bishop
Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville

Responsible for Module:
Prof. Dr. Dominik Grimm, Florian Haselbeck

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

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

Module Description

CS0263: Geothermal Energy Systems | Geothermal Energy Systems [GeoE]

Potentials of geothermal energy supply

Version of module description: Gültig ab winterterm 2022/23

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

Repeat Examination:
Next semester

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

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

This includes the design and working principle of a heat pump system and its integration in technical building equipment as well as the analysis of their ecological and economic sustainable operation on living quarter scale. The analysis is also done with regards to existing technical guidelines as well as legal boundary conditions. Practice-oriented tasks will be used to demonstrate and critically evaluate the basic planning steps of heat pump systems and obtaining the relevant parameters. Existing and innovative geothermal exploration concepts will be analyzed and discussed against this background.

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

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

Teaching and Learning Methods:
The content is taught in lectures and presentations and strengthened by case studies and exercises. If applicable, the module is complemented by an excursion.

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

Reading List:
Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen (2005): Oberflächennahe Geothermie.
Bauer, M., Freeden, W., Jacobi, H., Neu, Th. (Hrsg.) (2018): Handbuch Oberflächennahe Geothermie. Springer Spektrum, 1. Auflage.
Stober, I. & Bucher, K. (2014): Geothermal Energy. Springer Spektrum, 1st edition.
Hölting, B., Coldewey, W.G. (2013): Hydrogeologie. Springer Spektrum, 8. überarbeitete Auflage.
Dassargues, A. (2018): Hydrogeology: Groundwater Science and Engineering, CRC Press, 1st edition.
Grotzinger, T. & Jordan, T. (2017): Press/Siever Allgemeine Geologie. Springer Spektrum, 7. Auflage
Grotzinger, T. & Jordan, T. (2014): Understanding Earth. W.H. Freeman & Company, 7th edition

Responsible for Module:
Vienken, Thomas; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Geothermal Energy Systems (Vorlesung mit integrierten Übungen, 4 SWS)

Vienken T [L], Vienken T
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1218: Applied Engineer Mathematics | Angewandte Ingenieursmathematik und Software [AEM]

Version of module description: Gültig ab summerterm 2017

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:
The assessment is based on a written examination (60 minutes). Students will perform programming tasks and show their ability to apply general mathematical methods of modelling and simulation. Questions concerning respective case examples will show their ability to correctly relate and evaluate issues.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic Mathematics

Content:
The course provides the mathematical basics of engineering mathematics with the focus on power engineering-related problems. Main contents are: Accounting methods - Integral and differential calculations - Systems of linear / non-linear differential equations 1st order - Partial differential equations - Matrices and vector calculations - Linear algebra - Basics of numerical solution methods. MATLAB solves mathematics problems in technology and natural sciences.

Intended Learning Outcomes:
After their participation in the course, students are aware of basic methods in modelling and simulation of mathematical systems of equations. By the building and the application of suitable solving methods the mathematical knowledge of the students will be deepened and tested. In the process of the course, mathematical problems are solved with the aid of MATLAB, in order to learn the program application and the interpretation of the results. In addition, VBA (Visual Basic) is used to teach and apply accounting methods in power engineering.

Teaching and Learning Methods:
This module consists of a lecture and related tutorials. The contents of the lecture will be taught in a presentation and will be deepened by the students' work on exercises. These often comprise individual work on programming tasks and simulations.

Media:
Presentation, script, examples

Reading List:
Ingenieure und Naturwissenschaftler (v. L. Papula, Vieweg und Teubner Verlag, 2009), Mathematik mit MATLAB (v. H. Blenker, Springer Verlag, 2000), Numerische Mathematik für Ingenieure und Naturwissenschaftler (v. F. Weller, Vieweg Verlag, 1996)

Responsible for Module:
Matthias Gaderer gaderer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung
Angewandte Ingenieursmathematik
2 SWS
Katharina Koch

Übung
Angewandte Ingenieursmathematik
2 SWS
Katharina Koch

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

Module Description

WZ1240: Advanced Simulation Topics | Fortgeschrittene Simulationsthemen

Version of module description: Gültig ab winterterm 2016/17

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

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

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

Repeat Examination:

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

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

Intended Learning Outcomes:
After participating in the module events, the participants will understand advanced methods for modelling, simulation and optimisation and will be able to select and apply methods appropriate to

the problem at hand. The chosen approach and the essential implementation steps are presented and explained in a seminar paper.

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

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

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

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

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

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

Module Description

WZ1664: Energy Storage | Energy Storage

Version of module description: Gültig ab winterterm 2021/22

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamic, basic but profound knowledge in physics

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

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

Teaching and Learning Methods:
The module consists of a lecture course with integrated practical elements. The lecture's content are mediated by the instructor's presentation and exercise examples. By solving given tasks at

home and if necessary students presentations the acquired knowledge is consodiated. The writing of the term paper is also a means of consolidation.

Media:
Powerpoint, whiteboard, exercise sheets

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

Responsible for Module:
Matthias Gaderer

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

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

Energy and Economics | Energy and Economics

Module Description

CS0260: Energy and Economics | Energy and Economics [EUW]

Version of module description: Gültig ab summerterm 2022

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

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

Description of Examination Method:
The examination will take the form of a written test (60 minutes). The students prove that they can understand and answer questions and the connections between the energy conversion, the conversion of renewable raw materials, the energy supply in general and the current energy-political and economic situation. Group work can be included and be part of the exam.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prior participation and passing of the fundamentals of Thermodynamics module is required for participation in the Energy and Economics module.

Content:
The module deals with the basics of energy sources, climate change and the technology of the heat, electricity and fuel market and the use of renewable raw materials, including an introduction to simple technical systems and current topics on the energy industry. It also deals with electricity trading, CO2 trading and the current situation of various energy technologies.
In exercises small examples are calculated to the economy (production costs of heat and power of plants (e.g. combined heat and power plants).

Intended Learning Outcomes:
By participating in the module, students will be able to understand the energy sources and simple principles of energy conversion into heat and electricity. They can perform simple economic assessments of energy systems and understand related market mechanisms of the electricity and heat market.

Teaching and Learning Methods:
The module consists of a lecture with exercises. The contents of the lecture are conveyed in the lecture and through presentations.

Media:
Presentations, exercise

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

Responsible for Module:
Gaderer, Matthias; 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

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

Version of module description: Gültig ab winterterm 2017/18

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:

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

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

Teaching and Learning Methods:
The module comprises lectures and tutorials (including an excursion). The contents are presented in talks and presentations. To deepen their knowledge students shall be encouraged to study the

literature and examine with regards to content the topics. In the exercises performed as part of the module learned theory shall directly be applied with a practical orientation by means of arithmetic examples.

Media:
Presentations, practical course

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

Responsible for Module:
Matthias Gaderer gaderer@tum.de

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

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

Research Internship (max. 10 ECTS) | Research Internship (max. 10 ECTS)

Module Description

CS0294: Research Internship Master 5 ECTS | Research Internship Master 5 ECTS

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration are evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Background knowledge of the respective focus to which the project topics of the research internships are assigned. In this case, having a background in Python or SuperPro Designer and experience in the laboratory is often recommended.

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 120 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an

internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

Intended Learning Outcomes:
After participation in the module, students understand the principles of approach to (research)projects in addition to the subject-specific knowledge and working methods taught in the research internship projects, the planning of project work and the critical evaluation of the project results and can apply them to new project tasks. Furthermore, they are able to document, interpret and summarise project work and results in written form.

Teaching and Learning Methods:
Depending on the focus and topic, for example, experiments in laboratories, guided or independent literature and data research, concept studies, simulations, methods for project and experimental design or test evaluation

Media:
Depending on the focus and topic, e.g., experimental equipment (laboratory), databases, libraries, specialized software, programming software, simulation software, project and experimental design software

Reading List:
technical literature;
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

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

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Master 5 ECTS (Praktikum, 5 SWS)
Blombach B, Glawischnig E, Hädrich M, Vital S

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Costa Riquelme R [L], Costa Riquelme R

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Sieber V [L], Abbas Nia A, Al-Shameri A, Arana Pena S, Dsouza Z, Fornoni E, Friedrichs J, Fuchs A, Giustino A, Grundheber J, Hofer N, Hörnschemeyer K, Hupfeld E, Kampl L, Köllen T, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Rau M, Romeis D, Rühmann B, Scheerer J, Schieder D, Schulz M, Sieber V, Siebert D, Skopp A

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Zavrel M [L], Beerhalter D, Borger J, Dsouza V, Geisler N, Marino Jara J, Oktay I, Stegemeyer U, van der Walt H, Zavrel M

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

Module Description

CS0297: Research Internship Master 10 ECTS | Research Internship Master 10 ECTS

Version of module description: Gültig ab summerterm 2024

Module Level: Master	Language: English	Duration: one semester	Frequency: winter/summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 60	**Contact Hours:** 240

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration are evaluated.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Background knowledge of the respective focus to which the project topics of the research internships are assigned. In this case, having a background in Python or SuperPro Designer and experience in the laboratory is often recommended.

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 360 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

Intended Learning Outcomes:
After participation in the module, students understand the principles of approach to (research)projects in addition to the subject-specific knowledge and working methods taught in the research internship projects, the planning of project work and the critical evaluation of the project results and can apply them to new project tasks. Furthermore, they are able to document, interpret and summarise project work and results in written form.

Teaching and Learning Methods:
Depending on the focus and topic, for example, experiments in laboratories, guided or independent literature and data research, concept studies, simulations, methods for project and experimental design or test evaluation

Media:
Depending on the focus and topic, e.g., experimental equipment (laboratory), databases, libraries, specialized software, programming software, simulation software, project and experimental design software

Reading List:
technical literature;
Davies, M. B. (2007): Doing a successful research project. Using qualitative or quantitative methods. Basingstoke: Palgrave

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

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Master 10 ECTS (Forschungspraktikum, 10 SWS)
Banlaki I, Crean E, Gaizauskaite A, Kalkowski J, Li Y, Niederholtmeyer H

Research Internship Master 10 ECTS (RES) (Praktikum, 10 SWS)
Gaderer M [L], Huber B, Putra L

Research Internship Master 10 ECTS (Sieber) (Forschungspraktikum, 10 SWS)
Sieber V [L], Abbas Nia A, Al-Shameri A, Arana Pena S, Dsouza Z, Fornoni E, Friedrichs J, Fuchs A, Giustino A, Grundheber J, Hofer N, Hörnschemeyer K, Hupfeld E, Kampl L, Köllen T, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Romeis D, Rühmann B, Scheerer J, Schulz M, Sieber V, Siebert D, Skopp A
For further information in this module, please click campus.tum.de or here.

Elective Modules BOKU | Wahlmodule der BOKU

Module Description

CS0002BOK: Energy Water Economy and Electricity Market | Energiewasserwirtschaft und Strommarkt

Version of module description: Gültig ab winterterm 2021/22

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:

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

CS0060BOK: BOKU: Automation of Bioprocesses | BOKU: Automation of Bioprocesses

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 52	**Contact Hours:** 23

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

Description of Examination Method:
Continuous assessment

The lecture is split into a theoretical and a practical part. The evaluation criterion for the theoretical part is based on the assessment of involvement and active participation and represents 40% of the final grade.
The practical part is organized in form of teamwork practice. The task to be solved is an automation problem in industrial environment. This part contributes 60% to the final grade.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Lecture

- Basics of automation, definitions, layout of a biotech plant

- Hardware: signal acquisition, interfacing, visualisation, systems hierarchy and ´architecture (field bus, smart sensors, actors)

- Design, system specification, contract specification

- Validation (QA) (GAMP)

Practical:

- Layout of vessel, I scheme, I/O list, layout system specification, contract specification

- DEMO process control software

Intended Learning Outcomes:
After successful completion of this course, students will be able to explain general bioprocess automation concepts and process control strategies as well as hardware and software solutions. Students will be able to select required hardware components and software solutions for bioprocess automation. They can define specification requirements.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Gerald Striedner (BOKU)

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

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

Module Description

CS0089BOK: Seminar in Energy and Process Engineering | Seminar in Energy and Process Engineering

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
Mündlicher Vortrag (PowerPoint o.ä.) und Abstract über gewähltes Thema. In die Beurteilung #ießen Aufbau, Inhalt und Präsentation des Vortrags sowie die anschließende kritische Diskussion mit ein. Abstract: 20% Präsentation: 70% Diskussion / Fragerunde: 10% Nicht fristgerecht abgegebene Abstracts können nicht berücksichtigt werden! Die Vorbesprechung und die Präsentationen #nden online via Zoom-Videokonferenz statt. Einteilung: Siehe BOKU Learn Kurs!

Repeat Examination:

(Recommended) Prerequisites:

Content:
Jeder Teilnehmer soll an einem der angebotenen Termine, ein von Ihm ausgearbeitetes Thema in Form eines wissenschaftlichen Vortrags präsentieren und sich einigen Fragen stellen. Zudem soll zum Vortrag eine Zusammenfassung/ Abstract (1-2 DIN A4 - Seiten) als Handout für die Diskussionsteilnehmer erstellt werden, der die wichtigsten Punkte des Vortrags zusammenfasst. Themen können von den Studierenden eingebracht werden oder der Themenliste entnommen werden. Vorschläge sind u.a.:
- Nachhaltige Energiegewinnung aus erneuerbaren Ressourcen
- Power-to-Heat
- Power-to-Gas
- Power-to-Mobility
- Einsatz nachwachsender Rohsto#e im Energiesektor
- Kälte- und Kühltechnik

Intended Learning Outcomes:
- Konfrontation der Studierenden mit Spezialthemen der Energie- und Verfahrenstechnik, Einschätzung und Beurteilung dieser Problemstellungen.
- Praktische Erfahrung zur Präsentation und Aufbreitung wissenschaftlicher Fragestellungen.
- Erstellung eines Abstracts / Zusammenfassung

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Verfahrens- und Energietechnik

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

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

Module Description

WZ9382BOK: Biogenic Solid and Liquid Fuels | Brenn- und Kraftstoffe

Version of module description: Gültig ab summerterm 2002

Module Level:	Language:	Duration:	Frequency:
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:

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

WZ9388BOK: Biogas Technology | Biogastechnologie

Version of module description: Gültig ab winterterm 2013/14

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

WZ9423BOK: Energy Economics | Energiewirtschaft

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
Written

Repeat Examination:

(Recommended) Prerequisites:

Content:
Overview about the energy ecenomy. General points of view for the treatment of problems of energy economics. General introduction in circle processes for the production of electric energy, power plants for production of heat and electric energy, combustion of fossil and renewable fuels, technology of combustion and vessels, emissions by combustion.

Energy use in industry. Efficient energy conversion and utilization. Optimization of heating and cooling processes. Problems of optimisation in the energy economy. Calculation of costs in the energy-technology. Energy controlling in industry and trade.

Intended Learning Outcomes:
Basic knowledge about facts and contexts in the energy economy should be arranged. Furthermore an introduction is given in methods, that are absolutely necessary to the judgment of processes of energy economy. In the course some procedures are expounded to estimate the economic conditions of processes in energy technology.

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

WZ9513BOK: Energy Engineering | Energy Engineering

Version of module description: Gültig ab winterterm 2017/18

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

WZ9514BOK: Electrical Power Engineering | Elektrische Energietechnik

Version of module description: Gültig ab winterterm 2017/18

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

WZ9516BOK: Renewable Energy Resources | Renewable Energy Resources

Version of module description: Gültig ab winterterm 2017/18

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

WZ9517BOK: Applied Measurement and Control Systems | Applied Measurement and Control Systems

Version of module description: Gültig ab winterterm 2017/18

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

WZ9518BOK: Practical Course in Energy Engineering | Practical Course in Energy Engineering

Version of module description: Gültig ab winterterm 2017/18

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

WZ9519BOK:

Version of module description: Gültig ab winterterm 2017/18

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

WZ9520BOK: Future energy supply in dependence of resource availability | Zukünftige Energieversorgung in Abhängigkeit der Ressourcenverfügbarkeit

Version of module description: Gültig ab winterterm 2017/18

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

WZ9523BOK: Seminar on Energy Economics | Energiewirtschaftliches Seminar

Version of module description: Gültig ab winterterm 2017/18

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.

Environment and Ecology | Umwelt und Ökologie

Module Description

CLA11317: Interdisciplinary Lecture Series Environment: Politics and Society | Ringvorlesung Umwelt: Politik und Gesellschaft

Version of module description: Gültig ab summerterm 2015

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:** 15	**Contact Hours:** 15

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

Description of Examination Method:
A successful accomplishment of 9 academic performances is mandatory for the examination!
The examination consists of a short PowerPoint presentation at the end of the semester. The presentation can be created alone or in groups of two. Everyone has to speak one minute.
The examination is ungraded.

Repeat Examination:

(Recommended) Prerequisites:

Content:
The lecture series Umwelt (environment) is an interdisciplinary, public lecture organised by the Environmental Department of the Studentische Vertretung (Student Representatives) of the TU Munich. Experts speak e.g. on technical environmental protection, health, consumer and climate protection. In the summer semester, it offers students the opportunity to learn about the political and social dimensions of current ecological topics and research results at a scientific level.

The lecture series Umwelt (environment) is offered in the winter semester in the module CLA11200 Ringvorlesung Umwelt: Ökologie und Technik (Lecture series on the environment: ecology and technology). It is only possible to gain given credits twice for the lecture series within each study program.

Intended Learning Outcomes:
Students are able to follow expert presentations on political and social dimensions of environmental problems and identify core theses and central facts.

Teaching and Learning Methods:
Lectures, presentations, discussions

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Out of Sight, Out of Mind? A Journey into the World's Hidden Realities (Ringvorlesung) (Vorlesung mit integrierten Übungen, 1,5 SWS)
Nogueira de Carvalho M, Pahl A, Slanitz A
For further information in this module, please click campus.tum.de or here.

Module Description

CLA31900: Lecture Series Environment - TUM | Vortragsreihe Umwelt - TUM

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 67	**Contact Hours:** 23

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

Description of Examination Method:
The examination consists of a poster created in a group of 2-3 people connecting topics from at least two lectures. In order to collect material for the poster, participants have to organize themselves in discussion groups with 5-6 people.
Each discussion group will split into two groupes for the poster. At the end of the semester the poster has to be presented. Every member of the poster group has to speak one minute,
The grade will consist of the poster and its presentation.
Mandatory requirements for the examination
For the 3-ECTS course a successful accomplishment of 16 academic performances is mandatory for the examination!

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The systematic integration of education for sustainable development at the university is an extremely complex challenge that can only be addressed through a plural and multi-perspective approach. Within the framework of the UNESCO World Programme of Action "Bildung für Nachhaltige Entwicklung“ (BNE; =Education for Sustainable Development), the interdisciplinary lecture series Umwelt - TUM takes place at the TUM Campus Garching, which deals with changing topics in the field of environmental sustainability.

It is organized by the newly founded branch of the environmental department AStA TUM at the Garching campus to promote sustainability awareness at TUM and to offer interested students the opportunity to deal with the topic in more detail.

Intended Learning Outcomes:
After successful participation in this module, students are able to understand lectures at a high scientific level and reproduce central statements. Students are able to comprehend analyses of sustainable development and are familiar with formulating their own positions and justifying them in discussions. Furthermore, they know where they can explore the topic of sustainability in more detail on campus, whether in the form of course offerings, internships, projects or thesis.

Teaching and Learning Methods:
It consists of six lectures and an organizational meeting at the beginning. Each lecture includes two 40-minute presentations, a 15-minute break and a subsequent 45-minute discussion with the speakers, which is realized in cooperation with the Zentrum for Schlüsselkompetenzen (Center for Key Competencies) of the Faculty of Mechanical Engineering.
The lectures and presentation slides will be uploaded to the online learning platform Moodle.
As homework, students will prepare a short report of the lectures and the discussion session. In addition, introductory and further literature will be addressed to enhance more detailed discussions of the lectures.

Media:

Reading List:

Responsible for Module:
Dr. phil. Alfred Slanitz (WTG@MCTS)

Courses (Type of course, Weekly hours per semester), Instructor:
Out of Sight, Out of Mind? A Journey into the World's Hidden Realities (Ringvorlesung) (Vorlesung mit integrierten Übungen, 1,5 SWS)
Nogueira de Carvalho M, Pahl A, Slanitz A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0015BOK: BOKU: Gender, Food Systems and Natural Resources | BOKU: Gender, Food Systems and Natural Resources

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**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:
50% written annotated bibliography (individual grade) 50% presentation/podcast (graded as group work) Both components must be passed in order to pass the course. Students are expected to attend every session. For successful completion of the course attendance of at least 80% of lectures is required.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Interest in the topics relating to this course. Students from a diversity of disciplines and backgrounds are invited to join.

Content:
This course critically assesses how the use, management and knowledge of land, water and the wider ecology is gendered. While women's importance as users, guardians and managers of natural resources and their roles in enabling family food and nutrition security are highlighted globally, the rights to land, water and trees, as well as access to other resources, infrastructure and services, are vested in men. In this course we aim to understand these contradictions, and their implications in different farming systems, practices and socio-political contexts. We will investigate the theory, policy and practice of gender in the governance of food systems and natural resources; and analyse the shortcomings of attempts to integrate women into development programmes. This course will further introduce alternative rights-based approaches to food systems and natural resources, such as food sovereignty, food justice and the right to food, from the perspective of social movements and civil society. In order to achieve a more sustainable use of natural resources it is crucial to understand how and by whom they are used, managed and governed and what are the challenges and barriers, but also the opportunities for different actors. In order

to leverage a transformation toward food and nutrition security for all, a societal transformation is urgently required and more attention has to be paid to underlying structural power dynamics and inequalities among the actors involved. We will assess relevant Sustainable Development Goals (e.g., SDG2, SDG5, SDG12) and the role they play in these processes. To enable students to analyse and/or undertake research on people-nature-food linkages, we will explore conceptual frameworks, analytical insights and methodological tools stemming from different approaches to addressing gender. These frameworks will be based on thematic case studies that will provide deeper insights into different geographic, socio-economic and socio-cultural contexts.

Intended Learning Outcomes:
On completion of this course, students will be able to:
1. Understand meanings and interpretations of gender in theory, policy and practice, and how these impact on the development and governance of food systems and natural resources.
2. Assess how structural inequality and different forms of violence undermine diverse rights of people, with a focus on how this relates to the sustainability of natural resources.
3. Explore how social movements and civil society challenge the dominant agri-food system, focusing in particular on the concept and practice of food sovereignty, food justice and the right to food.
4. Critically assess diverse research approaches and methodologies and the positionality of researchers as well as ethical implications of research.
Students will gain key competences in:
- scientific reading and writing, working with academic literature through guided reading, presenting and discussing readings in class, writing an annotated bibliography (as part of the assessment, 50%)
- media-supported presentation skills, producing a podcast
- team work capacity
- facilitation skills, through active participation in different interactive formats (e.g., World Café, Fishbowl discussion) and online facilitation
- discussions and plenary debate
- peer review: receiving and providing guided feedback

Teaching and Learning Methods:
Learning will be facilitated through a variety of methods which may include lectures, seminars, workshops, presentations by guest speakers, group work and online activities. Students are expected to engage in both class and online activities and discussions. This course also requires students to participate in guided reading and self-directed study to support the learning gained from timetabled sessions. Required and optional readings will be uploaded in advance on BOKUlearn. The emphasis is on student participation and fostering dialogue and debate. Students should feel able to explore and develop their understanding of key concepts introduced in the sessions through discussions in a supportive but challenging environment. Each session will consist of lectures, interactive group activities and/or guest speakers. Case studies presented by guest speakers from academia and civil society, based on research, project and advocacy work, will enable students to gain insights into the social, political, economic and cultural conditions of development and practice in various regions of the world. Through in-class discussions and guided

CS0015BOK:

Module Description

CS0077BOK: Global Change and Pest Management | Global Change and Pest Management

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
The exam will be taken in written form and lasts 120 min. 12 questions are to answer with a mean duration of 10 min. One question is related to the lecture of Herbert Formayer, four to Gernot Hoch and seven to Andreas Walzer. The assessment criteria (4 points per question, reachable points in total = 48) are the following: 44 points (92%) = 1; 38 points (79%) = 2; 34 points (71%) = 3;

Repeat Examination:

(Recommended) Prerequisites:
lecture units signi#cantly enables the probability to reach the learning outcomes.

Content:
In the lecture we will present the global change drivers land use change, biotic invasions and climate change, which have strong implications on pest management in agriculture and forestry. We introduce the dimensions and causes of each global change driver and discuss their e#ects on pests in agriculture (8 units) and forestry (4 units) on the basis of scienti#c case studies. The detailed topics are (1) land use change: green revolution, increased use of pesticides and N-fertilizer and their e#ects on pest species, the loss and fragmentation of natural habitats; (2) biotic invasions: neobiota as invasive pest and weeds – pathways, risk, approaches for control; (3) Climate change: basics, e#ects of increased atmospheric CO2 concentrations and ambient temperatures on pest species, climate change scenarios; and (4) interaction e#ects between biotic invasions and climate change.

Intended Learning Outcomes:
The students acquire knowledge about the causes of global change and its interplay with pest

management in agriculture and forestry. In detail, students understand how land use changes can a#ect population dynamics of pest arthropods and particularly biological control by their natural enemies. Students will be aware of the challenges arising from neobiota becoming invasive pests. They know about possible pathways, risks and control approaches; they understand how climate change could impact pest management in agriculture and forestry. They know how changes in temperature, precipitation, and atmospheric CO2 can a#ect host plants, herbivorous arthropods and their natural enemies as well as the trophic interactions in the system. They realize the interactions of biotic invasions and climate change a#ecting pest management. Finally, they are able to describe and discuss the quintessence of scienti#c tables and #gures in publications dealing
with global change and pest management.

Teaching and Learning Methods:
Frontalvorlesung

Media:

Reading List:
PDFs of the slides are available on boku.learn

Responsible for Module:
BOKU - Institut für Pflanzenschutz

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

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

Module Description

CS0101BOK: Plant and Environment Technology | Plant and Environment Technology

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
written test, seminar attendance

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Chemische Industrie, Anlagen- und Umweltmanagement

Content:
Safety Technique, Industrial Organisation, Economic Industrial Management, Maintenance, Planning of Plants, Structure of Personell, Equipments and Plants for Environmental Protection, Developments regarding Environmental Protection (production-oriented, product-oriented, service-oriented), Environmetal Management EMAS and ISO, Ecological Industrial Balance, Material Flow Balances, Cleaner Production.

Intended Learning Outcomes:
students are aware of environmental problems involved in the development, design and operation of process plants.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Holztechnologie und Nachwachsende Rohstoffe

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

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

Module Description

CS0157BOK: Integrated Landscape Management and Nature Conservation | Integrale Landnutzung, Habitatmanagement & Naturschutz

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
presentation and active participation

Repeat Examination:

(Recommended) Prerequisites:

Content:
introduction to nature conservation issues, rational and motivation for the lecture, different historic aspects of landuse management fragmentation, habitat and game management, edge effect, importance of pasture for biodiversity, management of nationalparks (e.g. NP Neusiedler See, NP Donauauen), adaptive management of NP visitors natural reserves network in Austria, concept of near to nature silviculture, Natura 2000, coarse woody debris management, population viability analysis, hemeroby versus naturalness

Intended Learning Outcomes:
There is a need for professional knowledge about goals and definition of nature conservation, silvicultural treatment plans, requirements of deer populations or aspects for conservation of biodiversity in discussions with NGO's. Students should become aquanted with ecological aspects of several land use practices and habitat management methods to be familar with the basic principles of nature conservation strategies.

Teaching and Learning Methods:
active participation in lecture 45%

content of seminar work 35%
presentation of seminar work 20%

Media:

Reading List:
HAMPIKE, U. 1991: Naturschutz-Ökonomie. UTB 1650. Ulmer, Stuttgart.
JEDICKE, E., 1994: Biotopverbund. Grundlagen und Maßnahmen einer neuen Naturschutzstrategie. 2. Aufl. Ulmer, Stuttgart.
KAULE, G, 1986: Arten- und Biotopschutz. UTB, Große Reihe, Ulmer, Stuttgart.
KIMMINS, H. 1992: Balancing Act: Environmental Issues in Forestry. UBC Press - University of British Columbia, Vancouver.
LEIBUNDGUT, H., 1990: Waldbau als Naturschutz. Haupt, Bern u. Stuttgart.
LEOPOLD, A. , 1992: Am Anfang war die Erde. Plädoyer für Umwelt-Ethik. Knesebeck, München.
MAYER, H. ZUKRIGL, K., SCHREMPF, W., SCHLAGER, G., 1987: Urwaldreste, Naturwaldreservate und schützenswerte Naturwälder in Österreich. Eigenverlag Institut für Waldbau, BOKU.
NOSS, R. F. & COOPERRIDER, A. Y. (1994): Saving Nature´s Legacy. Protecting and Restoring Biodiversity. Island Press. Washington, D.C., Covelo, California.
PLACHTER, H., 1991: Naturschutz. UTB für Wissenschaft: Uni-Taschenbücher; 1563. G. Fischer, Stuttgart.
SCHERZINGER, W. 1996: Naturschutz im Wald : Qualitätsziele einer dynamischen Waldentwicklung. Ulmer, Stuttgart.
SZARO, R. Z. & JOHNSTON, D. W., 1996 (Edit.): Biodiversity in Managed Landscapes. Theory and Practice. Oxford Univesity Press. New York, Oxford.

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

WZ9417BOK: Ecology | Ökologie

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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:
written
Five questions (6 points each, 30 points overall) are asked corresponding to the five focal subject areas.
0-14 = 5
15-18 = 4
19-23 = 3
24-27 = 2
28-30 = 1

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
none

Content:
1. FUNDAMENTAL PRINCIPLES: environmental factors, bioindication, resources
2. INTERACTIONS: competition, predation, decomposers
3. BIOCOENOSES (COMMUNITIES): energy flow, nutrient balance, structure, stability, succession
4. POPULATIONS: adaptation, evolution, ecological niche, individuals - population, migration, dispersal, life cycle, frequency of occurrence, endangerment

Intended Learning Outcomes:
After successful completion of the course, the students have theoretical and practical knowledge of ecological cycles, interactions and population ecology. They know fundamental terms and facts and understand the great importance of interactions in ecosystems and organisms. Their gained

knowledge establishes the basis for problem solving in conservation and management, but also for the understanding of biodiversity.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Ökologie (LV-Nr. 831330)
2 SWS
Karl Georg Bernhardt, Herwig Waidbacher, Peter Hietz, Otto Moog, Eva Maria Schöll

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

Module Description

WZ9419BOK: Crop Production Systems in Organic Agriculture | Crop Production Systems in Organic Agriculture

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
Theoretical questions and short calculations

Repeat Examination:

(Recommended) Prerequisites:
no

Content:
Investigation and development of cropping systems with balance and planning instruments:

- nutrient balances (field, farmyard, stable balance)
- nutrient planning
- organic manure planning
- humus balance

Excursions to the research station Groß Enzersdorf and to an organic farm

Intended Learning Outcomes:
Qualification for the system approach of organic farming land use systems:
- understanding of crop rotation interactions with soil, weeds and pests
- understanding of the soil tillage interactions with crop rotations, plant nutrition / fertilizer and nutrient / humus balances
- understanding of nutrient and carboncycles between field and stable (fodder budget)
- interpretation of development of main crops / inter crops / mxied crops in the field
- introduction to evaluation methods in the field

Teaching and Learning Methods:
Development of calculations in the seminar with additional homework

Media:

Reading List:
Freyer, B. 2003: Fruchtfolgen - konventionell, integriert, biologisch. Verlag Eugen Ulmer, Stuttgart

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Übung (3 ECTS)
Crop production systems in organic agriculture (in Eng.) (LV-Nr. 933307)
2 SWS
Gabriele Gollner, Margot Siederits, Agnes Schweinzer, Marie-Luise Wohlmuth

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

Module Description

WZ9426BOK: Environmental Law | Umweltrecht

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
written and oral

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Concept and content of environmental law; historical background; basic principals of constitutional law (basic rights, national objectives, allocation of rights and duties); Institutions and Instruments of environmental law (decision making authorities, procedures, assessment of environmental effects); selected fields of environmental law (e.g. laws pertaining to water and waterways, waste legislation, industrial law, nature protection and landscape conservation)

Intended Learning Outcomes:
Understanding of interactions of nature, law and society; awareness raising for the principle of responsibility; awareness raising for nature as a national objective; environmental protection as objective and justification for protection of the country and its citizens; overview of decisions making authorities; understanding for deficits, errors and lacks of environmental law.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Umweltrecht (LV-Nr. 736304)
2 SWS
Martin Kind

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

Module Description

WZ9475BOK: Waste Technology | Entsorgungstechnik

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	Language: German	Duration: one semester	Frequency: summer semester
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:
Written
The written exam consists of open questions, multiple - choice questions and yes/no questions.
To obtain a positive evaluation it is required to achieve 63% of the maximal achievable points (>/= 15 of 24 points).
You find further scaling of the grades on your exams!

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Details concerning the topics Biological Treatment, Incineration, Incineration Residues, Disposal of Sewage Sludge etc.

Intended Learning Outcomes:
The standard of knowledge and the state-of-the-art of selective fields in waste disposal are communicated

Teaching and Learning Methods:
Class lecture

Media:

Reading List:
Standhartinger K., Chemie für Ahnungslose - Eine Einstiegshilfe für Studierende. Hirzel S. Verlag, Stuttgart, ISBN 9783777613017.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Entsorgungstechnik (LV-Nr. 813339)
3 SWS
Marion Humer-Huber, Erwin Binner, Josef Stubenvoll

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

Module Description

WZ9476BOK: Plant and Environment Technology | Umwelttechnik in der Holzindustrie

Version of module description: Gültig ab 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 test, seminar attendance

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Safety Technique, Industrial Organisation, Economic Industrial Management, Maintenance, Planning of Plants, Structure of Personell, Equipments and Plants for Environmental Protection, Developments regarding Environmental Protection (production-oriented, product-oriented, service-oriented), Environmetal Management EMAS and ISO, Ecological Industrial Balance, Material Flow Balances, Cleaner Production.

Intended Learning Outcomes:
It is the target of the lecture to give an introduction into the problems of development, planning and operation of industrial plants.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung und Seminar (2 ECTS)
Umwelttechnik in der Holzindustrie (LV-Nr. 891349)
2 SWS
Siegfried Pöchtrager, Tobias Pröll, Ena Smidt

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

Module Description

WZ9478BOK: Water Quality Assessment | Qualitätsbeurteilung von Wasser und Abwasser

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4.5	**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:
written exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
none

Content:
How to define goals and formulate concepts for the design of monitoring programmes.
-National and international legal framworks and requirements for the quality evaluation for drinking water, fresh water, waste water and sewage sludge (Codex, AEVO, WHO, EU).
-Substances and microorganisms in water and their relevance from the technical and hygienic point of view.
-Sampling, conservation and analysis of water and waste water in theory and practice.
-Interrelation and interpretation between microbiological and chemical data.
-HACCP-concept, water safety plan, EU-Risk Assessment.
-Practical experiments.

Intended Learning Outcomes:
Theoretical and practical instructions for the generation and interpretation of data, especially for drinking water and waste water; theoretical and practical approach.

Identification of factors which could influence the monitoring and interpretation of data

Teaching and Learning Methods:
Lecture with exercises
Practical chemical and microbiological experiments, excursions.

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (4,5 ECTS)
Qualitätsbeurteilung von Wasser und Abwasser (LV-Nr. 811312)
3 SWS
Maria Fürhacker, Gerhard Lindner, Roza Allabashi, Marija Zunabovic-Pichler

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

Module Description

WZ9481BOK: Global Change Ecology | Globaler Wandel und Ökosysteme

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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:
written

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Overcoming the impact of global, anthropological global changes on organisms and ecosystem will be among our the greatest challenge in the future. In this lecture stuents will learn the theoretical background of the mode of action of selected global changes as greenhouse effect (atmospheric CO2 concentrations, warming, extreme weather events), ozone hole vs. surface ozone and interactions between these factors. Following, methodological approaches for studying global change effects will be discussed. Then, a state-of-the art of global change ecology in terrestrial ecosystems and their feedback mechanisms will be given. At the end, a critical discussion with students about the presentation of this topic in media will be organised.

Intended Learning Outcomes:
1. Getting to know the most important, anthropogenic global changes.
2. Understanding the mechanisms how organisms and ecosystems respond to global change factors.
3. Knowing experimental and methodological approaches to study past and prospected global changes.
4. Explore key research findings on global change effects on organisms and ecosystems.
5. Critical discussion of scientific and pseudo-scientific publications on this topic.

Teaching and Learning Methods:
multimedia-supported

Media:

Reading List:
will be announced in class

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Globaler Wandel und Ökosysteme
2 SWS
Johann Zaller

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

Module Description

WZ9482BOK: Seminar in Global Change and Ecosystems | Seminar in Global Change and Ecosystems

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**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:
Evaluation of student presentation of a scientific publication.
Evaluation of content and form of presentation; details will be announced in course.
For a successful approbation, max. 2 missing dates will be tolerated.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
This seminar complements and extends the lecture VO 833.318 Global Change and Ecosystems. In the focus will be the following anthropogenic, global changes and their effects on organisms and ecosystem: greenhouse effect (atmospheric CO2 concentrations, warming, extreme weather events), ozone hole vs. surface ozone, increasing nitrogen deposition, land use change, decline in biodiversity, light pollution, noise pollution, plastic pollution, genetically modified organisms, pesticide use. In this seminar topics from the lecture will be complemented and deepened by student presentations. Great emphasis will be given on a critical discussion of the relevant scientific literature.

Intended Learning Outcomes:
1. Learn how to utilize relevant scientific data bases.
2. Critical discussion of scientific literature and knowledge.
3. Improvement of presentation skills.

Teaching and Learning Methods:
Presentation of scientific articles

Media:

Reading List:
wird bekanntgegeben

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar (2 ECTS)
Seminar in global change and ecosystems (in Eng.) (LV-Nr. 833319)
1
Johann Zaller
For further information in this module, please click campus.tum.de or here.

Economics of Renewable Resources | Ökonomie nachwachsender Rohstoffe

Elective Modules TUM | Wahlmodule der TUM

Module Description

CS0096: Advanced Empirical Research Methods | Advanced Empirical Research Methods

Version of module description: Gültig ab summerterm 2024

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 takes the form of a written seminar paper with a maximum length of 15 pages. The students analyze a provided data set based on an individually posed question. The results are written down and submitted in the form of a seminar paper that has the structure of a scientific paper. The length of the seminar paper is a maximum of 15 pages. The students should be able to select, justify and implement suitable econometric methods for economic impact assessment based on the given question.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Statistics

Content:
Selected statistical methods required for impact analysis in the economics field, e.g. Difference in Difference, Propensity Score Matching, Instrumental Variable Method. Problems of endogeneity and selfselection bias during data collection and analysis. Conception of suitable data collections. The methods will be presented in the lecture. As part of the exercise, its application is carried out on concrete case studies

Intended Learning Outcomes:
After attending the module, students will be familiar with the most important statistical methods in the field of Impact Assessment to address the problem of endogeneity and the selfselection bias in economic and social sciences. They are able to select and execute the appropriate statistical models for specific case studies. They know how to collect data themselves in order to perform such impact assessment. In addition, students are able to understand statistics in scientific literature (peer reviewed journals).

Teaching and Learning Methods:
The lecture and exercise will be done using Powerpoint and Stata. In addition, scientifically published studies will be integrated into the lectures. In the exercise, the students themselves analyze data sets that are made available. The results of the case studies are then discussed and questioned individually and / or in groups from different perspectives by the students. Scientific publications using statistical analysis are analyzed and discussed by the students.

Media:
Presentations, slide scripts, Articles

Reading List:
Kleiber & Zeileis (2008): Applied Econometrics with R, Springer; Angrist & Pischke (2009): Mostly Harmless Econometrics: An Empiricist's Companion, Princeton Univers. Press.

Responsible for Module:
Faße, Anja; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Empirical Research Methods (Lecture) (Vorlesung, 2 SWS)
Faße A [L], Faße A

Advanced Empirical Research Methods (Exercise) (Übung, 2 SWS)
Faße A [L], Richter S, Shayo G
For further information in this module, please click campus.tum.de or here.

Module Description

CS0098: Operations Research | Operations Research

Version of module description: Gültig ab winterterm 2023/24

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. In that examination, students must demonstrate their ability to formulate and solve decision models with appropriate methods. Type of assessment: in writing duration of assessment: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Bachelor Business administration; advanced knowledge of mathematics and statistics

Content:
The module is divided into six distinctive areas:

Part 1: Basic Concepts
Part 2: Quantitative Modelling
Part 3: Linear Optimization
Part 4: Graph Theorie
Part 5: Integer and Combinatorical Optimization
Part 6: Dynamic Optimization

Intended Learning Outcomes:
The course introduces fundamental and advanced methods for modeling and solution of business problems with concepts from Operations Research (OR). Students will be introduced to using quantitative methods for planning and decision-making in companies and societies. Students will apply analytical methods of problem-solving and decision-making that is useful in the management of organizations.

Teaching and Learning Methods:
Lecture (theory), tutorials with group work and presentation

Media:
Seminaristic tution using beamer, overhead projector, flipchart

Reading List:
Hilier, F. and Lieberman, G., Introduction to Operations Research, McGraw-Hill, 2009
Kallrath, J and Wilson, J. M., Business Optimisation using mathematical Programming, London (Macmillan) 1997
Winston, W.: Operations Research - Applications and Algorithms. 4th ed. (internat. student ed.), Belmont, Calif. (Duxbury), 2004.
Taha, H. A., Operations Research, 7th ed., Upper Saddle River, N.J. (Prentice Hall) 2003.
Domschke, W., Drexl, A., Klein, R., Scholl, A, Einführung in Operations Research, Berlin (Springer) 2015.
Domschke, W. et al., Übungen und Fallbeispiele zum Operations Research, Springer, Berlin–Heidelberg, 2015

Responsible for Module:
Hübner, Alexander; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Operations Research (Vorlesung mit integrierten Übungen, 4 SWS)
Hübner A [L], Hübner A, Riesenegger L
For further information in this module, please click campus.tum.de or here.

Module Description

CS0102: Introduction to Game Theory | Introduction to Game Theory [IGT]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**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:
Learning outcomes are verified in a written exam (90 minutes). Students show the extent to which they have understood the taught game-theoretical definitions and terminology. 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 and answer comprehension questions concerning the properties and the advantages and disadvantages of the different solution concepts.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Module Mathematics (WZ1601) or Advanced Mathematics 1 (CS0175)

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, modeling concrete case studies related to sustainability as cooperative and non-cooperative 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 sustainability-related 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:
Thielen, Clemens; Prof. Dr. rer. nat.

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

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

Module Description

CS0111: Advanced Development Economics | Advanced Development Economics

Version of module description: Gültig ab winterterm 2023/24

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:
End of Semester

(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 exercise will be done by PowerPoint. In addition, current examples from newspapers and journals will be integrated into the lectures. In the exercise, 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:
Faße, Anja; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Development Economics (Lecture) (Vorlesung, 2 SWS)
Faße A [L], Faße A

Advanced Development Economics (Tutorial) (Übung, 2 SWS)
Faße A [L], Faße A, Shayo G
For further information in this module, please click campus.tum.de or here.

Module Description

CS0113: Innovation in Bioeconomy | Innovation in Bioeconomy

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**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:
The grading is based on a written exam (90 Minutes). The written form of the exam allows a comprehensive assessment of students' knowledge and understanding of the principles of innovation management and entrepreneurship with a focus on bioeconomic questions and concepts. Building on a core understanding of the principles of innovation management and entrepreneurship, students will answer questions about the more recent innovation and entrepreneurship concepts and have the ability to explain the adapted strategies and options for new ventures firms. They will also be able to assess the relevance of technologies and resources related to the bioeconomy and the different options to design sustainable business models in the context of bioeconomic questions.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Entrepreneurship, Introduction to Innovation Management

Content:
The module introduces students into advanced principles of innovation management and entrepreneurship from a sustainable perspective. Students will be equiped with basic knowledge on:
- design of business models to implement sustainable innovation
- advanced methods to generate and implement sustainable innovation
- role of ecosystems and networks

Beyond that, students will engage in break-out group workshops to personally experience the process of developing and evaluating sustainable innovation activities. Students give presentations to the audience and discuss their results.

Intended Learning Outcomes:
Following the completion of the course, the students will be familiarized with theoretical concepts and empirical methods to:
• assess the different forms and contents for identifiying and organising entrepreneurial ideas and innovative solutions in the context of the Bioeconomy by including broader economic, environmental and societal effects
• derive recommendations about the design and practices of innovation management and entrepreneurship and how to implement sustainable innovation
• identify and evaluate environmental technologies and design scenarios for firms to implement sustainable innovation

Teaching and Learning Methods:
The module will combine several learning methods.
- The basic knowledge as well as real world examples and case studies will be provided through the lecture.
- Discussions in the lecture and active participation are encouraged and will contribute to deepen the understanding of the concepts introduced.
- In the tutorial, the academic concepts will be discussed and applied in case studies. The students will further apply (part of) their theoretical knowledge to real-world problems and present their results in teams. This format fosters team work.
- Students will get additional background knowledge from the scientific literature in private reading.

Media:
Presentation, Power-Point Slides, Case Studies

Reading List:
The reading list is compiled from the latest contributions of relevant scientific journals, including the Academy of Management Journal, Research Policy, Strategic Management Journal, and will be made available to the students.

Responsible for Module:
Doblinger, Claudia; Prof. Dr. rer. pol. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Innovation in Bioeconomy (Lecture) (Vorlesung, 2 SWS)
Doblinger C [L], Doblinger C

Innovation in Bioeconomy (Exercise) (Übung, 2 SWS)
Doblinger C [L], Doblinger C, Fischer D
For further information in this module, please click campus.tum.de or here.

Module Description

CS01

Teaching and Learning Methods:
The lecture and the seminar will be done by PowerPoint. In addition, current examples of trade policy from the media and journals will be integrated into the lectures. In the seminar, the students research current case studies on 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. Empirical trade models are used and discussed.

Media:
Presentations, slide scripts, Articles

Reading List:
Krugman, Obstfeld (2016) International Economics: Theory and Policy, Global Edition; Michael Todaro, Stephen Smith (2012). Economic Development, Pearson.

Responsible for Module:
Prof. Dr. Anja Faße

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

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

Module Description

CS0118: Environmental Accounting in Economics and Sustainability Sciences | Environmental Accounting in Economics and Sustainability Sciences

Version of module description: Gültig ab winterterm 2023/24

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 accounting in economics. Example problems will have to be explained, solved and discussed. Type of examination: written, no additional tools allowed, duration of examination: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Micro- and Macroeconomics, Advanced Sustainability and Life Cycle Assessment

Content:
Fundamentals of the national accounts (input-output analysis) and the extension to environmental and social accounts (NAMEA, Social Accounting matrix). Integration of environmental accounts through physical and monetary environmental accounts and their advantages and disadvantages. Execution of multiplier analyzes with Excel. Use of input-output analysis and its environmental extensions for material flow analysis. Dynamic and multi-regional input-output approaches and hybrid Life Cycle Assessment.

Intended Learning Outcomes:
After the module, students will be able to understand and develop the system of national accounts and the integration of environmental accounts (monetary and physical) at national and regional level. They are able to perform and interpret a multiplier analysis. They use advanced methods of input-output analysis to solve problems in material flow analysis.

Teaching and Learning Methods:
The lecture and the tutorial will be done by Powerpoint and Excel. In addition, current examples from scientific journals and data sets will be integrated into the lectures. For advanced examples the use of a mathematical software suite such as Matlab and input-output as well as life cycle inventory databases is intended. These case studies are then analyzed and discussed individually and / or in groups from different perspectives together by the students.

Media:
Presentations, slide scripts, Articles

Reading List:
Taylor (2008): Village Economies: The Design, Estimation, and Use of Villagewide Economic Models. Cambridge University Press; Anguita & Wagner (2010): Environmental Social Accounting Matrices: Theory and Applications, Routledge. Brunner/Rechberger (2017): Handbook of Material Flow Analysis, CRC Press; Miller/Blair (2009): Input-output Analysis: foundations and extensions, Cambridge University Press; and recent journal articles (to be announced in the lectures)

Responsible for Module:
Anja Faße

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

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

Module Description

CS0119: Behavioral Public Economics | Behavioral Public Economics

Version of module description: Gültig ab winterterm 2023/24

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 describe theories, methods and concepts of Behavioral Public Economics. Students should be able to explain important examples from the academic literature. Type of examination: written, calculators are allowed, no additional tools allowed, duration of examination: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Microeconomics, Advanced Microeconomics

Content:
In this course combines public economics with recent contributions of behavioral economics. Students will learn how to apply findings from behavioral economics to the public sector. This course will combine standard models from text books with recent academic papers. We will cover classic theories, their behavioral extensions, and empirical studies. Cover topics will be:
- Welfare Analysis
- Taxation
- Public Goods / Externalities
- Political Economy (Politicians and Voting)
- Public Policy (Savings, Poverty, Health, Environment)

Intended Learning Outcomes:
After attending the module, students will understand current topics in Public Economics and know the relevant insight from behavioral economics. They are capable of applying economic theory to analyze current problems and they can reference the relevant empirical evidence. Students can

analyze and evaluate policy proposals. Based on existing examples they can design and discuss their own policy interventions.

Teaching and Learning Methods:
The lecture will be mostly done by presentations. In addition, articles from newspapers and journals are integrated into the lectures. Together with the lecturer, students will study the content and methods of the academic papers. In the exercises, students will practice solving the learned models. This will either be done jointly on the blackboard or as work in smaller groups. Classroom experiments are carried out for selected topics.

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

Reading List:
Atkinson, A. and Stiglitz, J. (1980), Lectures on Public Economics, McGraw-Hill; reprinted by Princeton University Press (2015).
Gruber, J. (2016) Public Finance and Public Policy, 5th edition, Worth Publishers.
Additional references of academic papers

Responsible for Module:
Goerg, Sebastian; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Behavioral Public Economics (Exercise) (Übung, 2 SWS)
Goerg S [L], Goerg S

Behavioral Public Economics (Lecture) (Vorlesung, 2 SWS)
Goerg S [L], Goerg S, Speckner M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0121: Sustainable Production | Sustainable Production [SP]

Version of module description: Gültig ab 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:
Written exam (90 minutes): By solving problems from the thematic field of the module students have to prove their understanding of the management of industrial production processes and technologies under consideration of sustainability aspects. In doing so they have to prove their techno-economic understanding, knowledge on quantitative methods for the analysis, assessment and optimisation of production systems, as well as their analytical and verbal skills in the field. They need to show that they are able to discuss the treated approaches and to derive further research needs. Learning aids: pocket calculator.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
-

Content:
The module covers inter alia the following topics:
• Sustainability aspects of industrial production and consumption
• Reasons for considering sustainability aspects in production management
• Measuring sustainability of production and operations
• Sustainable product and service design
• Sustainable sourcing
• Sustainable production management
• Sustainability of logistics
• Managing wastes, waste water, air emissions and product returns

Intended Learning Outcomes:
The module aims at enabling students to approach management tasks of production systems under consideration of sustainability aspects. This covers especially , especially the analysis, assessment and optimisation of these using a quantitative systems analysis approach.

The students understand that production and consumption activities have sustainability impacts and why these have to be considered in the management of production systems. They apply quantitative approaches for the analysis, assessment and optimisation of these systems on example planning tasks. They are capable to discuss the approaches critically, derive further development needs and transfer these approaches to other fields.

Teaching and Learning Methods:
Format: Lecture with exercise to introduce, train and deepen the contents of the module.

Teaching / learning methods:
- Media-assisted presentations
- Group work / case studies with presentation
- Individulal assignments and presentation

The teaching and learning methods are combinded specifically for the treated topics. Typically, a thematic impulse or overview is given with a media-assisted presentation. Individual or group work assignments provide the possibility to apply the acquired competencies, to repeat and deepen these as well as to prepare the transfer to other fields.

Media:
Digital projector, board, flipchart, online contents, case studies

Reading List:
Recommended reading:
• Stark R; Seliger G, Bonvoisin J (2017): Sustainable Manufacturing - Challenges, Solutions and Implementation Perspectives , Springer
• Reniers G, Sörensen K, Vranken K (2013): Management principles of sustainable industrial chemistry, Wiley VCH

Courses (Type of course, Weekly hours per semester), Instructor:
Sustainable Production (Vorlesung) (Vorlesung, 2 SWS)
Fröhling M [L], Heinrich V, Schirmeister J

Sustainable Production (Übung) (Übung, 2 SWS)
Fröhling M [L], Schirmeister J, Heinrich V
For further information in this module, please click campus.tum.de or here.

Module Description

CS0122: Personnel and Organizational Economics | Personnel and Organizational Economics

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination will be given in the form of a written examination. The students should be able to describe theories, methods and concepts of Personnel and Organizational Economics. Students should be able to explain important examples from the academic literature. Type of examination: written, calculators are allowed, no additional tools allowed, duration of examination: 90 minutes. In order to be admitted to the examination, successful completion of a course assignment is required. In the assignment, students apply what they have learned and demonstrate in a group work that they can understand and present a current research paper.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Microeconomics, Advanced Microeconomics

Content:
In this course we develop a simple theoretical framework for thinking about firm-worker interactions (the principal-agent model). We use it to organize the large empirical literature on personnel motivation, personnel selection, and organizations as a whole. The relevant are:
- The principal-agent-problem
- Employee motivation
- Recruiting and wage setting
- Tournaments as incentives
- Teams

Intended Learning Outcomes:
After attending the module, students will understand the impact of individuals' incentives in organizations in general and at the workplace as a concrete example. Students will understand how to model diverging motives and incentives and how those may result in conflicts. In addition, they are capable of the interpreting and summarizing the empirical evidence on those topics. Students will learn about possible solutions to align the incentives within organizations and are capable of solving these problems with the help of models.

Teaching and Learning Methods:
The lecture will be mostly done by presentations. In addition, articles from newspapers and journals are integrated into the lectures. Together with the lecturer, students will study the content and methods of the academic papers. In the exercises, students will practice solving the learned models. This will either be done jointly on the blackboard or as work in smaller groups. Classroom experiments are carried out for selected topics.

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

Reading List:
Peter Kuhn, Personnel Economics, Oxford University Press;
Zusätzliches Literaturverzeichnis wissenschaftlicher Publikationen

Responsible for Module:
Goerg, Sebastian; Prof. Dr. rer. pol.

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

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

Module Description

CS0123: Advanced Seminar in Behavioral Economics | Advanced Seminar in Behavioral Economics

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 7	**Total Hours:** 210	**Self-study Hours:** 150	**Contact Hours:** 60

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

Description of Examination Method:
The examination consists of a written seminar paper and an oral presentation with discussion. The seminar paper should cover 15-20 pages and is written in the style of a journal article. At the end of the module students present their work in a 30 minutes presentation. Weighting: Seminar paper 2, Presentation 1. The seminar paper demonstrates the student's ability to summarize the literature, explain research methods, present research findings and discuss them approbriately.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
-

Content:
This advanced seminar focuses on recent developments in Behavioral Economics. After being introduced to adequate research themes in the area of behavioral economics, students explore the academic literature on a chosen topic and develop their own research question. The topics are typically related to human behavior in an economic context and potential behavioral interventions.
Potential topics are:
-Green Nudges
-Social Comparison
-Choice Architecture

Intended Learning Outcomes:
The objective of the module is to equip the participants with the necessary skill and tools for a successful master thesis project.

Specifically, students will learn to:

- Read and understand recent research contributions
- Develop and pursue interesting research questions
- Conduct a literature review
- Eventually, design and conduct an experimental or empirical study
- Write a seminar paper in which they summarize the literature and explain research methods and results
- Present research findings and defend them in a discussion

Teaching and Learning Methods:
In an introductory session, the theme of the seminar is introduced and elaborated in detail. The introduction will also introduce the relevant behavioral economics literature. Based on the introduction, students will develop their own research question and decide on the adequate research methods. During the term students have to reach different milestones (e.g., choose a topic, choose a research method, collect data, outline their paper, write the paper, present the results) on specific dates. Following the submission of the seminar paper, students will present and discuss their research question and findings. During all stages of the seminar students will be assisted by the lecturer(s).

Media:
Research papers; presentation slides

Reading List:
Cartwright, E. (2018). Behavioral economics. Routledge.
Davis, D. D., & Holt, C. A. (2021). Experimental economics. Princeton university press.
Additional current research articles will be provided during the seminar

Responsible for Module:
Goerg, Sebastian; Prof. Dr. rer. pol.

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

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

Module Description

CS0125: Plant and Technology Management | Plant and Technology Management [PTM]

Version of module description: Gültig ab winterterm 2020/21

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

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

Description of Examination Method:
Written exam (90 minutes): By solving problems from the thematic field of the module students have to prove their understanding of the management of industrial plants and technologies, their ability to techno-economic assessment and optimization methods and their analytical and verbal skills in the field. In the solution of the problems they need to demonstrate their ability to analyse technical systems, assess them from an economic point of view and apply techno-economic methods to solve planning and optimization problems arising in the life cycle of these plants.
In addition, they need to show that they are able to discuss the application of these methods in practice and to derive further research needs. Learning aids: pocket calculator.

Alternative: For smaller groups (<15 students) parts of the examination can be held in form of a case study. In this case studies, students have to demonstrate in a group work that they acquired the above mentioned abilitites by solving problems of practical relevance. This acknowledges the complexity of real world problems and the necessity to solve these in (interdisciplinary) team works. With the case study solution students have to provide a statement of the individual contributions to the solutions. Weighting: 1:1.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
-

Content:
The module contains units covering the following topics:
• Introduction to Plant and Technology Management
• Life cycle of industrial plants

• Analysis and modelling of industrial production systems
• Project management in engineering
• Network and facility location planning
• Investment estimation
• Cost estimation
• Plant and process optimisation
• Maintenance and repair
• Quality Management
• Re-location, dismantling and recycling

Intended Learning Outcomes:
The students are able to solve techno-economic analysis, planning, and optimisation problems associated with the life cycle of industrial plants. This comprises also linked topics of technology assessment and management. After completion of this module the students are able to identify and characterise these problems and structure them. Further, they are able to determine needed data and apply suitable methods for the solution of the problems. They discuss the achievements and shortcomings of these methods for a practical application. They are able to transfer these contents to an application in practice.

Teaching and Learning Methods:
Format: Lecture with tutorial to introduce, train and deepen the contents of the module.

Teaching / learning methods:
- Media-assisted presentations
- Group work / case studies with presentation
- Individual assignments and presentation
The teaching and learning methods are combinded specifically for the treated topics. Typically, a thematic impulse or overview is given with a media-assisted presentation. Individual or group work assignments provide the possibility to apply the acquired competencies, to repeat and deepen these as well as to prepare the transfer to other fields.

Media:
Digital projector, board, flipchart, online contents, case studies

Reading List:
Empfohlene Fachliteratur:
1. Chauvel (2003): Manual of Process Economic Evaluation, Edition Technip
2. Couper (2003): Process engineering economics, Marcel Dekker Inc
3. Geldermann (2014): Anlagen- und Energiewirtschaft
4. Goetsch/Davis (2015): Quality Management for Organizational Excellence: Introduction to Total Quality, Pearson
5. Mobley/Higgins/Wikoff (2014): Maintenance Engineering Handbook, McGrawHill
6. Peters/Timmmerhaus/West (2003): Plant Design and Economic for Chemical Engineers, McGrawHill

Weitere Literaturempfehlungen werden in den Veranstaltungen gegeben.

Responsible for Module:
Magnus Fröhling

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

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

Module Description

CS0126: Advanced Seminar in Circular Economy and Sustainability Management | Advanced Seminar in Circular Economy and Sustainability Management [ASCESM]

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 7	**Total Hours:** 210	**Self-study Hours:** 150	**Contact Hours:** 60

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

Description of Examination Method:
Term paper: Students have to write a scientific paper on the given topic (15-20 pages). In doing so they have to show that they are capable to find relevant literature, structure a problem, solve it, and document the results of the process in a scientific paper.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
-

Content:
"The module deals with actual topics from Circular Economy and Sustainability Management. These differ from semester to semester. Topics will be announced at the end of the preceeding semester.

Intended Learning Outcomes:
The seminar aims at enabling students for scientific work. After passing the module the sutdents are able to find, structure and analyse relevant literature, solve the problem scientifically, discuss the solution critically, summarize the work in a term paper, hold a scientific presentation, and discuss and defend their work. Thereby the students acquire in-depht knowledge on a current topic from the thematic field of circular economy and sustainability management.

Teaching and Learning Methods:
Seminar: after an introduction on the topic the students carry out a literature research, structure the problem, identify solution approaches, apply these. They summarize their findings in a term

paper and a scientific presentation. In this process they are supervised, receive materials, thematic introductions, advise in scientific work and continuous feedback in the seminar sessions. The seminar closes with a final presentation.

Teaching / learning methods:
- Kick-off session: media-assisted presentation
- Individual work and feedback
- Interim presentations / workshops
- Final presentation
- Computer lab exercises using LCA software systems and Life Cycle Inventory Data bases.

Media:
Digital projector, board, flipchart, online contents, recent scientific journal publications, computer lab

Reading List:
Recommended reading:
• Gastel B; Day R A (2017): How to write and publish a sicentific paper, Cambridge University Press
• Glasman-Deal H (2009): Science Research Writing For Non-Native Speakers Of English: A Guide for Non-Native Speakers of English, Imperial College Press
• Skern T (2011): Writing Scientific English: A Workbook, UTB

Topic related reading, especially articles in international peer reviewed journals, will be provided in the kick-off meeting of the module.

Responsible for Module:
Fröhling, Magnus; Prof. Dr. rer. pol.

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

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

Module Description

CS0128: Corporate Sustainability Management | Corporate Sustainability Management [CSM]

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**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:
Written exam (90 minutes): Students have to solve problems from the thematic field of the module. They have to prove their ability to use the right vocabulary, apply their knowledge on advanced topics in strategic and operational sustainability management.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The Corporate Sustainability Management module includes a detailed discussion of the term sustainability (three-pillar model) and the history of the content. Based on this, the basic premises for sustainable management and sustainable economic activity are derived and discussed in a social, political, environmental, economic and corporate context. The national, European and international strategies for sustainable management are presented (e.g. bioeconomy, circular economy, green economy). Furthermore, established measurement concepts and key performance indicators (KPIs) for sustainability (e.g. resource productivity, life cycle costing) are discussed and applied to exemplary products and value chains within the framework of "Corporate Social Responsibility Reporting".

Intended Learning Outcomes:
After completion of the module, the students are able to understand sustainability concepts and to compare sustainability-oriented corporate profiles as a supplement to value-added corporate development. They can develop and apply concepts for the derivation, evaluation and operational integration of economic, ecological and social indicators. This enables the students to carry out

sustainability assessments based on common and innovative new measurement concepts and indicators and to apply the results in the company.

Teaching and Learning Methods:
The module includes a lecture and an exercise. During the lecture, the content is communicated by presentations and discussions. The lectures serves to communicate the theoretical basics and terms of sustainability management including small exercises for group work. The students are encouraged to further deepen their knowledge of the proposed literature. As the highest level of competence, the lecture communicates an understanding of the evaluation of various sustainability concepts for use in operational management.
In the exercise, the students deepen the knowledge they have acquired by case studies. The content of the lectures and exercises is deepened both in small working groups and in individual work. As the highest level of competence, the exercise conveys the step-by-step development and incorporation of sustainability concepts using case studies of real and fictitious company concepts to achieve strategic and operational targets for sustainable development of the selected company.

Media:
Presentations, slide scripts, case descriptions of real and fictitious companies with sustainability management problems

Reading List:
Müller-Christ, G. (2010) Sustainable Management. Introduction into Resource Orientation and Contradictory Management Rationalities. Baden-Baden: Nomos
Schellnhuber, H. J.; Molina, M.; Stern, N.; Huber, V.; Kadner, S. (2010): Global Sustainability. A Nobel Cause. New York: Cambridge University Press
Seliger, G. (2012): Sustainable Manufacturing. Shaping Global Value Creation. Berlin: Springer
Von Hauff, M.; Kleine, A. (2009): Nachhaltige Entwicklung (Sustainable Development). Grundlagen und Umsetzung (Basics and Implementation). München: Oldenburg Wissenschaftsverlag

Responsible for Module:
Röder, Hubert; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Corporate Sustainability Management (Exercise) (Übung, 3 SWS)
Röder H [L], Röder H

Corporate Sustainability Management (Lecture) (Vorlesung, 1 SWS)
Röder H [L], Röder H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0170: Advanced Modelling and Optimization | Advanced Modelling and Optimization

Version of module description: Gültig ab winterterm 2021/22

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 7	**Total Hours:** 210	**Self-study Hours:** 150	**Contact Hours:** 60

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

Description of Examination Method:
The examination is based on two project works (each 50% of evaluation).

The project works examine the understanding of the modeling and programming techniques discussed in the course. The project works includes, appling algorithms to solve problems, creating mathematical models for examplary problems, and discuss presented results. By this the students have to demonstrate that they have understood and can apply the mathematical models and methods to solve planning problems. The project paper serves the assessment of the understanding of the modeling and programming language.

For the project paper the participants get a randomly assigned fictive, extensive decision problem.
For this problem, the following has to be prepared:
- a modeling of the problem as a mathematical program, as well as explanation of the program
- an implementation of the program in a known optimization and programming language
- a verbal and graphical explanation of the of the results for the original problem

The grading of the project paper is done by the following criteria:
- Correctness of modeling and implementation as well as of the results (60% of examination)
- Clarity, comprehensibility and efficiency of the implementation (30% of evaluation)
- correct language, typesetting and outer form of the paper (10% of evaluation)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Operations Research (CS0098)

Content:
This course is about modeling, solving and analyzing planning and decision problems using mathematial concepts. The course teaches the basics of linear, discrete and dynamic optimization. In addition, there is an introduction to optimization and corresponding programming languages, as well as teaching methods for analyzing and structuring algorithms, designing suitable object-oriented data structures, applying known standard algorithms and connecting them to other resources and programming environments.

Intended Learning Outcomes:
After successful completion of the module students are capable of modelling planning problems. Students learn to model real life business problems by applying mathematical programming techniques. They can independently implement mathematical models by using an optimization language and heuristical approaches. They are able to solve the models within the scope of a case study and can interpret the results. Furthermore, they deepen their knowledge in several different modeling techniques and basics of object oriented programming.

Teaching and Learning Methods:
The module consists of a lecture and exercise courses, which are provided weekly. In the lecture the content is jointly developed with the students mainly by using slides. The exercise course repeats parts of the lecture contents by using examples and offering the opportunitis to implement poblems individually. The excercises give the student the opportunity to pose questions and receive immediately help from the teaching assistant.

Media:
Script, Presentation slides

Reading List:
Hilier, F. and Lieberman, G., Introduction to Operations Research, McGraw-Hill, 2009
Popp, Andreas: Modellierung und Optimierung mit OPL. epubli, 2015
Schildt, H.: Java, A Beginner's Guide, 5th Edition, McGraw-hill, 2011
Winston, W.: Operations Research - Applications and Algorithms. 4th ed. (internat. student ed.), Belmont, Calif. (Duxbury), 2004.

Responsible for Module:
Alexander Hübner alexander.huebner@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

CS0177: Discrete Event Simulation | Discrete Event Simulation

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 7	**Total Hours:** 210	**Self-study Hours:** 135	**Contact Hours:** 75

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

Description of Examination Method:
The examination consists of two individual tasks and a project work. The individual work is done as homework and is composed as follows:
• R-Statistics homework (10 % of the evaluation)
• AnyLogic homework (10 % of the evaluation)

The project work serves to evaluate the understanding in handling and application of simulations. For the project work the participants receive a randomly assigned extensive fictitious simulation problem. The project work consists of the presentation of the project plan, a project report, an oral presentation of 20 min and a discussion time of 10 min.

The evaluation of the project work is based on the following criteria:
• presentation of the project plan (10 % of the evaluation)
• written documentation of the project work (50% of the evaluation)
• presentation and discussion of the project work (20% of the evaluation)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in mathematics and statistics, especially in probability theory and probability distributions as well as descriptive and inductive statistics

Content:
• Basics of simulation
• Steps in a Simulation Study
• Conceptual Modeling
• Introduction to ARIS: Representation of processes using event-driven process chains

• Data collection and modeling of input data
• Introduction to R: Analysis of distributions
• Modeling and implementation of simulation models
• Introduction to simulation software (e.g. AnyLogic) and basic as well as advanced simulation techniques
• Visualization of simulations
• Verification, Validation and Calibration of a simulation
• Methods for determining the simulation setting
• Statistical methods for the analysis of simulation results

Intended Learning Outcomes:
Students
• apply their knowledge of probability theory and probability distributions
• are able to analyze production and logistic systems, represent processes and design proposals for optimization.
• apply the necessary methodological knowledge for the independent execution of simulation studies.
• are able to apply simulation software such as AnyLogic practically.
• can present results of a simulation study and derive concrete recommendations for action from their analyses.

Teaching and Learning Methods:
The module consists of a lecture and an exercise, which take place weekly. In the lecture, the contents are derived together with the participants. The exercise repeats the lecture contents with examples and deepens core concepts through independent simulation and computational studies of selected problems. The students are supported in solving the exercises by the tutors.

Media:
Presentations, cases and solutions

Reading List:
• Kelton, W. D., R. P. Sadowski, and D. T. Sturrock, Simulation with Arena, 3. Aufl., Boston (McGraw-Hill) 2003.
• Law, A. M. and W. D. Kelton, Simulation Modeling and Analysis, 4. Ed., Boston (McGraw-Hill) 2007.

Responsible for Module:
Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Discrete Event Simulation (Lecture) (Vorlesung, 2 SWS)
Schäfer F [L], Schäfer F, Tuma N

Discrete Event Simulation (Exercise) (Übung, 2 SWS)
Schäfer F [L], Schäfer F, Tuma N
For further information in this module, please click campus.tum.de or here.

Module Description

CS0227: LCA Case Studies | LCA Case Studies [LCA CS]

Version of module description: Gültig ab summerterm 2022

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:
Written group assignment and oral group presentation: Students are training their skills in Life Cycle Assessment by carrying out and report a small LCA study including data collection. Students are free to use the openLCA software for modelling. Performing the calculations with spread-sheets is also fully accepted.

In groups of at least two persons, students identify and select a topic for their LCA case study. Each group has to perform all four phases of an LCA. This consists of
- Writing a goal and scope definition,
- Collecting data for carrying out the inventory analysis,
- Selecting suitable life cycle impact categories and performing a life cycle impact assessment,
- Interpreting the results, discussing the own study including its limitations by comparing it with other LCA studies/reports in the same/similar topic.
- Presenting the results in form of a presentation and a written report

The examination consists of three parts. The weighting is as follows:
(1) Goal and scope definition (20%)
(2) Final presentation (30%)
(3) Final report (50%)

In the Goal and Scope Definition (~5 pages), the topic and purpose of the LCA case study is established and decisions are made about the product system being studies. In drafting the goal and scope definition, students show that they are able to identify and select an object for analysis, to structure a problem and plan the outset and further steps of their study.

In the final group presentation (25'), students present their results and have to show that they are able to summarize their findings in a scientific presentation, discuss and defend them (15' for presentation, 10' for discussion).

In the final report (15-20 pages), the students show that they are able to perform a simple LCA case study. Moreover, they proof their study design in a transparent and logical way. By presenting the results of the LCA case study as well as discussing the findings and limitations, students proof their ability to find relevant literature, carry out a small LCA study and document the results of the process in a scientific paper.

Repeat Examination:

(Recommended) Prerequisites:
The contents of the module Advanced Sustainability and Life Cycle Assessment is required. It can be obtained in parallel to this seminar.

Content:
The module contains units covering the following topics:
• Systems and life cycle thinking
• Life Cycle Assessment
• Goal and Scope Definition to plan the outline of the LCA study
• Life Cycle Inventory for data collection and reconciliation
• Life Cycle Impact Assessment to assess the potential environmental impacts
• Handling of data uncertainty
• Literature research and current trends and developments
• Software systems and databases for life cycle assessment
• Case studies

Intended Learning Outcomes:
The students use the concepts and tools of life cycle assessment. The goal is to be able to analyse industrial metabolisms as well as products and services regarding their environmental impacts. Thus, students gain a deeper understanding of the LCA methodology and procedure by applying the theoretical knowledge to a practical example.
At the end of the module students are able to carry out an own LCA. This involves carrying out the four phases of an LCA study
• the goal and scope definition phase: to identify and select a suitable product or service system to carry out an LCA case study, explain the key aspects of the goal and scope definition and their relevance for the subsequent LCA phases, to define a functional unit and reference flow for the LCA case
• the inventory analysis phase: to collect the input/output data with regard to the system being studied.
• the impact assessment phase: to address the environmental aspects and potential environmental impacts throughout the life cycle of a product or a service system.
• the interpretation phase: the results of the life cycle inventory and life cycle impact assessment are summarized and discussed as a basis for conclusions, recommendations and decision-making in accordance with the goal and scope definition.

Applying LCA methodology can support further development and improvement of systems, products, and services. This can support decision-making processes, marketing and product/ service improvement in the context of various stakeholders.

Teaching and Learning Methods:
Seminar: In parallel to the lecture "Advanced Sustainability and Life Cycle Assessment", this seminar format provides the opportunity to apply the theoretical knowledge of LCA by applying it to a small LCA case study and gaining a deeper understanding of the LCA methodology. After an introduction to the topic, the students identify a product/service system to analyse, carry out a full LCA (incl. data collection, literature research). They receive intermediate feedback to a Goal and Scope Definition of their study. In a next step they carry out a full LCA. In this process they are supervised, receive materials, thematic input, advice in scientific work and continuous feedback in the seminar sessions. The seminar closes with a final presentation.

Teaching / learning methods:
• Kick-off meeting
• Media-assisted presentations
• Video-based tutorials for methodology (e.g. LCA software)
• Individual work and feedback consultations
• Group work / case studies with presentation
• Interim presentations / workshops
• Final group presentations
• Group assignments

Media:
Digital projector, board, flipchart, online contents, videos, case studies, LCA software, presentations

Reading List:
Recommended reading:
• Curran, M.A. (2015): Life Cycle Assessment Student Handbook, Scrivener Publishing.
• Fröhling, M.; Hiete, M. (2020): Sustainability and Life Cycle Assessment in Industrial Biotechnology. Springer, Cham.
• Guinée, J.B. (2002): Handbook on life cycle assessment: operational guide to the ISO standards. Kluwer, Dordrecht.
• Hauschild, M.Z. & Huijbregts, M.A.J. (2015): Life Cycle Impact Assessment (LCA Compendium - The Complete World of Life Cycle Assessment), Springer, Cham.
• Hauschild, M.; Rosenbaum, R.K.; Olsen, S.I. (2018): Life Cycle Assessment: Theory and Practice. Springer, Cham.
• Jolliet, O., Saade-Sbeih, M. (2015): Environmental Life Cycle Assessment. CRC Press.
• Klöpffer, W. & Grahl, B. (2014): Life Cycle Assessment (LCA), Wiley-VCH.

Responsible for Module:
Fröhling, Magnus; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
LCA Case Studies (Seminar, 3 SWS)
Fröhling M [L], Schirmeister J, Corella Puertas M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0228: Technology and Management of Renewable Energies in a Global Context | Technology and Management of Renewable Energies in a Global Context [REAE]

Version of module description: Gültig ab summerterm 2024

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:
The exam will be in form of an oral presentation of the students (20+10 minutes; 75% of the grade) and a short report of the students' project work (max. 5 pages, not counting front page and cited literature; 25% of the grade).

In this students' project, the students demonstrate understanding of specific questions related to a defined topic concerning the technology and management of renewable energies in a global context. Students have to show in their presentation that they can analyse, solve and answer defined problems and questions related to this topic. Participants of the course show that they have done appropriate research work and are able to present their results. By answering follow-up questions related to their presentation they show that they have learned to put their research outcome into the relevant technical or country context. The presentation slides and the short report will be handed over to the lecturers and will be included in the grading.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic know-how related to specific techniques of renewable energies (e.g. solar energy, wind energy, hydropower, biomass conversion technology, geothermal energy) as well as management of energy systems either on a company or on state level.

Content:
A) Technical aspects of different forms of renewable energies (e.g. current state of technology, technical options for the future, technical bottlenecks, scale-up possibilities)
- Wind power

- Hydropower
- Photovoltaics, solarpower
- Geothermal energy
- Biomass use for energy purposes
- Biofuels, electric vehicles, E-fuels
- Hydrogen
- Other forms of renewable energies

B) Economic aspects related to defined renewable energies (e.g. cost of use/production, cost structure and development in the past, learning curves, innovation and diffusion of renewable energies)
C) Influencing factors for adoption and use of renewable energies (e.g. natural/local conditions, availability of renewable resources, technical infrastructure, user structure of energy, cost and economic factors, financing, political and regulatory issues, social acceptance, behaviour of stakeholders and people)
D) Situation and development in a specific (country) context (e.g. governance, policy goals and activities, competing factors and interests (e.g. by fossil energy use or related companies/ stakeholders), legal and regulatory stability)

Intended Learning Outcomes:
At the end of the module, students will be able to analyse and elaborate solutions for existing problems related to the technology and management of renewable energies and apply such solutions to the specific context of selected countries worldwide. They consider both the technical side as well as the economic and management dimension in order to develop integrated solutions for a specific question related to renewable energies. Additionally they take the specific context and situation (e.g. technical infrastructure and know-how, maintenance, electrical or other grids, political and regulatory rules, economic framework, company and user structure) in one or several countries or regions into account when analysing and elaborating solutions for the question on-hand. They are able to apply their knowledge to create an oral presentation and a written summary of their findings. Presented results are discussed with the audience so that students are able to defend their solution and put it in an appropriate context.

Teaching and Learning Methods:
The module is a seminar, where course participants form (preferably international) teams that investigate a given topic by autonomously doing research work and discussing results within the team. During regular meetings with the lecturers questions can be discussed, next steps are defined and (interim) results are presented. Lecturers will provide basic and background material for the students as well as actual information for the given topics that are elaborated by the student teams.

Learning activities: Literature/document research, student group project

Media:
Presentation slides, online discussion forum (all lecture materials are available via Moodle)

Reading List:
Specific literature and documents will be provided to the topics that are worked on in the student projects

Responsible for Module:
Menrad, Klaus; Prof. Dr.sc.agr.

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

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

Module Description

CS0259: Communication and Presentation | Kommunikation und Präsentation

Version of module description: Gültig ab winterterm 2022/23

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:
In the course of the semester elaboration of presentations (individual and group presentations, role play, case processing in the group, video analyses) shall be expected (non-graded) as an exam achievement by the students. The module shall be terminated by a written test (90 min). In this exam the students shall convey different models from communications psychology without tools or illustrate them by using different mentioned scenarios.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The module of Communication and Presentation is divided into the following fields:

• Basics of communications and communication methodology
• Communication rules nd their application in daily professional life
• Axioms of communications
• The four levels of communications ('four-ear-model')
• Communications in groups
• Giving and taking constructive feedback
• Do´s and Don´ts of communications
• Advantageous basic attitudes and communication techniques of non-directive conversation guidance

Intended Learning Outcomes:
After having participated in the module the students are able to understand basic communication models and allocate underlying theory to models accordingly.
Furthermore the students are able to describe communication by using case studies.
The four-level model of communications may be used in everyday life and in professional life.
When communicating in groups the students may give and take constructive feedback.

Teaching and Learning Methods:
During the lecture a speech (including discussion) will be worked out by the students. During the exercises role plays, case studies will be performed. In video analyses individual and group presentations shall be performed and analysed.

Media:
Presentations, script, video, exercise sheets, flipchart, powerpoint, showing films

Reading List:
Schulz von Thun, F. (2014). Miteinander reden 1: Störungen und Klärungen. Allgemeine Psychologie der Kommunikation. Hamburg: Rowohlt Verlag.
Schulz von Thun, F. (2014). Miteinander reden 2: Stile, Werte und Persönlichkeitsentwicklung. Differentielle Psychologie der Kommunikation. Hamburg: Rowohlt Verlag.
Schulz von Thun, F. (2014). Miteinander reden 3: Das "Innere Team" und situationsgerechte Kommunikation. Hamburg: Rowohlt Verlag.
Schulz von Thun, F. (2014). Miteinander reden 4: 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:

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

Module Description

CS0275: Economic Valuation of Consumer and Environmental (non-market) Goods | Economic Valuation of Consumer and Environmental (non-market) Goods

Version of module description: Gültig ab summerterm 2024

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 as well as students' presentations.
The students should be able to evaluate and use the taught methods of market analysis. Using case studies, students must discuss various questions related to the theoretical background of non market goods and consumer goods. Besides that, the students have to answer questions about the used statistical programs and data analysis. Duration of written examination: 60 minutes. The proportion of the written examination is 50% of the total grade.

The students' presentations aims to present the scientific methods and results of a student project elaborated during the semester. The students present individually or in groups the elaborated results and discuss them with their colleagues and lecturers. Powerpoint and presentation equipment are allowed for the presentations. Students must give an intermediate presentation (duration: 10 minutes) and a final presentation (duration: 20 minutes). Students will only be admitted to the final presentation if they have successfully completed the interim presentation. The proportion of the presentations is 50% of the total grade.

Both parts of the grade (written examination and presentation) must be passed in order to successfully complete the module.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prerequisites for the successful participation is knowledge about,
- basic knowledge about non-market goods

- basics of multivariate analysis methods
-basics in empirical data collection

Content:
This course aims to explain the valuation of consumer goods and non-market goods.

In the first part of the lecture, students will learn basic aspects of consumer goods and of environmental goods.
Consumer goods: The students get to know different types of consumer goods (e.g. durable goods, nondurable goods, services) and how they can be characterized.
Non-market goods: These goods provide many services, like clean air, carbon capturing or protection against floods or erosion. These ecosystem services are not traded on a market and accordingly do not have an observable market price. To show the value of environmental services, e.g. to evaluate policy measures that enhance or reduce ecosystem services, we need approaches for nevertheless quantifying the value of environmental services.

Based on the first part, the second part of the course introduces and discusses different methods for (non-) market valuation of consumer goods and environmental services. Students will learn the theoretical background of a Choice Based Conjoint Analysis as well as its application by means of examples. The analysis of sample data will also be discussed and practiced with the help of appropriate software (e.g. Sawthooth).

In the third part of the module, students have to apply the methods and tools they have learned. The students receive already collected data (in the field of consumer goods) or implement their own online survey using a Choice Based Conjoint approach (in the field of non-market goods). Students have to develop specific research questions based on the given data or non-market good scenario using also information provided in scientific literature. After that, students must analyze data using a Choice-Based Conjoint analysis to answer their research questions. In a final step, students must present their findings.

Intended Learning Outcomes:
After attending the module, students can characterize current topics and methods in the evaluation of consumer and environmental (non-market) goods. Students will learn to analyze and use different concepts for valuing consumer goods and environmental services as well as the concepts' strengths and weaknesses. Further, they will learn how to collect, analyze, and evaluate data by using choice analytics survey software as well as to interpret the results.

Teaching and Learning Methods:
The lecture will be mostly done by presentations. In addition, articles from newspapers and journals are integrated into the lectures. Together with the lecturer, students will study the content and methods of the academic papers.
In the project work, the students themselves either analyze collected data (which will be provided to the students) or implement an online survey for non-market goods and analyze the data

collected in this survey. The results of the evaluation are then presented and discussed individually and / or in groups from different perspectives by the students.

Media:
Presentations, slide scripts, articles

Reading List:
- Sawthooth manuels
- Hair, J.F., Black, W.D., Babin, B.J., & Anderson, R.E. (2013): Multivariate Data Analysis, Pearson, Upper Saddle River
- Champ, P.A., Boyle, K. J., and & Brown T. C., (2017): A Primer on Nonmarket Valuation, Springer

Responsible for Module:
Thomas Decker (thomas.anton.decker@mytum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Economic Valuation of Consumer and Environmental (non-market) Goods (Vorlesung mit integrierten Übungen, 4 SWS)
Pondorfer A [L], Pondorfer A, Decker T
For further information in this module, please click campus.tum.de or here.

Module Description

CS0305: Research Excursion Master | Research Excursion Master

Versionersionersi

A bullet point list with typically 10-12 entries will be provided by the professors and lecturers with the announcement of the research excursion 1 month before the start of lectures in the semester in which the excursion is offered, at the latest.

After the excursion the results of the applied methodologies are presented and discussed in a workshop. Key findings and the results of the workshop are included in a final excursion report by the students.

Intended Learning Outcomes:
The excursion aims to support the scientific profile building of students and the acquisition of scientific, practical and social competencies and the application to case studies visited during the excursion. It supports the competence acquisition in other modules and / or the study programs in general. The students get practical insights into the topical field of the research excursion, deepen their comptencies in this field regarding ongoing research and apply their competencies to real case studies in practice.

In particular, the intended learning outcomes are the following:
- Select relevant scientific and practic□□ on to praV ry 1Ti ited f the pdon togen the Tf h typur□l.and thert l

excursion and can due to the variety of possible destinations and topics not be specified further at this point.
- Individual work: the students will reflect their learnings in written form,
- Workshop: the students will present and discuss their findings in a workshop to gain practical experience for their future working conditions and formulate a final excursion report.

Media:
Digital projector, board, flipchart, online contents, recent scientific journal publications, equipment and utilities demonstrating production processes in practice

Reading List:
Topic related reading, especially articles in international peer reviewed journals, will be provided during the course of the module.

Responsible for Module:
Prof. Cordt Zollfrank Prof. Hubert Röder Prof. Magnus Fröhling

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

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

Version of module description: Gültig ab winterterm 2023/24

Module Level:	Language:	Duration:	Frequency:
Master	English	one semester	summer 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:
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:
End of Semester

(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

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

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

Module Description

WZ1103: Introduction to Economics of Renewable Resources | Einführung in die Ökonomie Nachwachsender Rohstoffe

Version of module description: Gültig ab winterterm 2021/22

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:
Die Prüfungsleistung wird in Form einer schriftlichen Klausur (120 Minuten) erbracht. In dieser soll nachgewiesen werden, dass in begrenzter Zeit und ohne Hilfsmittel ökonomische Zusammenhänge bei der Verwendung Nachwachsender Rohstoffe verstanden worden sind und im Zusammenhang mit einzelbetrieblichen Maßnahmen analysiert und weiterentwickelt werden können. Auch wird mittels der Klausur überprüft, inwieweit die Studierenden die verschiedenen Märkte nachwachsender Rohstoffe charakterisieren und mögliche Lösungswege für die stoffliche und energetische Nutzung aufzeigen können.
Der Teilbereich "Ökonomie Nachwachsender Rohstoffe" geht mit 65 % und der Teilbereich "Märkte Nachwachsender Rohstoffe" mit 35 % in die Gesamtnote ein.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Die Vorlesung gliedert sich in 3 Teilbereiche auf. Diese sind inhaltlich weitgehend voneinander unabhängig, thematisieren aber verschiedene Facetten der Ökonomie von Nachwachsenden Rohstoffen.
1. Vorlesung Ökonomie Nachwachsender Rohstoffe
Einführung in die Grundlagen der Ökonomie anhand ausgewählter Konversionspfade auf der Basis Nachwachsender Rohstoffe von Standortentscheidungen über die Beschaffung und Logistik, Produktion, zwischenbetrieblichen Verbindungen bis zur externen Berichterstattung
2. Übung zur Ökonomie Nachwachsender Rohstoffe

Die fachlichen Inhalte der Vorlesung werden anhand von Fallbeispielen analysiert und kritisch bewertet, so dass die Teilnehmer die Inhalte in ihrer späteren beruflichen Tätigkeit eigenständig weiterentwickeln können.
3. Vorlesung Märkte Nachwachsender Rohstoffe
Darstellung verschiedener Märkte der Nachwachsenden Rohstoffe. Diese sind aufgeteilt in die stoffliche Nutzung (Bioschmierstoffe, Werkstoffe, chemische Grundstoffe und Feinchemikalien) und in die energetische Nutzung (Wärme, Elektrizität und Mobilität)

Intended Learning Outcomes:
Nach der Teilnahme an der Modulveranstaltung können die Studierenden die ökonomischen Grundlagen der Verwendung Nachwachsender Rohstoffe differenziert anwenden und die Wirtschaftlichkeit anhand von einzelbetrieblichen Fallbeispielen analysieren und bewerten. Des Weiteren sind sie in der Lage, die betriebs- und marktwirtschaftlichen Zusammenhänge bei der Verwertung Nachwachsender Rohstoffe kritisch zu beurteilen und aktuelle Entwicklungen dabei einzubeziehen. Darüber hinaus können die Studierenden die verschiedenen Vermarktungsformen und Marktgrößen von Nachwachsenden Rohstoffen einschätzen und vergleichend kombinieren.

Teaching and Learning Methods:
Vorlesung; Diskussionen; Fallbeispiele
Mit Hilfe der Vorlesungen und der Übung werden alle Teilbereiche des Moduls vorgestellt. Mit Hilfe dieser Methode kann das umfangreiche Stoffvolumen am besten vermittelt werden. In den Diskussionen lernen die Studierenden, unterschiedliche Perspektiven zu integrieren und die Modulinhalte richtig einzuordnen und kritisch zu beurteilen.

Media:
Präsentationen, Skript, Fallbeispiele

Reading List:
Wacker, H., Blank, J. E.: Ressourcenökonomie, Bd. 1 und 2 Einführung in die Ressourcenökonomie, München, Oldenbourg Verlag, 1999.; KALTSCHMITT, M. und H. HARTMANN (Hrsg.): Energie aus Biomasse. Grundlagen, Techniken und Verfahren. Springer Berlin, 2009; Vahs, D., Schäfer-Kunz, J.: Einführung in die Betriebswirtschaftslehre. Schäffer-Poeschel Verlag Stuttgart. 2012

Responsible for Module:
Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Overview Markets of Renewable Resources (Lecture) (Vorlesung, 1,5 SWS)
Decker T

Management of Renewable Resources (Exercise) (Übung, 1 SWS)
Röder H

Management of Renewable Resources (Lecture) (Vorlesung, 1,5 SWS)
Röder H [L], Pokholkova M, Röder H
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1138: Investment, Financing, Money and Capital Markets | Investition, Finanzierung und Kapitalmärkte

Version of module description: Gültig ab winterterm 2015/16

Module Level: Master	**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:
Written examination (90 minutes): The students' knowledge is assessed with the help of a comprehensive and coherent case study. This includes students' ability to make and justify investment decisions as well as identify and justify a required financing for investment measures and a necessary use of guarantees.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of (financing) mathematics

Content:
Investment calculation methods / techniques (static, dynamic), instruments for financing and credit insurance, and debtor related problems will be commented with the aid of case examples.
1. Introduction and basics of investment calculation
2.Taxes in investment calculation
3. Optimum replacement time for investment products
4. Uncertainty and sequential decisions
5. Optimum portfolios
6. Financial planning (involves a field trip)
7. Internal financing and self-financing (involves a field trip)
8. External financing (borrowing and own finance)
9. Loan securities
10. Simultaneous investment and programme planning (field trip)
11. Detailed real-life cases

The analysis of case examples is required to ensure that students can make investment decisions independently in their future professional life and will be able to identify the most suitable forms of financing. Ideally, this is not taught in actual classes but by e-learning (individual and group work; chat; fora, students monitoring their own learning)

Individual excursions (to companies and/or financial institutes) offer additional real-life experience.

Intended Learning Outcomes:
Students who have completed this module are aware of the principal methods of static and dynamic investment calculation, including their respective advantages and disadvantages. They can apply those methods to a business context, taking tax into account and using a spreadsheet program.
They are able to calculate and analyze investments offered by companies and derive recommendations for selecting the best offer (from a range of offers).
Students also recognise the potential of companies' internal and external financing (including on the capital market) and the key types of loan securities. They are able to undertake financial planning and evaluate how that might be implemented in a business setting as well as analyse the correct use of common securities relative to the value of the loan.

Teaching and Learning Methods:
Blended Learning inclucing 50 % presence required (lectures, tutorials) and 50 % e-learning (via vhb) with the aid of online exercises, a case study and online tutorials.
Teaching of methods via our own e-learning system (developed for vhb) (starting SS2015) as well as in addition to traditional lectures requiring the students' presence.

Media:
Blackboard, PowerPoint,
e-learning (via vhb) (script, blog, exercise sets)

Reading List:
Bodmer, U.: Geldanlage und Finanzierung. Ulmer Verlag. Stuttgart. 1998.
Drukarczyk, J.: Finanzierung. 10. Auflage. Lucius & Lucius. Stuttgart 2008.
Sachs, G.: Technik der Finanzplanung. In: Hauschildt et al. (Hrsg.): Finanzplanung und Finanzkontrolle. Hagener Universitätstexte. Verlag Vahlen. München.
Zantow, R.: Finanzwirtschaft des Unternehmens; Pearson Verlag.
Zellweger, Th. und U. Fueglistaller: Finanzielles Risiko- und Investitionsverhalten von Familienunternehmen. In: Ernst Young AG und P. Bühler (Hrsg.):Schriften des Family Business Center der Universität Sankt Gallen.2005.
Zellweger, Th. und U. Fueglistaller: Rendite und Spielregeln in Familienunternehmen. In: Ernst Young AG und P. Bühler (Hrsg.):Schriften des Family Business Center der Universität Sankt Gallen.2005.

Responsible for Module:
Ulrich Bodmer (ulrich.bodmer@mytum.de)

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

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

Elective Modules BOKU | Wahlmodule der BOKU

Module Description

CS0034BOK: BOKU: Computer Simulation in Energy and Resource Economics | BOKU: Computer Simulation in Energy and Resource Economics

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 45	**Contact Hours:** 30

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

Description of Examination Method:
Weekly Assignments (50% of points) Final oral examination (50% of points) Extra points in the human-zombie deathmatch

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic programming knowledge in any programming language (R, Python, C, Java, VB-Script, etc...) is a prerequisite.

Content:
Economic agents that show bounded rationality or strategic behaviour and markets that are out of equilibrium pose serious problems to traditional economic modelling techniques.

This course introduces the students to the concept of agent based modelling which allows addressing these issues.

After presenting general agent based models in economics, we focus mainly on modelling the design of electricity markets.

Intended Learning Outcomes:
The students learn to understand the concept of agent based modelling, get to know important agent

Module Description

CS0035BOK: Entrepreneurship and innovation (incl. patent licensing) | Entrepreneurship und Innovation (inkl. Patentwesen)

Version of module description: Gültig ab winterterm 2018/19

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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

CS0078BOK: Innovation Processes in the Forest-based Bioeconomy | Innovation Processes in the Forest-based Bioeconomy

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
Prüfungsimmanent (Diskusion der zu lesenden Texte und abschließende Präsentation der eigenen Reflexion)

Repeat Examination:

(Recommended) Prerequisites:
Kenntnis der Methoden wissenschaftlichen Arbeitens wird ausdrücklich empfohlen

Content:
Die LVA setzt den Fokus auf Innovations- und Bioökonomieforschung im Kontext der Forst- und Holzwirtschaft, und erweitert diese um systemische Perspektiven hinsichtlich technologischer Innovationen, geeigneter sozioökonomischer und ökosozialer Rahmenbedingungen.

Intended Learning Outcomes:
• Einführung in den wissenschaftlichen Diskurs zu den Themen Bioökonomie, Circular Economy, und Sustainable Development im Kontext von Innovationsprozessen in der Forst- und Holzwirtschaft.
• Einblick in folgende Forschungsfelder als interdisziplinärer Zugang zur Betrachtung der Wertschöpfungskette Holz in Innovationsprozesse
Umweltbewertung im Innovationsprozess
- Gesellschaftliche Wahrnehmung hinsichtlich Ressourcennutzung, Produktionsprozessen und Produkten
• Studierende lernen aktuelle Diskurse als Forschungskontext und als Rahmenbedingungen für Innovationsprozesse kennen.
• Studierende erwerben die Kompetenz, Problemstellungen in der (holzbasierten) Bioökonomie zu

re#ektieren und einen Forschungsbedarf abzuleiten.
• Studierende der Lehrveranstaltung werden befähigt mit wiss. Quellen fundiert zu diskutieren, ihre Argumente zu strukturieren und Forschungsfragen zu Innovationsprozessen in der holzbasierten Bioökonomie zu formulieren.

Teaching and Learning Methods:
Impusvorträge der Lehrenden, Guided reading und gemeinsame Reflexion

Media:

Reading List:
Wird auf BokuLearn (https://learn.boku.ac.at/) zur Verfügung gestellt

Responsible for Module:
BOKU - Institut für Marketing und Innovation

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

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

Module Description

CS0116BOK: Game Theory in Environmental and Natural Resource Management | Game Theory in Environmental and Natural Resource Management [CS0116BOK]

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Written Exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
This course offers an introduction to Game Theory with examples in Environmental and Natural Resource Management. Game Theory is the mathematical study of strategic interaction among independent self-interested agents.
Game theoretic concepts are applied in disciplines as diverse as economics (e.g., competing firms), political science (e.g., political candidates competing for votes), and biology (e.g., animals fighting over prey) – among others. In environmental and natural resource management, Game Theory is a helpful tool to analyze e.g., international environmental problems, situations when international environmental treaties are decided, or competition over exhaustible natural resources. Prominent games which are utilized to gain insights into international environmental problems are e.g., the Prisoners' dilemma, or the so-called Chicken Game.
Students attending this course will be introduced to formal game theoretic concepts and its practical applications. The lecture will roughly follow this outline:
1. Introduction:
- What is game theory about?
- Basic concepts: Theory of rational choice; representation of games: normal form representation, extensive form representation; Information sets; Strategies (pure and mixed strategies)

2. Static games of complete information:
- Dominance: dominant strategies, dominated strategies, iterated deletion of dominated strategies
- Nash equilibrium (NE): definition of a NE, best-response correspondence, Examples
- Mixed Strategy Nash equilibrium: definition, mixed best-response correspondence and mixed NE
3. Dynamic games of complete information:
- Definition of subgame perfect NE, finding subgame perfect NE in games of complete and perfect information by backwards induction.

Intended Learning Outcomes:
On successful completion of this course, students will be able to
- Identify strategic situations and represent them as games
- Solve simple games using various techniques
- Analyze economic situations using game theoretic techniques

Teaching and Learning Methods:

Media:

Reading List:
Literature:
• Osborne, Martin J. (2004). An Introduction to Game Theory. Oxford University Press
(also recommended)
• Gibbons, Roberts (1992). A primer in Game Theory. Prentice Hall
• Riek, Christian (1993). Spieltheorie. Einführung für Sozial und Wirtschaftswissenschaftler. Gabler Verlag

Responsible for Module:
BOKU Klöckl, Claude Institut für Nachhaltige Wirtschaftsentwicklung

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

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

Module Description

WZ9383BOK: to be provided | Beschaffung

Version of module description: Gültig ab summerterm 2013

Module Level:	Language:	Duration:	Frequency:
Credits:* 1	**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

WZ9385BOK: Survey Research in the Social Sciences | Wirtschafts- und sozialwissenschaftliche Umfrageforschung

Version of module description: Gültig ab summerterm 2011

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

WZ9435BOK: Resource and Environmental Economics | Resource and Environmental Economics

Version of module description: Gültig ab winterterm 2017/18

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

WZ9457BOK: Modeling of Techno-economical Processes | Modellierung technoökonomischer Prozesse

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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 exam and successful exercise units

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
basic knowledge in computing

Content:
In this course, possibilities for modeling technologically relevant problems within industrial manufacturing processes are elaborated. Multivariate correlations that occur within industrial manufacturing processes, impede the usage of simple analytical software packages. Thus, more sophisticated programs are needed for analyzing increasingly complex problems. In especially, tools for modeling and simulation in MATLAB are presented and applied in the exercising units.

Course structure:
- process analysis (plausibility check of technologically relevant correlations and collected data)
- data acquisition
- data management
- evaluating data quality
- considering time lags (static and dynamic simulation of the material flow)
- model calibration (using multivariate statistical approaches)
- model validation
- model application (prediction of technological properties)
- process adaptation and failure detection

Intended Learning Outcomes:
Students are able to evaluate data quality, detect multivariate correlations, consider time lags using material flows and statistically optimize processes with respect to economically relevant factors.

Teaching and Learning Methods:
Lecture with exercises

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung mit Übung (2 ECTS)
Modellierung Technoökonomischer Prozesse (LV-Nr. 734334)
2 SWS
Martin Riegler

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

Module Description

WZ9472BOK:

Version of module description: Gültig ab winterterm 2017/18

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

WZ9477BOK:

Version of module description: Gültig ab winterterm 2017/18

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

WZ9485BOK: Logistic Systems | Unternehmensnetzwerke (Logistik)

Version of module description: Gültig ab winterterm 2017/18

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

WZ9493BOK: Economic of Sustainable Land Use under Global Change | Ökonomik Nachhaltiger Landnutzung im Globalen Wandel

Version of module description: Gültig ab winterterm 2017/18

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

WZ9521BOK: Environmental Economics at Company Level | Betriebliche Umweltökonomie

Version of module description: Gültig ab summerterm 2017

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

WZ9522BOK: Farm Business Management I | Landwirtschaftliche Betriebswirtschaftslehre I

Version of module description: Gültig ab winterterm 2017/18

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

WZ9524BOK: Market Research and Market Analysis | Marktforschung und Marktanalyse

Version of module description: Gültig ab summerterm 2017

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

WZ9526BOK: Logistics in forestry and timber industry | Logistik in der Forst- und Holzwirtschaft

Version of module description: Gültig ab winterterm 2017/18

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.

General Education Modules | Allgemeinbildende Wahlmodule

General Education Modules TUM | Allgemeinbildende Module der TUM

Module Description

AR30317: Lecture Series TUM.wood | Ringvorlesung TUM.wood
[TUM.wood]

From tree to architecture – the value chain of wood

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** one-time
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 written exam is implemented at the end of the semester.
Answerings questions regarding the content of the lectures is the main aspect of the exam. There ´s a possibility that it contains tasks, which require independant thinking and development of the gained knowledge. Drawing scetches, answering multipe-choice questions and verbalizing your own resolution can be part of the exam.

Length: 90 min.
Tools: dictionary

Repeat Examination:

(Recommended) Prerequisites:
Es werden rudimentäre Grundkenntnisse im allgemeinen Themenkomplex Wald, Holz, Bauwesen empfohlen.

Content:
The lecture series should offer an overview about the relations in the whole value chain of wood and forestry. A holistic approach beyond the limits of the faculties should deepen the understanding for the ecologic, economic, socio-cultural and technical aspects of the topic ‘building with timber’.

Intended Learning Outcomes:
After having participated the course the students will be able to:

- understand the important aspects, challenges and strategies of modern silviculture in central Europe
- analyze the ecologic and economic relations between silviculture, wood processing and implementation in the building construction sector
- understand the state of the art in the production of solid timber and timber products
- gain an insight in the development of biogenic polymers
- gain an overview of the engineers topics of structural design, fire safety and building physics in timber construction
- gain an overview of the implementation fields of timber in building construction (multi storey buildings, timber engineering, construction in existing contexts…)
- understand the most important parameters at construction and design of timber buildings

Teaching and Learning Methods:
The interdisciplinary approach of TUM.wood is reflected by its teaching proposition. The aligned programme of the associated departments invites the students of the involved faculties to gain knowledge of the other areas of study. This comprehensive knowledge is presented within a series of lectures given by the different TUM.wood-partners. Referenced projects may show the complexity and conjunction of the diverse topics and relate therory and practice.
The content of the lectures shall be documented by the students themselves. These notes and the slides of the lecutres build the foundation for the exam. The main learning aspect is to understand the imparted knowledge and conncetion the coherences between the presented interdisciplinar topics. Suggestions for advanced literature will be given during the lessons.

Media:
Presentations of the lectures will be provided for the exam prepartions.

Reading List:
Kaufmann, H. und Nerdinger, W. (2011) Bauen mit Holz - Wege in die Zukunft. Ausstellungskatalog Pinakothek der Moderne. Prestel, München
Kaufmann, H. mit Krötsch, S. und Winter, S. (2021) Atlas Mehrgeschossiger Holzbau. Detail Verlag, München

www.dataholz.eu
www.informationsdienst-holz.de

Weitere projektbezogene Literaturempfehlungen werden zu Beginn der jeweiligen Veranstaltung mitgeteilt.
Je nach Themenschwerpunkt wird ein Handapparat zur Verfügung gestellt.

Responsible for Module:
Birk, Stephan; Prof. Dipl.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
TUM.wood Lecture Series: Exploring the Wood Value Chain (Vorlesung, 2 SWS)
Schuster S [L], Schuster S, Seidl R, Annighöfer P, Ludwig F, Dörfler K, Weber-Blaschke G, van de Kuilen J, Zollfrank C, Benz J, Winter S, Birk S, Nagler F
For further information in this module, please click campus.tum.de or here.

Module Description

CLA10626: Communicating Science | Wissenschaft in der Öffentlichkeit

Version of module description: Gültig ab winterterm 2002/03

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:** 15	**Contact Hours:** 15

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

Description of Examination Method:
Die Modulprüfung besteht aus einem Essay, in dem die Studierenden die ein Beispielthema aus Wissenschaft und Technik ziegruppen- und mediengerecht darstellen und erklären.

Repeat Examination:

(Recommended) Prerequisites:

Content:
Zeitung, Internet oder Science Center: Es gibt viele Gesichter der Kommunikation zwischen Wissenschaft und Öffentlichkeit. Welche konkreten Möglichkeiten der Vermittlung gibt es?

Welche Herausforderungen stellen sich in der Kommunikation zwischen Wissenschaft, Medien, Politik und Öffentlichkeit? Wie beschreiben Sie ihre wissenschaftliche Arbeit verständlich? Wie lassen sich komplexe Sachverhalte interessant aufbereiten? Wie wird die gesellschaftliche Relevanz wissenschaftlicher Themen dargestellt?

Intended Learning Outcomes:
Nach der erfolgreichen Teilnahme an dem Modul sind die Studierenden in der Lage, wichtige Aspekte der Wissenschaftskommunikation zu erkennen und deren Probleme zu analysieren. Zudem sind die Studierenden in der Lage Möglichkeiten zur Vermittlung von Wissenschaft und Öffentlichkeit zu diskutieren bzw. zu erklären.

Teaching and Learning Methods:
Vortrag, Präsentation, Übungen, Gruppenarbeit

Media:

Reading List:
M.-D. Weitze, W. M. Heckl: Wissenschaftskommunikation - Schlüsselideen, Akteure, Fallbeispiele. Springer-Verlag, 2016.

Responsible for Module:

Courses (Type of course

Module Description

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

Version of module description: Gültig ab summerterm 2024

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 module examination takes the form of a presentation followed by discussion. The learning outcomes are verified by a group project (3-4 students per group). The presentation of the developed code and the results of the project will be done together as a group, with each group member presenting one part. The presentation should be equally divided among the group members. After the presentation, each group member is asked individual questions about the project. The final grade will be based on the presentation and results of the project (duration of presentation and questions: approx. 30 min depending on group size; approx. 8-10 minutes per student). As a voluntary mid-term effort, the students can take part in a multiple-choice test (duration: 10 minutes). If they achieve at least 65% of the points in this test, a bonus of 0.3 will be credited on the grade of the presantation (however, an improvement of the grade from 4.3 to 4.0 is not possible).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Mathematical Skills in Linear Algebra and Statistics as well as Programming Skills in Python are expected

Content:
Technologies that generate analyses or predictions based on data can be found in almost all areas of our daily life (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, predicting 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 to various real-world problems.

The following contents will be treated exemplarily:
- Similarity and Distance Metrics
- Data Preprocessing and Visualization
- Dimensionality Reduction (e.g., Principal Component Analysis)
- Classification (Nearest-Neighbor, Logistic Regression, Decision Trees, Support Vector Machines (SVM))
- Model Selection and Hyperparameter Optimization (Confusion Matrix and Evaluation Measures, Cross-Validation, Hyperparameter tuning techniques, Common problems such as Over- vs. Underfitting)
- Clustering (K-Means, Hierarchical Clustering)
- Regression Models (Linear Regression, Support Vector Regression)

AI-based technologies have the potential to support many areas of biotechnology and sustainability, e.g. by guiding downstream research with data-driven predictions or supporting decision-making with demand forecasts. In this course, we will look at suitable practical examples and demonstrate their potential.

Intended Learning Outcomes:
The students know the fundamental and most important artificial 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. Students will understand how artificial intelligence can support areas of biotechnology and sustainability and are able to assess the potential of AI-based approaches in sustainability projects.

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:
Grimm, Dominik; Prof. Dr.

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

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

Module Description

CS0058: CFD - Simulation for Energy Systems | CFD - Simulation for Energy Systems [A-CFD]

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**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:
In modern CFD programs, complex mathematical models are made accessible to the user in a simple form. Nevertheless, it is crucial for the correct application of these models to know the basic, theoretical background. The examination performance therefore is a project report. The students prove that they can answer questions about the theory of CFD in writing and solve small computational problems. The students thus show that they are capable of implementing a flow simulation in CFD programs and interpreting the results obtained.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prerequisites for the successful participation is knowledge about
Fluid Dynamics

Content:
The course provides basic knowledge about the underlying theory of CFD simulation to enable students to conduct simple workflows within the CFD simulation software. Simplifications and models for solving the conversion equations of fluid dynamics - mass, impulse and energy - is shown. Furthermore, meshing and setting up useful boundary conditions for solving the flow equations is presented. After solving the CFD problem, validation and presentation of the results by means of flow profiles and animations will be done. The setup of a CFD model including geometric preparation of a model, meshing, pre-processing, solving, and post-processing will be demonstrated and carried out in the CFD software.

Intended Learning Outcomes:
After successful participation within this course, students are capable of carrying out simple workflows within the CFD simulation software (e. g. OpenFOAM, Ansys), including the preparation of a CAD model, meshing, pre-processing, solving, and post-processing. Furthermore, they gained a basic understanding of the relevant theory behind a CFD simulation software.

Teaching and Learning Methods:
The course is set up of a lecture and practical part. The lecture provides the aforementioned relevant theory underlying a CFD simulation software. The practical part includes a guided setup of a CFD model within the CFD software and an independently conducted project at the end of the semester.

Media:
Lecture, blackboard, computer/laptop

Reading List:
Ferziger, J.H.; Peric, M.: Numerische Strömungsmechanik, 1. Auflage, Springer, eBook ISBN 978-3-540-68228-8, 2008
Gersten, K.: Einführung in die Strömungsmechanik, 2. Auflage, Springer, eBook ISBN 978-3-663-14151-8, 1981
Laurien, E.; Oertel jr., H.: Numerische Strömungsmechanik, 3. Auflage, Springer, eBook ISBN 978-3-658-03145-9, 2013
Ferziger, J.H.; Peric, M.; Street, R.L.: Computational Methods for Fluid Dynamics, 4. Auflage, Springer, eBook ISBN 978-3-319-99693-6, 2019

Responsible for Module:
Matthias Gaderer gaderer@tum.de Bernhard Huber b.huber@tum.de

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

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

Module Description

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

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:

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

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

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

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

Media:
Presentations, slide scripts, program exercises

Reading List:

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

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

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

Module Description

CS0258: Nawaro in Communication and Didactics | Nawaro in Kommunikation und Didaktik

Version of module description: Gültig ab summerterm 2022

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:
Im Laufe des Semesters wird von den Studierenden als Studienleistung die Ausarbeitung von Präsentationen, Teilnahme an Rollenspielen und Fallbearbeitungen in der Gruppe mit Videoanalysen erwartet (unbenotet). Die benotete Prüfungsleistung wird in zwei Teilen erbracht. Der erste Teil ist eine bewertete Lehrveranstaltung (Präsentation: 20 min) in Gymnasien und anderen weiterführdenen Schulen, bei der die erworbenen didaktischen Fähigkeiten angewendet werden sollen (80 % der Note). Der zweite Teil der Prüfung besteht aus einem schriftlichen Bericht (ca. 10 Seiten) bezüglich der durchgeführten Lehrveranstaltung am Gymnasium (20 % der Note).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
keine

Content:
Vermittelt werden Grundlagen der Kommunikation und Didaktik, Kommunikationsmethodik, Kommunikationsregeln und deren Anwendung im Berufsalltag sowie zielorientierte Gesprächsführung. Außerdem werden Ausdruck und Sprache, Darstellung des Studienganges, Darstellung der Inhalte und deren praktische Vermittlung, die Organisation von Unterrichtseinheiten an den involvierten Schulen, die Charakterisierung des Unterrichtsbedarfs und Belange der Öffentlichkeitsarbeit behandelt.

Intended Learning Outcomes:
Nach der Teilnahme am Modul können die Studierenden grundlegende Beratungs- und Kommunikationsmodelle analysieren und die dahinterliegende Theorie den Modellen entsprechend zuordnen.

Des Weiteren können die Studierenden anhand von Fallbeispielen Beratungs- und Kommunikationsmodelle anwenden.
Darüberhinaus überprüfen sie ihre eigene Grundhaltung und reflektieren ihr eigenes Beratungs- und Kommunikationsverhalten. Die Studierenden können Lernziele passend zur jeweiligen Zielgruppe und zu den jeweils zu vermittelnden Inhalten formulieren und definieren.
Sie können entlang der Lernziele eine Unterrichtseinheit zeitlich in eine sinnvolle Reihenfolge bringen und können entsprechende Unterrichtsmethoden passend zu den Zielen auswählen.
Sie können einen Lehrplan für Ihre Unterrichtseinheit gestalten und auch umsetzen. Des weitern können die Studierenden ihre inhaltlichen Themen verbindlich erläutern und sie in Verbindung setzen mit den Arbeitsfeldern des Wissenschaftszentrums.Sie können den inhaltlichen Bedarf der Schule analysieren und den Unterrichtsumfang planen und sie sind befähigt Presse- und Öffentlichkeitsarbeit mit Inhalten und Intention aus dem Bereich Nachwachsender Rohstoffe zu koordinieren.

Teaching and Learning Methods:
Neben der Vorlesung werden Übungen, Rollenspiele, Fallstudien und Exkursionen und in Videoanalysen werden Einzel- und Gruppenpräsentationen durchgeführt und ananlysiert.
Außerdem findet eine Lehrprobe vor einer Schulklasse eines Gymnasiums der Region statt.

Media:
Präsentationen, Skriptum, Video, Übungsblätter, Flipchart,
Powerpoint, Filme zeigen, Anschauungsobjekte (nachwachsende Rohstoffe), Fallbeschreibungen, Schultafel, Powerpoint

Reading List:
Schulz von Thun, F. (2019). Miteinander reden 1-4: Störungen und Klärungen. Stile, Werte und Persönlichkeitsentwicklung. Das "Innere Team" und situationsgerechte Kommunikation. Fragen und Antworten. Hamburg: Rowohlt Verlag.

Lippitt, G. & Lippitt, R. (2015). Beratung als Prozess: Was Berater und ihre Kunden wissen sollten. Leonberg: Rosenberger Fachverlag.

Weisbach, C.-R., Sonne-Neubacher, P. & Praetorius, I. (2015). Professionelle Gesprächsführung: Ein praxisnahes Lese- und Übungsbuch. München: Deutscher Taschenbuch Verlag.

Berger, F. (2012). Personenzentrierte Beratung. In J. Eckert, E.-M. Biermann-Ratjen & D. Höger (Hrsg.). Gesprächspsychotherapie. Lehrbuch für die Praxis (S. 279-309). Berlin: Springer."

Responsible for Module:
Claudia Martin

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

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

Module Description

CS0298: Applied Ethics for Renewable Resources | Applied Ethics for Renewable Resources

Version of module description: Gültig ab winterterm 2024/25

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:
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:
Andrea Potzler

Courses (Type of course, Weekly hours per semester), Instructor:
Applied Ethics for Renewable Resources (Exercise) (Übung, 1 SWS)
Potzler A

Applied Ethics for Renewable Resources (Lecture) (Vorlesung, 1 SWS)
Potzler A
For further information in this module, please click campus.tum.de or here.

Module Description

MW2168: Particulare Nanotechnology | Partikuläre Nanotechnologie [PaNano]

Version of module description: Gültig ab winterterm 2013/14

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 60	**Contact Hours:** 60

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

Description of Examination Method:
Oral Examination, Protocol

Repeat Examination:

(Recommended) Prerequisites:
Heat and Mass Transfer in Chemical Processes, Mechanical Process Engineering, Nanomaterials, Interfaces and Particle Technology, Colloidal Systems

Content:
The practical cource particulate nanotechnology imparts basic synthesis and characterization techniques for nanoparticle systems. The focus of this modul is the production of superparamagnetic colloids and investigations towards physical properties investigation. Particle size and size distribution, specific surface area, adsorption properties and the chemical composition of the particles are analyzed. Spectroscopic and physical methods are demonstrated to characterize nano particles.

Intended Learning Outcomes:
- Wet-chemical particle synthesis (co-precipitation)
- Operation of a synthesis reactor
- Coating, freeze-drying, specific metal ion analysis
- Practical experience and understanding of several measurement methods: particle size and distribution, zeta potential, chemical composition, specific surface area, single crystal size
- Understanding of physical principles
- Surface determination with the help of BET isotherms
- Understanding and measurement experience with tensiometry, IR and Raman spectroscopy

Teaching and Learning Methods:
Laboratory practical course

Media:
Handout

Reading List:
Iron Oxides in the Laboratory, U. Schwertmann, R. M. Cornell; Introduction to Infrared and Raman Spectroscopy, N. B. Colthup, S. E. Wiberly, L. H. Daly

Responsible for Module:
Berensmeier, Sonja; Prof. Dr. rer. nat.

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

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

Module Description

SZ1102: EuroTeQ Intercultural Workshop – Intercultural competencies for working in multicultural teams | EuroTeQ Intercultural Workshop – Intercultural competencies for working in multicultural teams

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 1	**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:
1 written test 90 min. (100%)

Performance, testing the learning outcomes specified in the module description, is examined by a written test. Aids are permitted. Candidates work on tasks that focus on intercultural theories, intercultural models and other content covered in class. As part of the exam, students must prove their intercultural reflection skills by

Repeat Examination:

(Recommended) Prerequisites:
The course is especially intended for students in engineering programs, but is generally open to all TUM students. In particular, students who will be studying at a EuroTeQ partner university in the coming academic year or those, who are from partner universities and are currently studying at TUM and/or are participating in the EuroTeQ program should feel addressed. Students should envision themselves working in a European engineering context.

Content:
The workshops take place on 3-4 days in the specified period. One Workshop on Fridays / Saturdays and one on Mondays / Thursdays.
In addition to their specialist knowledge, future engineers must coordinate cross-disciplinary work and communicate with other disciplines. Accordingly, in a European job market, intercultural competencies and communication skills are required to create successful collaboration.
Intercultural agility, which is essential for studying and working in a multicultural environment, consists of a combination of knowledge about intercultural contexts and an ability to critically

analyze one's own thoughts and values from an intercultural perspective After the course, students can apply intercultural models and strategies based on these models for the practical management of complex, interculturally challenging situations in university and professional settings.

Intended Learning Outcomes:
Students can recognize how intercultural factors can play a role when working in multicultural teams and how our ways of thinking, values, attitudes and our personal background influence the way we interact with others. They have acquired tools for analyzing and interpreting interculturally complex situations in a goal-oriented manner and have discourse strategies to implement these in discussions in order to facilitate mutual understanding. Students can expand their own knowledge of divergent cultural values and standards by asking purposeful and appropriate questions and they can present their own perspective.

Teaching and Learning Methods:
The module consists of a course in which the learning content is studied in a communicative and action-oriented manner using self-experience exercises, video material, critical incidents and theoretical input in individual, partner and group work. Additional self-study material is provided (for preparation and follow-up work and for deepening one's own background knowledge) for consolidation and supplementation of the classroom sessions.

Media:
Multimedia-supported teaching and learning material, also online

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
The EuroTeQ Engineer: Cultural Agility for Studying and Working in Multicultural Settings (Workshop, 1 SWS)
Elekes R, Nierhoff-King B
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1664: Energy Storage | Energy Storage

Version of module description: Gültig ab winterterm 2021/22

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamic, basic but profound knowledge in physics

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

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

Teaching and Learning Methods:
The module consists of a lecture course with integrated practical elements. The lecture's content are mediated by the instructor's presentation and exercise examples. By solving given tasks at

home and if necessary students presentations the acquired knowledge is consodiated. The writing of the term paper is also a means of consolidation.

Media:
Powerpoint, whiteboard, exercise sheets

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

Responsible for Module:
Matthias Gaderer

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

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

General Education Modules BOKU | Allgemeinbildende Module der BOKU

Module Description

WZ9343BOK: Plant and Environment | Plant and Environment

Version of module description: Gültig ab winterterm 2012/13

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:
written and oral exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
B.Sc.

Content:
Introduction - stress, temperature - energy balance, light - quality and quantity, water and drought, flooding and oxygen deficiency, salt, heavy metals and phytoremediation, nitrogen and the N cycle, CO2 and the global carbon cycle; herbivores, pathogenes and defence; genetically modified crops; invasive plants, ecosystem services

Intended Learning Outcomes:
Understanding interactions between plants and their abiotic and biotic environment. The effect of natural and anthropogenic stress and the reaction of plants and the importance of plants for the human environment

Teaching and Learning Methods:
Lecture

Media:

Reading List:
Handed out during the course Schulze et al. Plant Ecology, Springer 2005
Larcher: Physiological Plant Ecology, Springer 2002

Responsible for Module:
Peter Hietz

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

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

Module Description

CS0002BOK: Energy Water Economy and Electricity Market | Energiewasserwirtschaft und Strommarkt

Version of module description: Gültig ab winterterm 2021/22

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:

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

CS0006BOK: Basics of Commodity Future Markets | Grundlagen von Warenterminmärkten

Version of module description: Gültig ab winterterm 2021/22

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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

CS0015BOK: BOKU: Gender, Food Systems and Natural Resources | BOKU: Gender, Food Systems and Natural Resources

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**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:
50% written annotated bibliography (individual grade) 50% presentation/podcast (graded as group work) Both components must be passed in order to pass the course. Students are expected to attend every session. For successful completion of the course attendance of at least 80% of lectures is required.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Interest in the topics relating to this course. Students from a diversity of disciplines and backgrounds are invited to join.

Content:
This course critically assesses how the use, management and knowledge of land, water and the wider ecology is gendered. While women's importance as users, guardians and managers of natural resources and their roles in enabling family food and nutrition security are highlighted globally, the rights to land, water and trees, as well as access to other resources, infrastructure and services, are vested in men. In this course we aim to understand these contradictions, and their implications in different farming systems, practices and socio-political contexts. We will investigate the theory, policy and practice of gender in the governance of food systems and natural resources; and analyse the shortcomings of attempts to integrate women into development programmes. This course will further introduce alternative rights-based approaches to food systems and natural resources, such as food sovereignty, food justice and the right to food, from the perspective of social movements and civil society. In order to achieve a more sustainable use of natural resources it is crucial to understand how and by whom they are used, managed and governed and what are the challenges and barriers, but also the opportunities for different actors. In order

to leverage a transformation toward food and nutrition security for all, a societal transformation is urgently required and more attention has to be paid to underlying structural power dynamics and inequalities among the actors involved. We will assess relevant Sustainable Development Goals (e.g., SDG2, SDG5, SDG12) and the role they play in these processes. To enable students to analyse and/or undertake research on people-nature-food linkages, we will explore conceptual frameworks, analytical insights and methodological tools stemming from different approaches to addressing gender. These frameworks will be based on thematic case studies that will provide deeper insights into different geographic, socio-economic and socio-cultural contexts.

Intended Learning Outcomes:
On completion of this course, students will be able to:
1. Understand meanings and interpretations of gender in theory, policy and practice, and how these impact on the development and governance of food systems and natural resources.
2. Assess how structural inequality and different forms of violence undermine diverse rights of people, with a focus on how this relates to the sustainability of natural resources.
3. Explore how social movements and civil society challenge the dominant agri-food system, focusing in particular on the concept and practice of food sovereignty, food justice and the right to food.
4. Critically assess diverse research approaches and methodologies and the positionality of researchers as well as ethical implications of research.
Students will gain key competences in:
- scientific reading and writing, working with academic literature through guided reading, presenting and discussing readings in class, writing an annotated bibliography (as part of the assessment, 50%)
- media-supported presentation skills, producing a podcast
- team work capacity
- facilitation skills, through active participation in different interactive formats (e.g., World Café, Fishbowl discussion) and online facilitation
- discussions and plenary debate
- peer review: receiving and providing guided feedback

Teaching and Learning Methods:
Learning will be facilitated through a variety of methods which may include lectures, seminars, workshops, presentations by guest speakers, group work and online activities. Students are expected to engage in both class and online activities and discussions. This course also requires students to participate in guided reading and self-directed study to support the learning gained from timetabled sessions. Required and optional readings will be uploaded in advance on BOKUlearn. The emphasis is on student participation and fostering dialogue and debate. Students should feel able to explore and develop their understanding of key concepts introduced in the sessions through discussions in a supportive but challenging environment. Each session will consist of lectures, interactive group activities and/or guest speakers. Case studies presented by guest speakers from academia and civil society, based on research, project and advocacy work, will enable students to gain insights into the social, political, economic and cultural conditions of development and practice in various regions of the world. Through in-class discussions and guided

CS0015BOK:

Module Description

CS0019BOK: BOKU: Forest Soil Biology | BOKU: Forest Soil Biology

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 45	**Contact Hours:** 30

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

Description of Examination Method:
The course is exam-immanent. Criteria are regular participation (at least 75%), commitment to practical work, evaluation and presentation of the results and active participation/discussion in the lectures

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
(1) Introduction to forest soil biology with a focus on biodiversity, litter degradation, humus formation and measurement methods for soil biological investigations.

(2) Excursions and method demonstration:
- Test area with automated greenhouse gas measurements as well as C, N and water balance
- Federal Research and Training Centre for Forests.

(3) Lectures: Degradation processes, influencing factors, important forest-soil organisms and their function, consequences of climate change for forest soils, online research and presentations on selected topics.

Intended Learning Outcomes:
Understanding the forest floor as a habitat for microorganisms, soil animals and plant roots. Insight into the interactions and activities of these organisms, their function and their dependence on the environment.

Teaching and Learning Methods:
Lecture with integrated exercises

Media:

Reading List:
Soil Biodiversity Atlas (freier Download unter: https://esdac.jrc.ec.europa.eu/content/atlas-soil-biodiversity)

Responsible for Module:
Andreas Schindlbacher Andreas.schindlbacher@boku.ac.at

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

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

Module Description

CS0027BOK: BOKU: Resource Efficiency and Bioeconomy of Bio-based Materials | BOKU: Resource Efficiency and Bioeconomy of Bio-based Materials

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 45	**Contact Hours:** 30

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

Description of Examination Method:
Ongoing evaluation within the framework of the course (examination immanence)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
•Environment and society: regional and global developments
•Resource efficiency, material efficiency, sustainability
•Cascading usage concepts with wood and their evaluation
•The cradle-to-cradle principle and product and process innovations derived from it
•Bioraffineriekonzepte
•Material resource efficiency and economic development
•Evaluation of resource and material efficiency
•Improving resource efficiency and innovation strategies
•Resource efficiency in agriculture, forestry, wood industry, industrial biotechnology and its assessment (case studies)
•Definitions of the bioeconomy as well as international strategies and scenarios
•Sustainable bioeconomy, the bioeconomy "at any price", ethical aspects
•Products made from renewable raw materials and residues (building materials, insulation materials, bio-based composites, adhesives, biopolymers, bio-based lightweight materials, special products, etc.)

Intended Learning Outcomes:
•Define "resource efficiency" qualitatively and quantitatively.
•A sound understanding of the term bioeconomy is available, including currently defined strategies for implementation.
•Ability to discuss and evaluate critical and controversial issues in the context of resource efficiency or bioeconomy, including ethical and societal aspects.
•Cradle-to-Cradle is understood as a possible guiding principle of the future.
•Students are familiar with best-practice examples.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Georg Gübitz Georg.guebitz.boku.ac.at

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

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

Module Description

CS0034BOK: BOKU: Computer Simulation in Energy and Resource Economics | BOKU: Computer Simulation in Energy and Resource Economics

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 45	**Contact Hours:** 30

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

Description of Examination Method:
Weekly Assignments (50% of points) Final oral examination (50% of points) Extra points in the human-zombie deathmatch

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic programming knowledge in any programming language (R, Python, C, Java, VB-Script, etc...) is a prerequisite.

Content:
Economic agents that show bounded rationality or strategic behaviour and markets that are out of equilibrium pose serious problems to traditional economic modelling techniques.

This course introduces the students to the concept of agent based modelling which allows addressing these issues.

After presenting general agent based models in economics, we focus mainly on modelling the design of electricity markets.

Intended Learning Outcomes:
The students learn to understand the concept of agent based modelling, get to know important agent based models and learn how to apply them appropriately. Students will also learn to implement, verify and validate basic agent based models in the programming language NetLogo.

Teaching and Learning Methods:
The course is split into a lecture part which introduces students to the basic theoretical background, a practical part in the computer room, where students learn to program in Netlogo, and weekly assignments for self-study at home.

Media:

Reading List:

Responsible for Module:
Johannes Schmidt johannes.schmidt@boku.ac.at

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

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

Module Description

CS0040BOK: Enterprise Networks (Logistics) L & S | Unternehmensnetzwerke (Logistik) VL & S

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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

CS0041BOK: A first Course in CAD | CAD Kurs

Version of module description: Gültig ab summerterm 2022

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:

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

CS0048BOK: Future Energy Supply Depending on Resource Availability | Zukünftige Energieversorgung in Abhängigkeit der Ressourcenverfügbarkeit

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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

CS0049BOK: Communication, Information and Participation | Kommunikation, Information und Partizipation

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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

CS0050BOK: Soil Microbiology | Bodenmikrobiologie

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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

CS0051BOK: Ecology of Roots & Mycorrhiza I | Ökologie von Wurzeln & Mykorrhiza I

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
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

CS0052BOK: Geothermal Energy - Geological Fundamentals and Applications | Geothermal Energy - Geological Fundamentals and Applications

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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

CS0053BOK: Selected Lectures in International Agricultural Economics | Selected Lectures in International Agricultural Economics [CS0053BOK]

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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

CS0054BOK: Seminar National and International Food Safty Autorities | Seminar National and International Food Safty Autorities

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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

CS0055BOK: Lecture and Seminar Open Innovation Strategies | Lecture and Seminar Open Innovation Strategies

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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

CS0056BOK: Lecture and Exercise Intercultural Communication | Lecture and Exercise Intercultural Communication

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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

CS0057BOK: Lecture and Exercise Organisational Behaviour and Gender Issues | Lecture and Exercise Organisational Behaviour and Gender Issues

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
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

CS0060BOK: BOKU: Automation of Bioprocesses | BOKU: Automation of Bioprocesses

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 52	**Contact Hours:** 23

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

Description of Examination Method:
Continuous assessment

The lecture is split into a theoretical and a practical part. The evaluation criterion for the theoretical part is based on the assessment of involvement and active participation and represents 40% of the final grade.
The practical part is organized in form of teamwork practice. The task to be solved is an automation problem in industrial environment. This part contributes 60% to the final grade.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Lecture

- Basics of automation, definitions, layout of a biotech plant

- Hardware: signal acquisition, interfacing, visualisation, systems hierarchy and ´architecture (field bus, smart sensors, actors)

- Design, system specification, contract specification

- Validation (QA) (GAMP)

Practical:

- Layout of vessel, I scheme, I/O list, layout system specification, contract specification

- DEMO process control software

Intended Learning Outcomes:
After successful completion of this course, students will be able to explain general bioprocess automation concepts and process control strategies as well as hardware and software solutions. Students will be able to select required hardware components and software solutions for bioprocess automation. They can define specification requirements.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Gerald Striedner (BOKU)

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

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

Module Description

CS0061BOK: BOKU: Planning and Assessment of Waste Management Systems | BOKU: Planning and Assessment of Waste Management Systems

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 51	**Contact Hours:** 24

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

Description of Examination Method:
The total grade consists of the following individual specification:

- Participation and self-dependence, small exercises: 30%
- LCA case study elaboration: 40%
- LCA case study epresentation and discussion: 30%

Continuous assessment

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
The content of the LVA Life cycle management (813.304) or similar knowledge to Life cycle Assessment, Impact categories, Assessment Methodologies... is expected.

Content:
- Introduction to the assessment of projects and plans - strategic environmental assessment (SEA) and life cycle assessment (LCA)
- Scenario development
- Details on impact assessment
- Modelling of waste treatment technologies in life cycle assessment
- Introduction to the life cycle assessment software GaBi
- Elaboration of a LCA case study using the GaBi-Software tool

Intended Learning Outcomes:
Participants are able to assess waste management measures and to use specific soft ware tools (e.g. GaBi 6.0). They know basic methods and instruments for environmental assessment and can also evaluate them practically. The participants are able to independently calculate a life cycle assessment.
They have theoretical and practical knowledge of basic methods and tools for environmental assessment (LCA) and strategic desicion-making in waste management planning

Teaching and Learning Methods:
lecture with exercises
The lecture is very similar to the procedure in reality. First, the basic scenarios of an SEA are discussed, and the LCA case studies are based on these. The calculation and presentation of the LCA results (preparation in small groups of 2-3 people) brings all participants to a comparable level of knowledge, which is necessary for the further discussion process.
The VO units are held in blocks (4 or 6 units each), each ending with a preparation for the exercises. Furthermore, pure "exercise blocks" are also carried out, which make it easier for the students to start the exercise by the presence of the lecturer. The attendance blocks correspond to 24 hours, whereby approx. 50-55 hours should be spent on the "home exercises".

Media:

Reading List:

Responsible for Module:
Gudrun Obersteiner (BOKU)

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

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

Module Description

CS0063BOK: BOKU: Crop Production | BOKU: Crop Production

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 52	**Contact Hours:** 23

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

Description of Examination Method:
Written and oral
There is a written exam shortly after the end of the course. It takes roughly half an hour and consists of about 15 questions in multiple choice mode or requiring very short written answers. Each question allows for an indicated number of points, which are given according to the correctness of the answer. A minimum of 50% of the points are necessary to pass. Marks are given relative to the number of marks exceeding that minimum.
Students who are not able to attend that exam are offered oral exams based on individual appointments. The questions will be selected from the previous written exam and the affiliation of marks is again related to the correctness of answers.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic knowledge in (plant) biology and physics on Matura level

Content:
Block A: Introduction to agronomy
1. Introduction
- Definition of course contents and objectives
- Arable crops and grassland as elements of agro-ecosystems
2. Historical view
3. Effects of environmental factors on field crops
4. Germination and crop establishment
5. Growth, development and yield formation
6. Crop husbandry
7. Environmental impacts of field crops

8. Systems of crop production - conventional/integrated/ecological agriculture

Block B: Fodder crops and catch/cover crops, grain crops rich in carbohydrates (cereals)
1. Botanical classification
2. Environmental needs
3. Definition, assessment and production of yield and quality
4. Crop husbandry

Block C: Grain crops rich in protein or oil; root and tuber crops; renewable resources
1. Botanical classification
2. Environmental needs
3. Definition, assessment and production of yield and quality
4. Crop husbandry

Intended Learning Outcomes:
Students acquire knowledge about field crop production with emphasis on the underlying physical, chemical and biological processes, also with view to environmental claims

Students can draw conclusions on suitable crop management practices

Students acquire detailed knowledge about environmental needs, yield, product quality and crop husbandry of important arable crop species in temperate climate zones

Teaching and Learning Methods:
Classroom lecture, assisted by moodle

Media:
course material available at BOKUlearn (Moodle)

Reading List:

Responsible for Module:
Hans-Peter Kaul (BOKU)

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

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

Module Description

CS0064BOK: BOKU: Biotechnology for Sustainable Processes and Environmental Protection | BOKU: Biotechnology for Sustainable Processes and Environmental Protection

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**Total Hours:** 100	**Self-study Hours:** 74	**Contact Hours:** 26

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

Description of Examination Method:
Written exam

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Sustainable processes based on biotechnology
Biotechnology for valorization of biomass and energy production
Enzymatic degradation and processing of lignocellulose
Enzymatic functionalization of natural and synthetic polymers
Mechanisms of enzyme catalyzed degradation of xenobiotics
Enzyme catalysed reactions in soil and water
Enzyme-remediation
Biomarkers
Biotechnological processes with photo-autotrophic microorganisms

Intended Learning Outcomes:
Knowledge about biotechnology based strategies in sustainable processes.
Understanding of the basic principles in enzyme based degradation of xenobiotics and biomass degradation in nature.
Facts about biotechnology for valorization of biomass and about bioenergy production.

Students will be familiar with general principles of biotechnological processes with photo-autotrophic microorganisms and will understand typical advantages and disadvantages.

Teaching and Learning Methods:
Classroom lecture, self-study

Media:

Reading List:

Responsible for Module:
Georg Gübitz (BOKU)

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

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

Module Description

CS0065BOK: Technical Geometry and Computer-Aided Drawing (CAD) | Technische Geometrie und Computergestütztes Zeichnen (CAD)

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**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

CS0066BOK: Digital Image Processing | Digital Image Processing

Version of module description: Gültig ab summerterm 2023

Module Level:	**Language:** English	**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

CS0067BOK: An Introduction Into Scientific Working | An Introduction Into Scientific Working

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**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

CS0068BOK: Citizen Science Seminar | Citizen Science Seminar

Version of module description: Gültig ab summerterm 2023

Module Level: Master	Language: German	Duration: one semester	Frequency: winter semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
1. Anwesenheitsp#icht bei mindestens drei Vorträgen 2. Seminararbeit über eines der Vortragsthemen, welches frei wählbar ist (es wird erwartet, dass Studierende weitere Literatur zum Thema recherchieren). Umfang der Seminararbeit: 8-12 Seiten Die Seminararbeit soll tiefergehende Informationen über das Vortragsthema enthalten und sich kritisch damit auseinandersetzen. Details dazu werden beim ersten Abhaltungstermin bekanntgegeben. 3. Die Zeugnisnote ergibt sich aus der Qualität der Seminararbeit .

Repeat Examination:

(Recommended) Prerequisites:

Content:
Citizen Science wird in den unterschiedlichsten Disziplinen immer öfter eingesetzt. Gut bekannt sind viele ökologische Projekte, in denen die Citizen Scientists Daten über das Vorkommen oder die
Verbreitung von Organismen sammeln, aber auch in den Geistes- und Sozialwissenschaften setzen
Wissenschaftler*innen immer öfter auf Citizen Science. In diesem Seminar möchten wir Gastvortragenden die Möglichkeit geben, aktuelle Projekte vorzustellen und mit Studierenden und anderen interessierten Personen zu diskutieren. Diese Vorträge werden viermal im Semester statt#nden und primär Projekte aus dem deutschsprachigen Raum abdecken.
Die Studierenden bekommen dabei einen Einblick in aktuelle Forschung und Projekte im Bereich Citizen Science und lernen dabei nicht nur wie ein Projekt funktionieren kann, sondern auch welche
Fallstricke es gibt. Am Ende des Semester wird von den Studierenden eine Seminararbeit über

eines der vorgestellten Projekte abgegeben, welche sich vertiefend mit dem vorgestellten Projekt befasst.

Intended Learning Outcomes:
Grundlagen wissenschaftliches Arbeiten
Ziel
1. Kennenlernen der Methode Citizen Science und diverser Projekte
2. Verbessertes Verständnis für Besonderheiten in der Zusammenarbeit mit Personen außerhalb der Wissenschaft
3. Kritisches Hinterfragen von wissenschaftlichen Methoden bzw. Ergebnissen

Teaching and Learning Methods:
Vorträge mit anschließender Diskussion, Recherche zu einzelnen Projekten, Verfassen einer Seminararbeit

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Zoologie

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

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

Module Description

CS0069BOK: Development Research and Practice | Development Research and Practice

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Continuous > attendance of 80% is compulsory > we will have short readiness tests at the beginning of each session. No #nal exam!

Repeat Examination:

(Recommended) Prerequisites:
Basic knowledge of English. The course is facilitated in a way that everyone can participate fully.

Content:
##Please note: we will not have a #nal exam, but short tests at the beginning of each session.
Participation in 80% of sessions is compulsory.##
Together with you, we want to address three questions:
Why development cooperation?
Our joint responsibility for global justice and sustainability based on the United Nations Sustainable Development Goals (SDGs)
What are the approaches in development cooperation?
Speci#c approaches and goals
transformative and human rights-based approaches
• Examples of goals in development cooperation: food and nutrition security, human right to adequate food, sustainable food systems, resilience, empowerment and women's rights, sustainable livelihoods, biodiversity
• The Sustainable Development Goals in international development
How is development cooperation done in practice?
Case studies from our work
• Sustainable #sheries

• Animal husbandry and resource con#icts in marginalised areas
• Large-scale land investment and land grabbing: impact on food and nutrition security
• Agroecology and organic farming
• Political cooperation and coherence

Intended Learning Outcomes:

Teaching and Learning Methods:
Vorlesung mit integrierten Übungen
Interactive learning with a focus on having a fruitful, rewarding time!

Media:

Reading List:

Responsible for Module:
BOKU- Institut für Entwicklungsforschung

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

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

Module Description

CS0070BOK: Energieholzbereitstellungssysteme | Energieholzbereitstellungssysteme

Version of module description: Gültig ab summerterm 2023

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

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:
BOKU

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

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

Module Description

CS0071BOK: Environmental Bioprocess Engineering | Environmental Bioprocess Engineering

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 30	**Contact Hours:** 90

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

Description of Examination Method:
Students have 60 min to answer 6 questions. Grading is based on correct answers as follows: 5: less than 50% 4: 50-70% 3: 71-80% 2: 81-90% 1: 91-100%

Repeat Examination:

(Recommended) Prerequisites:
Grundkenntnisse in Chemie, Biochemie, Mikrobiologie und Verfahrenstechnik

Content:
This lecture on bioprocess engineering focuses on processes that are of key importance for environmental biotechnology. Bes gy. B s

Students will understand the concept of sustainability and be able to #nding solutions for environmental issues.

Teaching and Learning Methods:
Interaktion Lehrende und Lernende

Media:

Reading List:

Responsible for Module:
BOKU - Department für Agrarbiotechnologie

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

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

Module Description

CS0072BOK: Facilitating Change for Sustainable Development | Facilitating Change for Sustainable Development

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Individual assessment

Repeat Examination:

(Recommended) Prerequisites:
This course is the second out of three, o#ering students insights into the management of farm and food system transitions in complex environments of the global south. The other two courses are Livelihood system dynamics in rural development (934304) and Participatory methods in development research and practice (934317)

Content:
Change that brings about sustainable agriculture, fair food systems and human wellbeing has long been an important goal in international development. This course focuses on facilitating change within households, communities or food value chains. It conceptualizes change as the co-evolution
of complex adaptive systems, underpinned by a selection of change theories and process models. Facilitators - such as agricultural advisory service providers - can mix these theories and models to
help stakeholders to create change and impact pathways. Since all change is impermanent and context dependent – that is, dependent on interrelationships, interdependencies, interconnectedness – the course emphasizes the need for integration and for understanding the whole – for example the importance of:
- Broadening perspectives (multi-level, multi-stakeholders, across timescales) of all actors in agricultural development and related systems;
initiatives;

- Collaborative leadership and collaborative networks within and between farmer communities;
- Integrating internal as well as external factors (drivers) of change in sustainable development processes.

The course aims to acquaint future practitioners with the theoretical foundation for facilitating complex change processes in the #eld of agriculture and sustainable development

Intended Learning Outcomes:
1. Recall conventional development models and alternative approaches.
2. Identify good learning principles for facilitating a change process with adult groups.
3. Understand the importance of group dynamics for facilitation processes.
4. Apply facilitation methods in the role of a “change facilitator”.
5. Debate on the challenge of translating program goals into real interaction.
6. Propose means to overcome barriers towards a new professionalism in agricultural development.
7. Organise facilitation methods into method families.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Entwicklungsforschung

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

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

Module Description

CS0073BOK: First Steps with R | First Steps with R

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
continuous assessment of course work, homework

Repeat Examination:

(Recommended) Prerequisites:

Content:
This course covers the #rst steps with the statistical computing environment R. It is the basis of many other courses o#ered at the Institute of Statistics and will be held as a blocked course at the beginning of the semester.
R is a #exible and powerful statistics program that is freely available. R is a noncommercial alternative to programs like SAS, SPSS, or S-PLUS.
The following topics will be covered:
* Installation, packages
* R as calculator, data types, classes, random number generator, control structures
* RStudio as an editor: RStudio is an integrated development environment (IDE) for R and includes
a console, a syntax-highlighting editor that supports direct code execution, as well as tools for plotting, history, debugging and workspace management.
* R Markdown reports: R Markdown documents are fully reproducible and weave together narrative text and code to produce elegantly formatted output.

Intended Learning Outcomes:
Participants should be able to use the basic functions of the R programming system and to do elmentary statistical analyses

Teaching and Learning Methods:
Vorlesung mit integrierten Übungen

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Statistik

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

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

Module Description

CS0074BOK: Frontiers in Social Ecology and Sustainability Transformations | Frontiers in Social Ecology and Sustainability Transformations

Version of module description: Gültig ab summerterm 2023

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

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:
BOKU

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

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

Module Description

CS0075BOK: Geographic Information Systems (GIS) in Education for Sustainable Development | Geographic Information Systems (GIS) in Education for Sustainable Development

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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:
BOKU

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

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

Module Description

CS0076BOK: Geometry for Engineers and Computer Aided Design | Geometry for Engineers and Computer Aided Design

Version of module description: Gültig ab summerterm 2023

Module Level: Master	Language: English	Duration: one semester	Frequency: summer semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 60	**Contact Hours:** 60

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:
BOKU

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

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

Module Description

CS0077BOK: Global Change and Pest Management | Global Change and Pest Management

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
The exam will be taken in written form and lasts 120 min. 12 questions are to answer with a mean duration of 10 min. One question is related to the lecture of Herbert Formayer, four to Gernot Hoch and seven to Andreas Walzer. The assessment criteria (4 points per question, reachable points in total = 48) are the following: 44 points (92%) = 1; 38 points (79%) = 2; 34 points (71%) = 3;

Repeat Examination:

(Recommended) Prerequisites:
lecture units signi#cantly enables the probability to reach the learning outcomes.

Content:
In the lecture we will present the global change drivers land use change, biotic invasions and climate change, which have strong implications on pest management in agriculture and forestry. We introduce the dimensions and causes of each global change driver and discuss their e#ects on pests in agriculture (8 units) and forestry (4 units) on the basis of scienti#c case studies. The detailed topics are (1) land use change: green revolution, increased use of pesticides and N-fertilizer and their e#ects on pest species, the loss and fragmentation of natural habitats; (2) biotic invasions: neobiota as invasive pest and weeds – pathways, risk, approaches for control; (3) Climate change: basics, e#ects of increased atmospheric CO2 concentrations and ambient temperatures on pest species, climate change scenarios; and (4) interaction e#ects between biotic invasions and climate change.

Intended Learning Outcomes:
The students acquire knowledge about the causes of global change and its interplay with pest

management in agriculture and forestry. In detail, students understand how land use changes can a#ect population dynamics of pest arthropods and particularly biological control by their natural enemies. Students will be aware of the challenges arising from neobiota becoming invasive pests. They know about possible pathways, risks and control approaches; they understand how climate change could impact pest management in agriculture and forestry. They know how changes in temperature, precipitation, and atmospheric CO2 can a#ect host plants, herbivorous arthropods and their natural enemies as well as the trophic interactions in the system. They realize the interactions of biotic invasions and climate change a#ecting pest management. Finally, they are able to describe and discuss the quintessence of scienti#c tables and #gures in publications dealing
with global change and pest management.

Teaching and Learning Methods:
Frontalvorlesung

Media:

Reading List:
PDFs of the slides are available on boku.learn

Responsible for Module:
BOKU - Institut für Pflanzenschutz

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

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

Module Description

CS0078BOK: Innovation Processes in the Forest-based Bioeconomy | Innovation Processes in the Forest-based Bioeconomy

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
Prüfungsimmanent (Diskusion der zu lesenden Texte und abschließende Präsentation der eigenen Reflexion)

Repeat Examination:

(Recommended) Prerequisites:
Kenntnis der Methoden wissenschaftlichen Arbeitens wird ausdrücklich empfohlen

Content:
Die LVA setzt den Fokus auf Innovations- und Bioökonomieforschung im Kontext der Forst- und Holzwirtschaft, und erweitert diese um systemische Perspektiven hinsichtlich technologischer Innovationen, geeigneter sozioökonomischer und ökosozialer Rahmenbedingungen.

Intended Learning Outcomes:
• Einführung in den wissenschaftlichen Diskurs zu den Themen Bioökonomie, Circular Economy, und Sustainable Development im Kontext von Innovationsprozessen in der Forst- und Holzwirtschaft.
• Einblick in folgende Forschungsfelder als interdisziplinärer Zugang zur Betrachtung der Wertschöpfungskette Holz in Innovationsprozesse
Umweltbewertung im Innovationsprozess
- Gesellschaftliche Wahrnehmung hinsichtlich Ressourcennutzung, Produktionsprozessen und Produkten
• Studierende lernen aktuelle Diskurse als Forschungskontext und als Rahmenbedingungen für Innovationsprozesse kennen.
• Studierende erwerben die Kompetenz, Problemstellungen in der (holzbasierten) Bioökonomie zu

re#ektieren und einen Forschungsbedarf abzuleiten.
• Studierende der Lehrveranstaltung werden befähigt mit wiss. Quellen fundiert zu diskutieren, ihre Argumente zu strukturieren und Forschungsfragen zu Innovationsprozessen in der holzbasierten Bioökonomie zu formulieren.

Teaching and Learning Methods:
Impusvorträge der Lehrenden, Guided reading und gemeinsame Reflexion

Media:

Reading List:
Wird auf BokuLearn (https://learn.boku.ac.at/) zur Verfügung gestellt

Responsible for Module:
BOKU - Institut für Marketing und Innovation

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

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

Module Description

CS0079BOK: Introduction in Hydraulics, Water and Waste Management | Introduction in Hydraulics, Water and Waste Management

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Continuous assessment during exercise units. Final written exam (multiple choice).

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
Combined lecture and exercises with the aim to provide basic knowledge in the #elds of water management, hydraulics, water and waste management at bachelor level in English language
The following topics will be addressed:
Hydraulics: Hydrostatics, Hydrodynamics (basic equations, conservation laws), pipe #ow (laminar and turbulent #ow, Darcy-Weisbach equation, friction factor, Moody-diagram) open-channel #ow (Manning-Strickler formula), gradually and rapidly varied #ow (hydraulic jump), , groundwater #ow (Darcy’s Law, Laplace equation, hydraulic conductivity).
Water Management / Hydrology: Water balance and water cycle, surface and subsurface #ow processes, interrelations to hydraulic calculations (discharge, #ood routing, #ood protection
Waste Management: basic legal framework in the EU (waste framework directive, hierarchy), waste
de#nitions and characterisation; impacts on waste generation, environmental impact by waste management, waste treatment strategies and processes, waste disposal.

Intended Learning Outcomes:
Students will gain competence in solving applied hydraulic problems to support the design of e.g. sewer systems, water courses or #ood protection measures.

Students will know about principles and fundamental facts of water management (hydrologocial modelling and #ood risk management)
Students will know about fundamental aspects of waste management.

Teaching and Learning Methods:
Combination of lectures and exercises.

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Hydrologie und Wasserwirtschaft

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

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

Module Description

CS0080BOK: Mechanisms of Cell Regulation in Biotechnology Practical | Mechanisms of Cell Regulation in Biotechnology Practical

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
immanenter Prüfungscharakter: die Qualität der Arbeit im Labor, die Ergebnisse und die Präsentation und Diskussion der Ergebnisse am Ende #ießen zu gleichen Teilen in die Endnote ein.

Repeat Examination:

(Recommended) Prerequisites:

Content:
Anhand aktueller Beispiele aus der Forschung werden Analysen zur Charakterisierung des Sto#wechsels von biotechnologisch relevanten Organismen durchgeführt. Die Experimente werden gemeinsam mit den Studierenden geplant und ausgewertet

Intended Learning Outcomes:
Nach erfolgreicher Absolvierung dieses Praktikums sind die Studierenden in der Lage komplexe Experimente auf dem Gebiet der mikrobiellen Sto#wechselregulation zu entwerfen, durchzuführen und auszuwerten.
Die Studierenden erkennen den Zusammenhang zwischen den Anforderungen an Metabolic Engineering und Bioprozesstechnologie, um Produktionsstämme erfolgreich entwerfen und Die Studierenden wissen, wie Enzymatische Analysen geplant und durchgeführt werden, um Bioprozesse charakterisieren zu können.

Teaching and Learning Methods:
Labor

Media:

Reading List:

Responsible for Module:
BOKU - Department für Biotechnologie

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

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

Module Description

CS0081BOK: Meteorologie | Meteorologie

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
schriftliche Klausur bestehend aus Multiple Choice Fragen (Rechenbeispielen, Theorie) sowie o#enen Fragen. Prüfungsmodalitäten werden in der Vorlesung bekanntgegeben.

Repeat Examination:

(Recommended) Prerequisites:

Content:
Aufbau der Atmosphäre, meteorologische Größen - Tages- und Jahresgang, globale Verteilungen und Messmethoden, Thermodynamik der Atmosphäre, Energiebilanz: Komponenten und Anwendungen im lokalen, regionalen und globalen Maßstab, Wasserkreislauf, atmosphärische Dynamik, Wettersysteme, Wetteranalyse und -vorhersage, Klimawandel, Klimaprojektionen

Intended Learning Outcomes:
Ziel
Das Bewußtsein um die Schönheit, Komplexität und Verwundbarkeit unserer Atmosphäre wecken. Das Versändnis für die Vorgänge in der Atmosphäre und deren Bedeutung für verschiedene Bereiche des Lebens heben. Grundkenntnisse vermitteln, die es gestatten, zu erkennen, bei welchen Fragestellungen meteorologische Überlegungen eingebunden werden müssen, und was quantitative Analysen und Abschätzungen erlernen.

Teaching and Learning Methods:
Frontalvorlesung

Media:

Reading List:
Folienskriptum wird den TeilnehmerInnen zur Verfügung gestellt.

Responsible for Module:
BOKU - Institut für Meteorologie und Klimatologie

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

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

Module Description

CS0082BOK: Microbial Ecology and Geomicrobiology | Microbial Ecology and Geomicrobiology

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
Schriftlich und mündlich
Exam grades are combined by evaluation of student lectures and a written report.

Repeat Examination:

(Recommended) Prerequisites:
basic microbiology (from bachelor studies)

Content:
Microorganisms play a crucial role on our planet. Essentially, no place is free from microorganisms and everything that happens on the surface of earth involves the action of microorganisms.
This course informs about general principles of natural habitats for bacteria and unicellular eukaryotes, including mechanisms of adaptation, natural selection, interaction in communities and design of habitats. Further the population structures of example ecosystems, such as soil, swamp, surface/pelagic water, groundwater, sediment, hot springs, animal digestion tracts, plant surfaces and rhizosphere are examined.
The role of microbial life on a global scale will be analyzed. Examples for biogeochemical cycles will
be discussed, with emphasis on natural degradation processes of carbon based materials of natural and arti#cial origin. Questions how a dead tree is degraded in the forest, how a plastic an digest grass will be examined and compared. The course takes a look how complex (biochemical) tasks are distributed between many individual species and what this means for the resilience of the biosphere. Important methods to study microbial life in natural habitats will be presented and discussed all along. The course provides insight into our current understanding of environmental microbiology but also how such insight can be obtained.

Finally, this course will address the question of where well-known individual microbial species live and which role they presumably play in a wider context. Open questions and current knowledge gaps will be identi#ed and discussed.

Intended Learning Outcomes:
Ziel
By the end of this course, students will be able to:
• describe microbial populations and living conditions of microorganisms in all major habitats, as they are: surface soil including rhizosphere, deep soil, mineral surfaces, freshwater, oceans including deep sea and sediments, animal surfaces and digestion tracts.
• describe how complex biochemical tasks like the degradation of wood or plastic work, distributed over many microbial species
• understand microbe-microbe, microbe-plant and microbe-material interactions
• understand how microbial communities de#ne and run biogeochemical cycles
• identify the appropriate method to address a given question in environmental microbiology
• analyze the role of well-known microorganisms in nature

Teaching and Learning Methods:
Interaktion Lehrende und Lernende
This course is held as inverted classroom. It consists of pre-recorded lectures, moderated seminars
by students and discussions in the classroom.
At the time being the course is planned as online course, however, depending on the rules in WS it
- or parts - might be held in presence.

Media:

Reading List:

Responsible for Module:
BOKU - Department für Biotechnologie

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

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

Module Description

CS0083BOK: Natur- und Landschaftsnutzung | Natur- und Landschaftsnutzung

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Schriftlich
Multiple Choice Fragen 40 Fragen Notenschlüssel: < 50%: nicht genügend 50 bis < 62,5%: genügend

Repeat Examination:

(Recommended) Prerequisites:
keine

Content:
Die Vorlesung erläutert einführend die Säulen des Natur- und Landschaftsschutzes mit den Schwerpunkten Schutzgebiete, Artenschutz, Landschafts- und eingri#sbezogene Planung. Darauf aufbauend werden ausgewählte Lebensraumtypen vorgestellt und Maßnahmen zu ihrer Erhaltung diskutiert. Bei den Lebensraumtypen handelt es sich um anthropogen entstandene Formen, die wesentlich den Charakter von Kulturlandschaften bestimmen. Hierzu zählen u.a. Streuobstwiesen, Feucht- und Streuwiesen, Feldgehölze und Hecken, Agrobiotope und urbane Sekundärbiotope (Stadtbiotope).

Intended Learning Outcomes:
- kennen die Säulen des Natur- und Landschaftsschutzes mit den Schwerpunkten Schutzgebiete, Artenschutz, Landschaftsplanung und Verträglichkeitsprüfung.
- können Traditionen und Trends im Natur- und Landschaftsschutz historisch einordnen.
- setzen die unterschiedlichen Aspekte von Natur- und Landschaftsschutz mit ihrer geschichtlichen
Entwicklung in Beziehung.

- kennen wichtige Lebensraumtypen wie Hecken, Streuobstwiesen, Agrobiotope, Weinbaulandschaften, Streuwiesen und Stadtbiotope.
- können die spezi#schen Herausforderungen und Maßnahmen zum Erhalt der Biodiversität in diesen Lebensräumen beurteilen.
- verstehen die Entwicklungen, die zum Rückgang der Biotop- und Artenvielfalt führen.
- ziehen das erworbene theoretische Wissen zur Beantwortung praxisnaher Fragestellungen zu Fachplanungen im Bereich Natur- und Landschaftsschutz heran.

Teaching and Learning Methods:
mit medialer Unterstützung

Media:

Reading List:
Die Folien zu jeder VO-Einheit können von BokuLearn heruntergeladen werden.

Responsible for Module:
BOKU - Institut für Landschaftsentwicklung, Erholungs- und Naturschutzplanung

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

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

Module Description

CS0084BOK: Negotiating Change: Simulating an International Conference for Sustainable Development | Negotiating Change: Simulating an International Conference for Sustainable Development

Version of module description: Gültig ab summerterm 2023

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

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:
BOKU

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

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

Module Description

CS0085BOK: On Site Solutions for Water Supply and Sanitation | On Site Solutions for Water Supply and Sanitation

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Schriftlich
due to the pandemic, the exams in February and March 2021 will be held as online oral exams

Repeat Examination:

(Recommended) Prerequisites:

Content:
Concepts and requirements for on-site solutions for water supply and sanitation in developed and developing countries.
- appropriate technologies and concepts
- towards sustainable implementation
- case studies

Intended Learning Outcomes:
Understanding concepts and requirements for on-site solutions for water supply and sanitation

Teaching and Learning Methods:

Media:

Reading List:
Lecture notes (presentations) will be provided in due time.

Responsible for Module:
BOKU - Institut für Siedlungswasserbau, Industriewasserwirtschaft und Gewässerschutz

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

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

Module Description

CS0086BOK: Physiology of Crop Nutrition | Physiology of Crop Nutrition

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 30	**Contact Hours:** 90

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

Description of Examination Method:
Mündlich

Repeat Examination:

(Recommended) Prerequisites:

Content:
• De#nition and classi#cation of nutrients
• Nutrient uptake mechanisms by plant roots
• Translocation of nutrients within the plant
• The role of mineral nutrition in yield formation
• Interaction of source and sink organs
• Functions of macro- and micronutrients
• Bene#cial elements
• Nutrition, diseases and pests
• Diagnosis of nutrient de#ciency and toxicity symptoms

Intended Learning Outcomes:
After completing this course, the students are able to
• discuss the mechanisms of selective nutrient uptake by plant roots.
• explain nutrient translocation via xylem and phloem.
• describe the role of nutrients in yield formation.
• discuss the transport of photosynthates from source to sink organs and the regulation of sourcesink relationships, including the role of phytohormones in these processes.

• explain the appearance and formation of nutrient de#ciency and toxicity symptoms in important crop plants.

Teaching and Learning Methods:
mit medialer Unterstützung

Media:

Reading List:
• Marschner's Mineral Nutrition of Higher Plants, 3rd edition. Petra Marschner. 2012, Academic Press. ISBN 9780123849052
• Mineral Nutrition of Plants – Principles and Perspectives, 2nd edition. Emanuel Epstein and Arnold J. Bloom. 2004, Oxford University Press. ISBN 9780878931729
• Handbuch zur visuellen Diagnose von Ernährungsstörungen bei Kulturp#anzen, 3rd edition. Wilfried Zorn et al. 2016, Springer Spektrum. ISBN 3662491451
Basic reading in plant physiology:
• Plant physiology, 3rd edition. Lincoln Taiz and Eduardo Zeiger. 2002, Oxford University Press. ISBN 0878938230

Responsible for Module:
BOKU - Institut für Pflanzenbau

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

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

Module Description

CS0087BOK: Ressourcennutzung und Ressourcenmärkte | Ressourcennutzung und Ressourcenmärkte

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Verständnis. Multiple Choice Prüfung und o#ene Fragen: Online Prüfung

Repeat Examination:

(Recommended) Prerequisites:
Mikro- und Makroökonomie

Content:
Nachhaltige Entwicklung steht vor der Herausforderung, natürliche Ressourcen so zu nutzen, dass
die Lebensgrundlagen zukünftiger Generationen weder durch Verknappung noch durch Verschmutzung gefährdet werden. Es ist aber nicht nur politisch, sondern auch theoretisch umstritten, wie eng die Restriktionen sind, welche die Nutzung natürlicher Ressourcen der gesellschaftlichen Entwicklung setzt - und wie mögliche Wege aus der multiplen Krise, die mit der derzeitigen Ressourcenverwendung verbunden ist (Klimawandel, Biodiversitätsverluste, globale Ungleichheit,…), aussehen können. Diese Lehrveranstaltung führt daher in unterschiedliche Theorien ein und zeigt ihre empirische Relevanz, um Studierende für eine fundierte Diskussion über Fragen nachhaltiger Ressourcennutzung vorzubereiten. Wir werden dafür neoklassische, ressourcenökonomische Theorie mit sozialökologischen und politikökologischen Ansätzen kontrastieren. Neben einer Einführung in die jeweiligen theoretischen Konzepte werden wir die gesellschaftliche Verwendung und Allokation von Ressourcen, insbesondere über Märkte, Ressourcenverwendung und eine Diskussion möglicher Zukunftsszenarien stehen am Ende der Lehrveranstaltung.

Intended Learning Outcomes:
Ressourcenökonomische und sozial-ökologische Ansätze zur Analyse der MenschUmweltbeziehungen verstehen
- Erkennen, in welchen Argumentationslinien nachhaltiger Entwicklung Elemente schwacher und starker Nachhaltigkeit enthalten sind
öGrößenordnungen der Entnahme, des Handels und der Verwendung natürlicher Ressourcen einschätzen können
- Ein Verständnis für die ungleiche Verteilung von Ressourcennutzung und Emissionen entwickeln und verstehen, welche politischen Maßnahmen Ungleichheit verringern oder erhöhen können
- Die Rolle von Handel in Hinblick auf E#zienz, ungleichen ökologischen Tausch und WohlfahrtserhTe unn Teenisc es

Module Description

CS0088BOK: Ringvorlesung Forstwirtschaft | Ringvorlesung Forstwirtschaft

Versio

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Department für Wald- und Bodenwissenschaften

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

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

Module Description

CS0089BOK: Seminar in Energy and Process Engineering | Seminar in Energy and Process Engineering

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
Mündlicher Vortrag (PowerPoint o.ä.) und Abstract über gewähltes Thema. In die Beurteilung #ießen Aufbau, Inhalt und Präsentation des Vortrags sowie die anschließende kritische Diskussion mit ein. Abstract: 20% Präsentation: 70% Diskussion / Fragerunde: 10% Nicht fristgerecht abgegebene Abstracts können nicht berücksichtigt werden! Die Vorbesprechung und die Präsentationen #nden online via Zoom-Videokonferenz statt. Einteilung: Siehe BOKU Learn Kurs!

Repeat Examination:

(Recommended) Prerequisites:

Content:
Jeder Teilnehmer soll an einem der angebotenen Termine, ein von Ihm ausgearbeitetes Thema in Form eines wissenschaftlichen Vortrags präsentieren und sich einigen Fragen stellen. Zudem soll zum Vortrag eine Zusammenfassung/ Abstract (1-2 DIN A4 - Seiten) als Handout für die Diskussionsteilnehmer erstellt werden, der die wichtigsten Punkte des Vortrags zusammenfasst. Themen können von den Studierenden eingebracht werden oder der Themenliste entnommen werden. Vorschläge sind u.a.:
- Nachhaltige Energiegewinnung aus erneuerbaren Ressourcen
- Power-to-Heat
- Power-to-Gas
- Power-to-Mobility
- Einsatz nachwachsender Rohsto#e im Energiesektor
- Kälte- und Kühltechnik

Intended Learning Outcomes:
- Konfrontation der Studierenden mit Spezialthemen der Energie- und Verfahrenstechnik, Einschätzung und Beurteilung dieser Problemstellungen.
- Praktische Erfahrung zur Präsentation und Aufbreitung wissenschaftlicher Fragestellungen.
- Erstellung eines Abstracts / Zusammenfassung

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Verfahrens- und Energietechnik

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

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

Module Description

CS0090BOK: Soil Physics and Chemistry | Soil Physics and Chemistry

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Schriftlich
Die Prüfung besteht aus zwei Teilen: Bodenphysik und Bodenchemie. Um die Prüfung positiv zu bestehen, sind in beiden Teilen je mindestens 55% der Gesamtpunktezahl zu erreichen. Im Fall eines negativen Abschneidens müssen beide Prüfungsteile wiederholt werden (nicht nur der negative Teil). Benotungsschema: >=90 Sehr Gut (1) >=80 Gut (2) >=70 Befriedigend (3) >=55 Genügend (4) <55 Nicht Genügend (5) Teil Bodenphysik Englische Fragen (o#ene Fragen) Teil Bodenchemie: in Englisch (Single und Multiple Choice) Prüfungsbeispiele (siehe "Prüfungsbeispiele") im BOKU Online verfügbar. Alle Fragen der Prüfung sind in englischer Sprache
zu beantworten. Die Verwendung eines Wörterbuchs ist nicht zulässig.

Repeat Examination:

(Recommended) Prerequisites:
Bodenkunde-, Physik- und Chemie-Kenntnisse auf Bachelorleve

Content:
Grundlagen der Bodenphysik und Bodenchemie
Teil Bodenchemie:
- Grundlagen der Bodenchemie
- Chemisches Verhalten ausgewählter Nähr- und Schadelemente (Sticksto#, Phosphor, Arsen, Cadmium) im Boden
- Grundlagen und ausgewählte Verfahren der Bodenanalytik

Intended Learning Outcomes:
Einführung in die Bodenphysik und Bodenchemie

Bodenphysik:
Lernergebnisse und Erworbene Kompetenzen:
Die Studierenden
- kennen grundlegende Gesetzmäßigkeiten der (Boden-)physik
- verstehen die wesentlichen Konzepte und Parameter der Bodenphysik und können diese auf bestimmte bodenphysikalischen Fragestellungen anwenden
- sind mit dem Verhalten ausgewählter Parameter (Bodendichten, -volumina, -strukturformen, Bodenwasser, -luft, -farbe vertraut

Detaillierte Lernziele (Learning outcomes) des Teils Bodenphysik sind in den Lernunterlagen (verfügbar im BOKULearn) de#niert.

Bodenchemie:
Lernergebnisse und Erworbene Kompetenzen:
Die Studierenden
- kennen grundlegende Gesetzmäßigkeiten der (Boden-)chemie
- verstehen fundamentale Konzepte der Bodenchemie und können diese auf bestimmte bodenchemische Fragestellungen anwenden
- sind mit dem Verhalten ausgewählter Elemente (P, N, As, Cd) im Boden vertraut
- kennen grundlegende Verfahren der Bodenanalytik und ihre Bedeutung

Detaillierte Lernziele (Learning outcomes) des Teils Bodenchemie sind in den Lernunterlagen (verfügbar im BOKULearn) de#niert.

Teaching and Learning Methods:
mit medialer Unterstützung

Media:

Reading List:

Rrgvnhas

Responsible for Module:
BOKU - Institut für Bodenforschung

Courses (Type of course, Weekly hours per semesevza mephfee e

Module Description

CS0091BOK: Statistics with R | Statistics with R

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
Schriftlich

Repeat Examination:

(Recommended) Prerequisites:

Content:
R ist ein #exibles und umfangreiches Statistikprogramm, das frei verfügbar ist. Es handelt sich dabei um eine Freeware-Implementierung der Statistiksprache S, die dem Programmpaket S-PLUS
zugrunde liegt.
Die in der Vorlesung gebotene Einführung wendet sich an Statistiknutzer, die an einer solchen nichtkommerziellen Alternative zu herkömmlichen Programmen wie SAS, SPSS oder eben S-PLUS
interessiert sind. Die Schwerpunkte sind:
* Einführung in grundlegende Programmeigenschaften (Installation, Bedienung, Dokumentation; Dateneingabe und -verwaltung; Gra#k)
* Demonstration der Sprachmöglichkeiten an Hand von elementaren statistischen Verfahren (statistische Tests, Regressionsanalyse, Varianzanalyse)
* Überblick über Erweiterungsmöglichkeiten (Au#nden und Installation von Erweiterungsmodulen; Automatisierung eigener Analysen; Online-Ressourcen) an Hand von weiterführenden statistischen Verfahren (z.B. Clusteranalyse) in Absprache mit den Teilnehmern.

Intended Learning Outcomes:
Die Teilnehmer sollen in die Lage versetzt werden, das Programmpaket R in seinen grundlegenden
Funktionen zu beherrschen und einfache statistische Auswertungen (numerisch und graphisch) vorzunehmen. Darüber hinaus soll es jedem Teilnehmer gelingen, sich nach Bedarf und Interesse in die weiterführenden Möglichkeiten des Programms einzuarbeiten.

Teaching and Learning Methods:
Teilnehmer, die an einem Zeugnis interessiert sind, können entweder selbständig ein statistisches Problem aus ihrem Interessensbereich wählen, oder ein solches vom Vortragenden erhalten. Das jeweilige Problem ist mit R zu bearbeiten, und die angewendeten Verfahren und erzielten Ergebnisse sind Gegenstand eines Prüfungsgesprächs. Termine werden individuell vereinbart. Die Note ergibt sich aus der Benotung der Übungsbeispiele.

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Statistik

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

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

Module Description

CS0092BOK: Wasserrecht | Wasserrecht

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Mündlich
Prüfungsmodus: Vorlesungsprüfung Die Prüfung wird mündlich am Institut für Rechtswissenschaften abgehalten. Der genaue Veranstaltungsraum wird rechtzeitig bekanntgegeben. Dauer der Prüfung: 30 min Die Prüfung ist ö#entlich. Regeln: - Zur Prüfung ist ein
Lichtbildausweis mitzubringen. - Hilfsmittel, wie LV Unterlagen, dürfen während der Prüfung NICHT verwendet werden.

Repeat Examination:

(Recommended) Prerequisites:
Es werden keine facheinschlägigen Vorkenntnisse vorausgesetzt

Content:
Die Lehrveranstaltung bietet eine Einführung in das Wasserrecht und einen Überblick über mit dem Wasserrecht in Zusammenhang stehende wichtige Bereiche des Umweltrechts.
Behandelt werden zunächst die Grundprinzipien des Rechts und darauf aufbauend der rechtliche Rahmen auf nationaler, europäischer und internationaler Ebene mit besonderem Fokus auf wasserrechtliche Bewilligungsverfahren, die Verleihung von Wasserrechten, Gewässerschutz und Gewässerpolizei sowie Vorsorge- und Sanierungsinstrumente.

Intended Learning Outcomes:
Nach Absolvierung der Lehrveranstaltung sind Studierende imstande Fragen des Wasserrechts zu erkennen und zu bewerten.

Teaching and Learning Methods:
Frontalvorlesung

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Rechtswissenschaften

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

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

Module Description

CS0093BOK: Project Citizen Science | Project Citizen Science

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**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:
Seminararbeit (100%)

Repeat Examination:

(Recommended) Prerequisites:
abgeschlossenes Bachelorstudium, Grundlagen der Statistik, Grundlagen wissenschaftliches Arbeiten

Content:
Citizen Science, also die aktive Einbindung der Bevölkerung in wissenschaftliche Projekte, ermöglicht die Beantwortung komplexer Fragestellungen im Bereich der Nachhaltigen Entwicklung (z.B. zur Erreichung der UN - Sustainable Development Goals). Viele Projekte aus der Ökologie befassen sich mit dem Thema der Biodiversität. In dieser Lehrveranstaltung bietet sich den Studierenden die einmalige Gelegenheit in einem der bekanntesten Citizen-ScienceProjekte Österreichs mitzuarbeiten und dabei eigene Fragestellungen zu bearbeiten und zu
beantworten. Die Studierenden können damit einerseits einen Beitrag zum Schutz der Biodiversität leisten, und andererseits selbst zur aktuellen Forschung beitragen.
Als Rahmen dient das Projekt Roadkill (www.roadkill.at), das bereits seit einigen Jahren sehr erfolgreich von den Lehrveranstaltungsleitern durchgeführt wird und bereits den BOKU Nachhaltigkeitspreis 2017 gewonnen hat, sowie für den Bundestierschutzpreis 2018 nominiert war. Die Studierenden bekommen in den einführenden Einheiten einen Einblick in das laufende Projekt und identi#zieren mögliche Forschungsfragen, die sie mit den im Projekt gesammelten Daten beantworten möchten. Wichtige Skills (z.B. Literatursuche und -verwaltung) werden ebenfalls behandelt um in mehreren angeleiteten Schritten in Form von Gruppenarbeiten die selbst gewählten Forschungsfragen in einer wissenschaftlichen Arbeit zu beantworten.

Intended Learning Outcomes:
1. Erlernen des wissenschaftlichen Arbeitens (Hypothesenerstellung, Methodende#nition, Datenanalyse, Verfassen einer Publikation) in einem preisgekrönten Citizen-Science-Projekt
2. Verbessertes Verständnis und Einblick in das Arbeiten mit Citizen-Science

Teaching and Learning Methods:
Gruppenarbeit
im Fokus steht selbstständiges Arbeiten angeleitet und unterstützt durch regelmäßige Projektmeetings und Methodenvermittlung

Media:

Reading List:

Responsible for Module:
BOKU

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

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

Module Description

CS0094BOK: Hygiene | Hygiene

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Schriftlich
Die schriftliche Prüfung umfasst insgesamt 6 Fragen, die nach einem Punkteschema (jeweils max. 5 Punkte) bewertet werden. Je nachdem, wie umfassend die Fragen beantwortet oder Fragen zu besonders wichtigen Themen falsch oder nicht beantwortet wurden, wird die Prüfung benotet, so dass sich letztlich die Gesamtnote nicht nur aus der reinen Punktezahl ergibt, d.h. es auch zu Punkteabzügen kommen kann. Benotungsschema: <15 Punkte: 5 (Nicht genügend) 15-19 Punkte: 4 (Genügend) 20-23 Punkte: 3 (Befriedigend) 24-27 Punkte: 2 (Gut) 28-30 Punkte: 1 (Sehr gut) .

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Grundkenntnisse in Mikrobiologie sind empfohlen

Content:
Ausgehend von der De#nition des Begri#es "Hygiene" und damit von einer sehr interdisziplinären Sichtweise wird die Relevanz der Hygiene für die Lebensmittelsicherheit und damit letztendlich für die Gesundheit des Menschen mit folgender Schwerpunktsetzung behandelt: Begri#sde#nition, aktueller Status und Trends in der Lebensmittelsicherheit, rechtlicher Rahmen (globale und europäische Rechtsgrundlagen), Lebensmittel und Qualität, Toxine, pathogene Mikroorganismen, Infektion/Intoxikation, Grundlagen der Epidemiologie und des ö#entlichen Gesundheitswesens, Mykotoxine, Viren, Prionen, Parasiten, Rückstände und Kontaminanten, biogene Amine, Allergene, Grundbegri#e der Toxikologie, Schädlinge, Lebensmittelverderb, Reinigung und Desinfektion.

Intended Learning Outcomes:
AbsolventInnen dieser Lehrveranstaltung beherrschen die Grundlagen der Hygiene als
AbsolventInnen dieser Lehrveranstaltung beherrschen die Grundlagen der Hygiene als zentralen Aspekt für die Lebensmittelsicherheit. Ihre Detailkompetenzen liegen im interdisziplinären Verständnis der vielfältigen Hygieneaspekte. Ihnen sind die dominierenden Gefahren betre#end die Sicherheit von Lebensmittel bekannt. Weiters verfügen sie über einen Einblick in die rechtlichen Grundlagen der Lebensmittelhygiene auf europäischer und internationaler Ebene.

Teaching and Learning Methods:
mit medialer Unterstützung

Media:

Reading List:
Die Vorlesungsunterlagen und ergänzende Unterlagen stehen als PDF-Dateien zum Download aus BOKUlearn zur Verfügung. Das dazu notwendige Passwort wird in der 1. Vorlesungseinheit bzw. via BOKUlearn bekannt gegeben.

Responsible for Module:
BOKU

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

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

Module Description

CS00

Zusammenhang mit Lebensmitteln auftreten, ab

Intended Learning Outcomes:
Nach erfolgreicher Absolvierung der Vorlesung sind die Studierenden mit den Grundlagen der Lebensmitteltoxikologie vertraut. Die Vorlesung soll einen Überblick über Toxine im Allgemeinen und giftige Lebensmittelinhaltssto#e sowie Giftsto#e, die bei der Lagerung, Verarbeitung oder Zubereitung entstehen, sowie deren Wirkungen geben. Als Voraussetzung zum Verständnis dieser Wirkungen werden Aufnahme-, Verteilungs- und Ausscheidungsmechanismen sowie metabolische Umsetzungen und die von den Sto#en selbst oder ihren Metaboliten verursachten Wirkungen, wie z.B. cytotoxische E#ekte, Mutagenität, Kanzerogenität, Störungen des Immunsystems Beein#ussungen der Reproduktion erläutert.
Nach Absolvierung dieser Vorlesung beherrschen die Studierenden u.a. folgende Fähigkeiten
- Sie können das toxikologische und medizinische Vokabular, das im Zusammenhang mit Lebensmittelinhaltssto#en, Kontaminanten und Zusatzsto#en von Bedeutung ist, verstehen und anwenden.
- Sie kennen die wichtigsten Giftsto#e, die in Lebensmitteln natürlicherweise vorhanden sind oder im Laufe der Produktion, Lagerung und Zubereitung auftreten können, und deren Wirkungen.
- Sie verstehen wichtige Mechanismen toxischer Wirkungen und können diese nachvollziehen.
- Sie kennen den Aufbau und die Funktion wichtiger Organe als Orte des Metabolismus von Fremdsto#en und als Zielorgane toxischer Wirkungen.
- Sie verstehen den Ein#uss von Giftsto#en auf wichtige Krankheitsverläufe, wie die Kanzerogenese oder die Beein#ussung des Immunsystems.
- Sie kennen die Bedeutung von Grenzwerten und deren Zusammenhänge mit toxischen Dosen bzw. Konzentrationen.
- Sie haben einen Überblick über wichtige Untersuchungsmethoden der Toxikologie.

Teaching and Learning Methods:
Frontalvorlesung

Media:

Reading List:
Unterlagen sind auf der Homepage von BokuLearn, zum Downloaden bereit gestellt.

Responsible for Module:
BOKU - Institut für Lebensmittelwissenschaften

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

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

Module Description

CS0096BOK: Food Biotechnology | Food Biotechnology

Version of module description: Gültig ab summerterm 2023

Module Level: Master	Language: English	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:
Schriftlich
Die schriftliche Prüfung umfasst insgesamt sechs Fragen (max. 5 Punkte/Frage). Je nachdem, wie umfassend die Fragen beantwortet oder Fragen zu besonders wichtigen Themen falsch oder nicht beantwortet wurden, werden die Punkte vergeben. < 15 Punkte: 5 (nicht bestanden) 15-19 Punkte: 4 19,5-23 Punkte: 3 23,5-27 Punkte: 2 27,5-30 Punkte: 1

Repeat Examination:

(Recommended) Prerequisites:
Grundlegende mikrobiologischen, biochemische und molekularbiologische Kenntnisse

Content:
A) Einleitung: Lebensmittel, Biotechnologie; Geschichte der LBT; Wechselbeziehung von LMBT und Ernährungswissenschaften, Welt-Ernährungssituation
B) Fermentierte Lebensmittel; Haltbarmachen von Lebensmitteln; Bacteriocine; Starterkulturen
C) fermentierte Milchprodukte - Gemüse - Fleisch
D) Mikrobielle Polysaccharide: Xanthan, Polysaccharide von Milchsäurebakterien
E) aktuelle Entwicklungen; metabolic engineering von Milchsäurebakterien
F) Aminosäureproduktion durch Corynebacterium und E. coli; metabolic engineering
G) Pilze, Einzeller-Protein, Fruchtkörper
H) Alkohol; Bier und Sake
I) Organische Säuren: Funktion, Zitronensäure, Milchsäure, Gluconsäure
J) Süßsto#e: Zuckeralkohole, Aspartam, Oligosaccharide
K) Geschmacks- und Geruchssto#e: Vanillin, Frambinon
L) mikrobielle Öle und Fette
M) Enzyme; Anwendungen in der Milch- und Backindustrie

Intended Learning Outcomes:
Nach erfolgreicher Absolvierung dieser Lehrveranstaltung sind die Studierenden mit den Strategien, Anforderungen und Möglichkeiten der Lebensmittel-Biotechnologie vertraut. Aufbauend auf mikrobiellen, biochemischen und molekularbiologischen Grundlagen ermöglicht die Vorlesung die Vernetzung lebensmittelbiotechnologischer Fragestellungen mit aktuellen technologischen, grundlagen-orientierten und legislativen Aspekten

Teaching and Learning Methods:
mit medialer Unterstützung

Media:

Reading List:
Die Vorlesungungsunterlagen werden via BOKU learn zur Verfügung gestellt.
Ergänzungsunterlagen werden ebenfalls via BOKU learn zur Verfügung gestellt.
Empfehlungen für Fachbücher werden zur Vorlesungsbeginn besprochen.

Responsible for Module:
BOKU - Institut für Lebensmitteltechnologie

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

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

Module Description

CS0097BOK: Scientific Computing | Scientific Computing

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
- Two tests - Home assignments (every week) & presentations in class: assignments are solved in groups, but have to be presented individually

Repeat Examination:

(Recommended) Prerequisites:
- Ability to handle your operating system, including the handling of #les and directories
- Basic maths skills
- Functions, derivative of a function (e.g. a polynomial)
- Plotting the graph of a function
- coordinate systems, how to calculate distances between points in 2d and 3d
- Theorem of Pythagoras, cosine/sine functions
- Statistical basics: how to calculate mean, max, min of a set of samples
- Programming skills are not required, but will be helpful of course

Content:
This class will introduce the students to Python, one of the most widely used languages in scienti#c programming and data analysis today. The class will #rst introduce students to the basic concepts of programming in Python. Afterwards, students will learn about the Python scienti#c ecosystem including numpy, scipy and pandas. The machine learning library scikitlearn will also be presented. The class focuses on programming techniques relevant for applications in research.

Intended Learning Outcomes:
After taking the class, students
- are able to write code in Python with a particular focus on data analysis

- understand the concept of functions
- know the Python Scienti#c Ecosystem, including Numpy, Scipy, and Pandas
- are able to download and load data using Python
- are able to plot data and calculate basic statistics using Python

Teaching and Learning Methods:
Vorlesung mit integrierten Übungen
The class is split into three parts:
- Interactive lecture with integrated exercises
- Exercises at home (each week)
- Presentation of exercises in class

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Nachhaltige Wirtschaftsentwicklung

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

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

Module Description

CS0098BOK: Mathematics for Engineers | Mathematics for Engineers

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Participation (presentation / discussion) and written exam.

Repeat Examination:

(Recommended) Prerequisites:

Content:
Lecture:
Introduction to mathematical software in applied sciences. How to implement basic and advanced mathematical methods, such as for solving di#erential equations or the analysis of experimantal data, in the mathematical program Mathematica.
Exercises:
The participants present mathematical questions or problems that they encounter in their study or research, such as di#erential equations or experimental data from their planned or ongoing master thesis or PhD thesis. They then use mathematical software, as discussed in the lecture, for these questions and problems.

Intended Learning Outcomes:
Successful application of mathematical methods by using mathematical software.

Teaching and Learning Methods:
Vorlesung mit integrierten Übungen

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Mathematik

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

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

Module Description

CS0099BOK: Programming with Python | Programming with Python

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Students will be evaluated based on 2 midterm programming exams (each 30 %) and a #nal project aimed at writing a user-friendly script able to parse, analyze and plot a given dataset of interest (40 %)

Repeat Examination:

(Recommended) Prerequisites:

Content:
Inhalt
Nowadays, the ability to design and write computer programs is becoming an indispensable skill. Among di#erent programming languages, Python has become popular and widely used in the #eld of biosciences, for its readability, object-oriented programming and many available libraries that extend its functionality. This course is aimed at bachelor, master and PhD students with no or very little programming experience, who want to learn basics of programming and how to write scripts using Python language. It is primarily oriented at developing practical programming skills and basics of problem-solving (algorithmic thinking) using computer programs, with the main focus on data analysis and plotting. Python modules and packages (e.g. numpy, matplotlib) will be introduced and used.
Topics
• General programming ideas
o Data types
o Flow control
o Functions
o String manipulation (parsing, formatting)

• Plotting and analysis of scienti#c data
o Spectroscopic data
o Protein sequences, structures
• Python packages
o Matplotlib
o Numpy
o Scipy
o Pandas

Intended Learning Outcomes:
Students will learn how to write basic scripts using Python, as well as how to use selected Python modules, primarily aimed at data analysis and plotting.
• Construct and develop basic blocks of tasks (functions).
• Write Python code to analyze and plot scienti#c data.
• Design and write programs to solve a given problem.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Molekulare Modellierung und Simulation

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

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

Module Description

CS0100BOK: Field Crops | Ackerbauliche Nutzpflanzenkunde

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4.5	**Total Hours:** 135	**Self-study Hours:** 45	**Contact Hours:** 90

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

Description of Examination Method:
Written
written examination (multiple choice test)

Repeat Examination:

(Recommended) Prerequisites:
Solid knowledge of botany

Content:
Cereal crops:
bread wheat, durum wheat, rye, oat, barley, triticale, maize and more
Legumes:
soybean, pea, faba bean, chickpea, lentil, lupins etc.
Oilseed crops:
OIlseed rape, sun#ower, oil pumpkin, linseed, poppy and others
Tuber and root crops:
potato, sugar beet, Jerusalem artichoke, fooder beets
Others:
Fibre crops, industria crops, energy crops, #eld vegetables, medical and spice crops ach of the #ve groups of #eld crops is outlined using a problem-based approach of knowledgetransfer. Plant breeding, agronomy and phytopathology issues will be covered for each crop
group.

Intended Learning Outcomes:
Students are achieving an overview of individual #eld crop species and groups of #eld crops with respect to plant breeding, agronomy and plant pathology. Students are able to link

agronomic knowledge with plant breeding and phytopathology issues for problem solving.

Teaching and Learning Methods:
Lecture, hands-on demonstrations at the BOKU experimental farm.

Media:

Reading List:
A script of this course will be available online.
BECKER, H., 2011, P#anzenzüchtung, 2. Au#., Verlag Eugen Ulmer, Stuttgart. UTB 1744.
DIEPENBROCK, W., F. ELLMER & J. LEON 2005, Ackerbau, P#anzenbau und
P#anzenzüchtung.
Verlag Eugen Ulmer, Stuttgart. Serie UTB.
FISCHBECK, G., W. PLARRE & W. SCHUSTER (Hrsg.), 1985, Lehrbuch der Züchtung
landwirtschaftlicher Kulturp#anzen, Band 2, Spezieller Teil. Zweite, neubearbeitete Au#age,
Verlag Paul Parey, Berlin.
DIEPENBROCK, W., G. FISCHBECK, K.-U. HEYLAND & N. KNAUER, 1999, Spezieller
P#anzenbau. 3.,
neubearb., ergänzte Au#age, Verlag Eugen Ulmer, Stuttgart. UTB 111.
HALLMANN, J., QUADT-HALLMANN, A. & A. VON TIEDEMANN, 2007, Phytomedizin
Grundwissen
Bachelor, Eugen Ulmer KG, Stuttgart. UTB 2863.
KÜHNE, S., BURTH, U. & P. MARX, 2006, Biologischer P#anzenschutz im Freiland. Eugen Ulmer
KG, Stuttgart.

Responsible for Module:
BOKU- Institute of Agronomy

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

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

Module Description

CS0102BOK: Geotechnics | Geotechnics

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** 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:
Written
The exam will be in the form of homework. Each student will solve a problem connected with three topics, using personalized data, which you will receive from the IGT secretariat. You will find detailed information in BOKUlearn.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge in soil mechanics

Content:
• Constitutive models and numerical analysis
• Advanced laboratory testing
• Dams and embankment
• Slope stability analysis
• Geotechnical earthquake engineering

Intended Learning Outcomes:
Know-how in advanced topics of soil mechanics and geotechnical engineering; hand-on experience of geotechnical software; design practice

Teaching and Learning Methods:
multimedia-supported

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Geotechnik (IGT)

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

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

Module Description

CS0103BOK: Agricultural Production and Policy Impact Modelling | Agricultural Production and Policy Impact Modelling

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** 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:
Seminar paper

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
The course captures:
1. Introduction to GAMS (http://www.gams.com)
- Sets and Conditions
2. Impact Analysis
- Farm Level Analysis
- Regional Analysis
- Sector (partial equilibrium models) Analysis
3. Evaluation of alternative Natural Resource Uses
4. Static and Dynamic Comparative Analyses
5. Fixing Unbounded and Infeasible Models using GAMSCHK
6. Efficient Report Writing of Model Results

Intended Learning Outcomes:
The objective of this course is to:
- carry out impact analyses in the #eld of agricultural, resource and environmental economics using GAMS (General Algebraic Modeling Systems),
- learn good model building in GAMS,

- build models for farm, regional, partial equilibrium, natural resource, and environmental analyses,
- interpret and synthesize model results.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Nachhaltige Wirtschaftsentwicklung

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

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

Module Description

CS0104BOK: Fish Farming and Aquaculture | Fish Farming and Aquaculture

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 45	**Contact Hours:** 15

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

Description of Examination Method:
written

Repeat Examination:
Next semester

(Recommended) Prerequisites:
general Hydrobiology

Content:
Fish farming and Principles in Aquaculture
International aquaculture
Austrian case studies
Modern aquaculture tecnologies

Intended Learning Outcomes:
- Describe the role of aquaculture at Austrian, European and worldwide level, both ecologically and economically;
- Understand principles in aquaculture
- Discuss various methods in fish farming

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU - Institute of Hydrobiology and Aquatic Ecosystem

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

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

Module Description

CS0106BOK: Advanced Methods in Remote Sensing: Machine Learning and Cloud Computing | Advanced Methods in Remote Sensing: Machine Learning and Cloud Computing [CS0106BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Continuous assessment and final project

Repeat Examination:

(Recommended) Prerequisites:
Basics programming skills. Basic principles of remote sensing and image classification.

Content:
1 Introduction to statistics and algebra.

2 Machine learning:
2.1 Feature extraction: Spatial, spectral and temporal.
2.2 Clustering: k means.
2.3 Supervised classification methods:
2.5.1. Decision trees (DT).
2.5.2. Random Forest (RF).
2.5.3. Support Vectors Machines (SVM).
2.5.4. Neural networks (NN).
2.4 Real world example I: Object detection and classification using very high spatial resolution.
2.5 Real world example II: Classification of hyperspectral images.

3 From local laptop to Cloud computing: Google Earth Engine.
3.1 Real world example III: Spring plant phenology products.
3.2 How to use machine learning in the cloud: remote sensing classification.

3.3 Real world example IV: Classification using very high spatial resolution data.
3. 3 Real world example V: mapping phenoregions and correlating temperature and satellite based phenometrics

Intended Learning Outcomes:
During this course the students will learn to design and deploy machine learning lgorithms as well as to use cloud computing for the analysis of remote sensing images. Both machine learning and cloud computing topics are explained using real world cases.

Teaching and Learning Methods:
Lectures with case studies.

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Geomatik - Izquierdo-Verdiguier, Emma

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

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

Module Description

CS0107BOK: Environmental Biotechnology Seminar | Seminar in Environmental Biotechnology [CS0107BOK]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
- Elaboration of the topic
- Speech and layout of the presentation
- Contributions to the discussion
- Completeness of the submitted materials

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The students will be confronted with current research topics in the field of environmental biotechnology and they will acquire and practice skills that are required for the presentation and discussion of scientific problems.
The following subject areas will be covered:
- Biomaterials and Enzyme Technology
- Syngas Technologies
- Environmental Microbiology
- Geobiotechnology & Environmental Chemistry
- Microbial Production Technology & Biorefineries
- Microalgae Biotechnology and related topics

Current topics and supervisors: see e-learning course
For registration follow the instruction on the BOKUlearn site!

Intended Learning Outcomes:
The students have obtained an overview on current scientific topics in the field of environmental biotechnology. They are able to perform a literature research on a given topic and to present the essential items in an oral presentation. Furthermore, they are able to actively participate in a scientific discussion.

Teaching and Learning Methods:
Based on a starting publication provided by the supervisor, the students perform a literature research and elaborate a scientific presentation on a specific topic in the field of environmental biotechnology. The oral presentations (15 min) are held in front of a plenum (participating students and supervisors) followed by a discussion. All students are also obliged to take part in the discussion.

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

CS0108BOK: Development Cooperation in the Water Sector | Development Cooperation in the Water Sector [CS0108BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:**	**Contact Hours:** 30

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

Description of Examination Method:
Exams are in an "open book" approach. Two exam dates will be offered: 18.12.2023, 16:00 - 17:00, in physical presence in HS 01 / MUG1 [HS XXI] (MUG1-EG/01) 12.01.2024, 16:00 - 17:00: This exam will be held online via ZOOM. Log in to the ZOOM meeting via bokuvienna.zoom.us > Sign in > Join a Meeting with the Meeting ID or the Zoom link: https://bokuvienna.zoom.us/j/68343192905?pwd=aW1wK0hicUh4N2ZIc2tVMUs2Y25ndz09 Meeting-ID: 683 4319 2905 Kenncode: 477338 The procedure for this ZOOM exam is explained in BOKUlearn.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
LV "Hydrologie und Wasserwirtschaft I + II" recommended; or equivalent experience
- English language skills

Content:
This course is about the water sector in international development cooperation. Therefore, the lecturer invited ten representatives from various international organisations as guest speakers. Two to three experts will share their first-hand experiences and illustrate their work with extraordinary examples from various countries and thematic fields every afternoon. The course is spread over five afternoons.

The guests:
- Managing Director of HYDROPHIL GmbH
- Task Manager of the African Water Facility at the African Development Bank
- Group Leader of the Water Security Research Group at the International Institute of Applied Systems Analysis (IIASA)

- Technical Officer for Water and Sanitation of the Austrian Development Agency
- Engineering Consultant with the Water & Sanitation Division of the Inter-American Development Bank
- Senior Environmental, Social and Governance Manager of the Austrian Development Bank
- Senior Water Resources Management Specialist in the Water Unit for Europe and Central Asia, The World Bank
- Head of Secretariat of the IAWD – International Association of Water Service Companies in the Danube River Catchment Area
- Head of the Hydro-consulting section in Vienna, AFRY's competence centre for Hydrology and Climate Change
- Member of the global SNV team and individual consultant for HYDROPHIL and the World Bank
- WASH & environmental advisor at the Austrian Red Cross

Each guest speaker will follow a similar approach:

Introduction:
The presenter starts by briefly introducing themselves, their career and the organisation s/he is affiliated with. The students will learn about the diversity of jobs and organisations. Hence, the course aims to show students the wide range of career opportunities they have in the global water sector in development cooperation.

Technical part:
Here, the guest is free to present any topic s/he has been working on related to the water sector in developing countries (or closely associated with it). The course's objective is to cover a broad cross-section from a thematic point of view. Contributions will cover the various sub-sectors, e.g. hydrology, water resources management, infrastructure development in water supply and wastewater, hydropower development, natural hazards, and climate change adaptation and mitigation. The learning content is presented first-hand by senior experts and managers. Challenges of their international activities are discussed.

Intended Learning Outcomes:
This course aims to show students the wide range of career opportunities they have in the international water sector. Challenges in international projects are discussed from a technical and project management perspective.

Teaching and Learning Methods:
interactive lecture

The learning content is presented first-hand by experts with project experience and discussed with the students. Students are expected to participate in the discussions during the course units actively.

Media:

Reading List:
Empfohlene Fachliteratur
The lecturer uploads the presented documents to BOKU-Learn after each course unit.

Responsible for Module:
BOKU Eder Gerald Institut für Hydrologie und Wasserwirtschaft

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

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

Module Description

CS0110BOK: Harvesting Systems for Mountainous Regions | Harvesting Systems for Mountainous Regions [CS0110BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 0	**Contact Hours:** 60

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

Description of Examination Method:
Written
Online via Moodle

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
• General conditions of harvesting systems in Austria
• Harvesting processes, operating techniques and systems
• Equipment and machines
• Damages to stock and soil
• Personal protective equipment
• Cutting and limbing methods using chain saw
• Accident prevention
• Cable yarding systems
• ÖNORM L5219
• Cable mechanics
• Ergonomics
• Concepts of stress and strain
• Noise, vibrations, work intensity, fumes, long-time loading barrier
• Expense budgeting (machines, harvesting method), cost category
• Productivity

Intended Learning Outcomes:
• Understanding and analyzing the dimensions within mountain forest harvesting systems
• Evaluate economic, ecologic and human dimensions of harvesting methods
• Understanding and applying important aspects of occupational health and safety

Teaching and Learning Methods:
mit medialer Unterstützung

Media:

Reading List:

Responsible for Module:
BOKU Stampfer Karl und Holzleitner Franz Institut für Forsttechnik

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

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

Module Description

CS0111BOK: Human Impacts in Riverine Landscapes | Human Impacts in Riverine Landscapes [CS0111BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 2	**Total Hours:** 45	**Self-study Hours:**	**Contact Hours:** 45

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

Description of Examination Method:
Written test, 8 questions need to be answered and argued (no multiple choice test)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in hydrobiology & fish ecology

Content:
Current problems in applied fish ecology

- Discussion of impact models (e.g. drivers and pressures - DPSIR, cascade models)
- Overview of the status quo of running waters (global, EU/Alps, Austria)
- Overview of major human pressures/related impacts
- Discussion of different types of human impacts
- Discussion of case studies

TOPICS OF LECTURES

#1 - Introduction

#2 - Impacts due to hydro-power production (Hydro-power use: run-of-river-/diversion-/storage power plants; connectivity/fragmentation)

#3 - Impoundments & reservoir flushing (flow patterns, sediment transport etc.)

#4 - Residual flow/water abstraction (minimum flow requirements)

#5 - Hydropeaking (magnitude, frequency, duration, effects on hydro-morphology)

#6 - Morphological impacts (effects on physical environment, riverine habitats, floodplains, vegetation/land-use etc.)

#7 - Pollution (organic pollution, toxic substances etc.)

#8 - Land use change (forms of land use, nutrients etc.)

#9 - Multiple impacts (interactions of pressures etc.)

Intended Learning Outcomes:
1. Get an overview of fish-ecological conditions in Austrian & European rivers.
2. Evaluate the impacts of human activities on running waters.
3. Lern and discuss methods for assessing and improving ecological integrity.

Teaching and Learning Methods:
9 lectures -> exam based on these contents

Media:

Reading List:

Responsible for Module:
BOKU Schmutz Stefan, Greimel Franz, Hayes Daniel S. Institut für Hydrobiologie und Gewässermanagement

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

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

Module Description

CS0112BOK: Lecture Series in Soil, Water and Atmosphere | Lecture Series in Soil, Water and Atmosphere [CS0112BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:**	**Duration:** one semester	**Frequency:** one-time
Credits:* 3	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:** 60

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:

Content:
This course introduces students to the science and practice of hydrology and water management. More specifically, it aims at understanding hydrological processes; physical, chemical and biological processes in soil and water; and soil-plant-water-atmosphere relations.
One focus is on the introduction of methods and techniques regarding monitoring and modelling of hydrological processes. The requirements of environmental, spatial data (e.g. precipitation, land cover, soil type, etc.) are emphasized and public access data sources are referenced. Examples of applications of hydrological models for flood forecasting and groundwater resources management are addressed. Hydrological processes are then considered in terms of sustainable management of water and soil. Another focus is on urban water management.
Topics include water balance components, soil properties, water retention and water fluxes, crop water requirements, water quality, drinking water supply, and wastewater treatment.

Intended Learning Outcomes:
After successful completion of this course, students will be able to
- name and describe the physical and hydraulic properties of soils and the respective methods of soil analysis

- explain the processes controlling the storage and transport of water within the unsaturated and saturated zone and river channels
- explain the FAO-approach for determining crop water requirements and irrigation demand
- argue the need for process monitoring with respect to model development and prospective planning
- identify the dominant hydrological processes for runoff formation
- find and apply public access data bases of environmental data sets

Teaching and Learning Methods:
interactive lecture

Media:

Reading List:

Responsible for Module:
BOKU Ertl Thomas, Holzmann Hubert, Nolz Reinhard Institut für Bodenphysik und landeskulturelle Wasserwirtschaft

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

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

Module Description

CS0113BOK: Molecular Evolution and Phylogenetics | Molecular Evolution and Phylogenetics [CS0113BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:**	**Contact Hours:** 30

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

Description of Examination Method:
Written exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The advancement of sequencing technologies has resulted in the generation of sequencing data at a scale without precedence. Importantly, such data cannot just enlighten us about the biology of individual species, but can also be used to infer phylogeny, to assess evolutionary trends, and to study the changes within genomes over time. The lecture will provide insight into the molecular principles underlying the evolution of DNA, proteins and genomes. Different ways how to perform phylogenetic analyses will be discussed. Bioinformatics methods to study molecular evolution will be presented.

Intended Learning Outcomes:
The students will obtain an overview of the molecular concepts underlying evolution, and will obtain knowledge on how bioinformatics can be used to perform phylogenetic analyses and evolutionary studies.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Himmelbauer Heinz Department für Biotechnologie

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

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

Module Description

CS0114BOK: Post-harvest Technology | Post-harvest Technology [CS0114BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**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:
Written
The mark results from the evaluation of the written exam. The mark of the lecture will be derived from the reached percentage of the points as followed. 90 – 100 % = 1 78 – 89 % = 2 66 – 77 % = 3 55 – 65 % = 4 0 – 54 % = 5 (failed) Duration of the written examination = 60min. For the written exam you can bring calculator, ruler, german/englisch dictionary and the formulary supplied on the bokulearn plattform.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Importance of post-harvest technology for the food chain

Biological and physical principles of post harvest technology

Selected post harvest technologies in agriculture:

Treatment of seed (drying, cleaning, sieving,?)

Alternative methods of seed treatments (warm-humid, microwave, high frequency energy)

Drying technology (principles and application; Ddying of agricultural products)

Crop conservation with silage making (principles and processes)

Storage of crops (potato, fruit, vegetable,?); Principles and applications

Special post-harvest technologies in horticulture and viticulture

Intended Learning Outcomes:
Understanding of biological and physical properties of harvested crops and their comprehension

Qualification for systematic analyses of post harvest technology

Qualification for planning of post harvest technology

Evaluation of post-harvest technologies on engineering fundamentals as well as ecological and economic aspects.

Teaching and Learning Methods:
interactive lecture

Media:

Reading List:

Responsible for Module:
BOKU Pejakovic Vladimir, Gronauer Andreas Institut für Landtechnik

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

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

Module Description

CS0115BOK: Organisational Behaviour | Organisational Behaviour [CS0115BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
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:
Written
A min. of 50% of points is necessary to complete the course.

Repeat Examination:

(Recommended) Prerequisites:
Some knowledge about general processes in organisations is desirable (e.g. based on your work experience, including summer jobs).

Content:
Organizational behaviour is a field of research that seeks to understand and explain human behaviour in the workplace. This addresses individual behaviour with topics such as work motivation and job satisfaction; dynamics within groups; as well as the influence of organisational structure and the use of technology on the behaviour of people. The aim is to manage people more effectively and to enhance the quality of employee’s work life. Understanding the human side of management will be helpful in your career, as you will depend on people to accomplish tasks and projects: you will need to work for other people, work with other people, and supervise other people. The course offers you the opportunity to apply concepts to real-world problems such as resolving conflicts and overcoming resistance to change, which will allow you to develop your leadership potential.

The course is designed as ‘team-based learning’. Students will be assigned to a team for the duration of the course. Course material will be mainly acquired through independent reading of the text book. During classes, the focus will be on case studies and role plays. Through its focus on work within the teams, it gives you an opportunity to better understand your own as well as other's behaviour.

The course is offered in time-compressed mode, i.e. there will be 5 classes with 5 hours each. You can choose between the course offered on Tuesday (in-class, thus focusing on face-to-face interactions), or the one offered on Saturday morning (online, thus focusing on virtual team work and digital competencies). For further information a detailed Syllabus will be available in late September.
Important: attendance in the first class is compulsory.

Intended Learning Outcomes:
Upon completion of the course, students are able to:
+) explain organisational theory as it relates to the design of organisations, teamwork, leadership, management practices, work motivation, and job satisfaction
+) evaluate the benefits and challenges of alternatives, and thus make sound recommendations to improve the performance at individual and team level
+) communicate their understanding of a problem clearly and non-judgementally, thus contributing to its resolution within a team
+) analyse team dynamics and structure team work so as to foster cooperation and synergies between team members, not least by providing constructive feedback to team members
+) recognize their own strengths and preferences (e.g. regarding leadership style, preferred organisational culture, work organisation)

Teaching and Learning Methods:
Vorlesung mit integrierten Übungen

Team-based Learning: students need to read chapters of the book before class. During class there are brief lecture providing theoretical input, and most of the time is devoted to group work (case studies and role plays). The groups reflect on the experiences during the group work and the insights are discussed in the plenary.

Media:

Reading List:

Responsible for Module:
BOKU Darnhofer, Ika Institut für Agrar- und Forstökonomie (AFO)

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

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

Module Description

CS0117BOK: Adhesive Technology | Adhesive Technology [CS0117BOK]

Version of module description: Gültig ab summerterm 2022

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:** 60

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

Description of Examination Method:
oral & immanent exam character (lab part) Due to the immanent exam character of this lecture (VU) a positiv exam is to be reached until February 15th of the following semester. Positive lab activities cannot be transfered to follow up semesters.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
This course and the practical exercises concentrate on the application oriented evaluation of the various adhesives in use in the woodworking industry:

Content of the course:

· Types, chemical basic and production of various adhesives

· properties of adhesives (in combination with practical exercises)

· application of adhesives, hardening and setting behaviour, forming of bonding strength

· basics of gluing and bonding

· possible problems in gluing and bonding

· modification of wood

· activation of the wood surface, binderless gluing

· ecological topics (effluents, waste, emissions)

· application and use of adhesives (in combination with practical exercises) .

Intended Learning Outcomes:
The students will learn in this course about various adhesives with different chemical composition and their production, properties and application. Reaching the aim of the course the student will have enough basic knowledge on adhesives in the woodworking industry to use in proper way adhesives as well as to evaluate and understand additional informations from various sources.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Konnerth Johannes, Logar Lucia, Van Herwijnen Hendrikus Institut für Holztechnologie und Nachwachsende Rohstoffe

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

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

Module Description

CS0118BOK: Protein Chemistry and Protein Engineering | Protein Chemistry and Protein Engineering [CS0118BOK]

Version of module description: Gültig ab summerterm 2022

Module Level: Master	Language: English	Duration: one semester	Frequency: summer semester
Credits:* 4	**Total Hours:** 90	**Self-study Hours:** 30	**Contact Hours:** 60

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

Description of Examination Method:
Successfull participation in practical part and written exam about the theoretical lecture part. Written exam: 6 questions with 5 points each sehr gut (very good, 1): 28-30 points gut (good, 2): 25-27 points befriedigend (3): 20-24 points genügend (4): 16-19 points nicht genügend (negative, 5): 0-15 points

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic lectures in Organic Chemistry, Biochemistry and Molecular Biology

Compulsory course for Master students in Biotechnology with focus on Bioprocess Engineering and Medicinal Biotechnology. Optional course for other master programmes.

Content:
THEORETICAL PART - LECTURES
The theoretical parts might not be presented in this order!

Unit 1: Historical perspective, Therapeutic use of antibodies, Evolution in nature and in the lab: ZAJC

Unit 2: Forces between molecules, Protein structures: ZAJC

Unit 3: Thermodynamics of protein folding and unfolding:
ZAJC

Unit 4: Real-world examples for recent advances in protein engineering: ZAJC

Unit 5: Mutagenesis strategies I: PETERBAUER

Unit 6: Mutagenesis strategies II: PETERBAUER

Unit 7: Protein libraries: WOZNIAK-KNOPP

Unit 8: Surface Display: WOZNIAK-KNOPP

Unit 9: Protein dynamics and molecular dynamics simulations: OOSTENBRINK

Unit 10: Functional studies on proteins I: Enzyme kinetics (steady-state versus presteady kinetics): FURTMÜLLER

Unit 11: Functional studies on proteins II: Ligand binding and protein-protein interaction (surface plasmon resonance, biolayer interferometry ect.): FURTMÜLLER

PRACTICAL PART:

Databases and phylogeny: LUDWIG

Protein structure modeling and prediction: OOSTENBRINK

Intended Learning Outcomes:
After completing this course and passing the exam students should understand the relationship between protein structure and function as well as protein dynamics and stability. Moreover they will have an overview about the most important techniques in elucidation of protein structure and quality. The principles in protein design and engineering will be discussed as well as the use of the most important databases, elucidation of protein phylogeny. Further, students will gain insight into the basics in protein modeling and structure prediction

Teaching and Learning Methods:
Theoretical lectures combined with practical courses

Media:

Reading List:

Responsible for Module:
BOKU Furtmüller Paul Georg, Ludwig Roland, Oostenbrink Chris, Peterbauer Clemens Karl, Wozniak-Knopp Gordana, Zajc Charlotte Institut für Biochemie

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

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

Module Description

CS0119BOK: Energy Technology Fundamentals | Grundlagen der Energietechnik [CS0119BOK]

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Written
ONLINE exam, Multiple Choice test, see Online information/Additional information and BOKU learn for details

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Knowledge of basic physics recommended.

Content:
Importance of energy for mankind
Mechanical and electrical energy and energy technology
Thermal energy and fundamentals of thermodynamics
Thermodynamic cycles, exergy and anergy
Practical thermodynamic cycles
Chemical energy technology
Electrochemical energy technology

Intended Learning Outcomes:
The students of this course...

... know the relevant forms of energy.
... are competent to work with energy and power units.
... know the definition and significance of thermodynamically relevant quantities of state (enthalpy and entropy).

... know the fundamental limitations for the conversion of energy to other energy forms.
... are able to apply the fundamental physical-thermodynamic principles to energy conversion chains and can, on this basis, determine efficiency figures for energy conversion processes.
... know the state-of-the-art technologies for the conversion of primary energy to final energy.

Teaching and Learning Methods:
multimedia-supported

Interactive online corse with pre-recorded video streams of the lecture and interactive video conferences for questions&answers and further discussion.

Media:

Reading List:

Responsible for Module:
BOKU Pröll Tobias Institut für Verfahrens- und Energietechnik

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

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

Module Description

CS0120BOK: Laboratory Diagnosis | Labordiagnostik [CS0120BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
assessment of active participation and a final protocol

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no practical experience necessary

Content:
Short overview of the protein extraction from plant tissue and protein detection using specific antibodies: ELISA immunoassay to detect plant viruses in plant tissues.
Short overview of the extraction of RNA from plant tissue and virus RNA detection using RT-PCR-based method.
DNA fingerprinting of different strains of phytopathogenic fungi.: PCR and digestion of the PCR product with restriction enzymes. DNA detection via gel electrophoresis.

In addition to the experiments that will be conducted by the students basic background information will be given concerning the different detection methods.

Intended Learning Outcomes:
Basic knowledge of antibody-based ELISA test as a tool to detect plant pathogens.
Basic knowledge of PCR-based detection of plant pathogens.
Students can perform ELISA test and PCR to detect plant pathogens.

Teaching and Learning Methods:
laboratory

Media:

Reading List:

Responsible for Module:
BOKU Wieczorek Krzysztof, Gasser Katharina, Hage-Ahmed Karin Institut für Pflanzenschutz

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

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

Module Description

CS0121BOK: Microbiology - Practical Course | Mikrobiologie - Übungen [CS0121BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:**	**Contact Hours:** 60

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

Description of Examination Method:
Immanenter Prüfungscharakter. Mitarbeit und Aufzeichnungen (20%), Identifizierungsbeispiel (40%), Schriftliches Colloquium am 6. Übungstermin (40%). Das schriftliche Colloquium (1h) besteht aus 5 Fragen zu je 6 Punkten. Notenschlüssel: 30-28 Punkte Sehr gut 27-24 Punkte Gut 23-20 Punkte Befriedigend 19-15 Punkte Genügend <15 Punkte Nicht genügend

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Based on the training of working under sterile conditions and handling of the microscope, the following contents are offered: culturing, enumeration and identification of micro-organisms in different materials, staining and physiological differentiation. Finally, a microbiological identification of a bacterial culture is independently performed, and this, together with the evaluation of all bacteriological preparations and a written examination, forms the basis for marking.

Intended Learning Outcomes:
After successful completion of the course, the students are able to handle nonhazardous microorganisms. They can perform basic techniques applied in routine laboratories (staining procedures, microscopic analysis, phenotypic identification, biochemical typing). Further they are able to ascertain the microbial counts of feeds and foods.

Teaching and Learning Methods:
Laboratory

Media:

Reading List:
The necessary scripts can be downloaded from BOKUlearn.

Responsible for Module:
BOKU Bücher Carola, Mrkonjic Fuka Mirna, Pacher Nicola, Tanuwidjaja Irina Institut für Lebensmittelwissenschaften

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

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

Module Description

CS0122BOK: Practical Course in Process Engineering | Verfahrenstechnisches Praktikum [CS0122BOK]

For organizational details please refer to BOKU-Learn! Please read all documents and information on BOKU-Learn before the start of the course!

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
WG ETEM: 95% Arithmetic mean of the grades of the protocols. All modules have to be completed positively. 5% counts the oral performance at the introductory lectures. In the case of insufficient preparation / negative oral examination, participation in the practical course can be denied by one of the lecturers. All protocols must be positively evaluated. Protocols are due 1 week after the practicum. Protocols handed in after the deadline will be graded as "Not Sufficient". WG PTNR: Pre-Examination of basic knowledge in energy technologies (50%) + evaluation of protocol (50%). Note: All moduls must be completed sucessfully. Protocolls which are submitted after the deadline, will be evaluated negative!

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
recommended but not mandatory:
VU Introduction to process engineering
VU General process engineering
VO Mechanical and thermic process engineering
VO Heat and mass transfer

Content:
Various exercises, measurements and experiments will be carried out in small groups (max. 3 persons) at different exercise stations with a process engineering context. The practical course is offered by two working groups of the institute. You can choose one working group. The following exercise stations are offered:

WG ETEM (Energy Engineering & Energy Management: Kotik, Wolf):
-) Fluidized bed system,
-) Heat pump technology,
-) Flow measurement and
-) Dwell time measurement

WG PTNR (Process Engineering Renewable Resources: Grausam, Pfeifer, Hrbek):
-) Classificaton of particles,
-) Extraction,
-) Rectification and
-) Drying

Intended Learning Outcomes:
After successful completion, students will be familiar with various unit operations from a practical perspective and will be able to better understand theoretical relationships.

Students gain basic theoretical and practical knowledge of the exercise stations performed. The processes from process engineering and process technology demonstrated in the exercise stations are understood by the students and the students are able to calculate as well as evaluate techno-economic key figures.

Due to the experience with pilot plants, the students are able to design simple technical processes and to integrate real techno-economic aspects into the considerations. In addition, students are able to search for scientific/technical literature, excavate it and prepare technical reports.

Teaching and Learning Methods:
Workshop

Media:

Reading List:

Responsible for Module:
BOKU Grausam Anita, Hrbek Jitka, Kotik Jan, Pfeifer Christoph, Wolf Magdalena Institut für Verfahrens- und Energietechnik

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

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

Module Description

CS0123BOK: Socio-cultural Aspects of the Development of Rural Areas | Sozio-kulturelle Aspekte der Regionalentwicklung [CS0123BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Written
A) Option Blended Learning: 4 positive in-class modules (short test and assessment of groupworks in each in-class module) OR B) Option E-Learning: written exam at the end of the semester

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
basic sociology knowledge

Content:
• Definitions, tasks and areas of regional management in Austria and abroad

• Actors, institutions, instruments and governance mechanisms

• Theories of regional development, collective action and social innovation

• Social and cultural capital as well as other types of community capital

• Tools and methods supporting development processes and development projects

• Best practice and assessment of development projects - with focus on socio-cultural aspects

Intended Learning Outcomes:
• Competences, methods and tools for practical regional development
• Insights into actors, organisations and processes of regional development

Teaching and Learning Methods:
A) Blended learning: i.e. self studying of knowledge, methods and tools based on text and audio files (on the learning platform BOKU learn); application of knowledge, methods and tools in different settings, such as case studies, team work and role play games (5 face-to-face meetings, minimum attendance is four)
B) E-Learning: self studying of knowledge based on text and audio files (on the learning platform BOKU learn) & written exam at the end of the semester (exam questions focus on real life cases and the application of learned methods and concepts)

Media:

Reading List:
Recommended Reading
Text and audio-files on BOKU learn site

Responsible for Module:
BOKU Altenbuchner Christine Institut für Nachhaltige Wirtschaftsentwicklung

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

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

Module Description

CS0127BOK: Campus of Change - Sustainable Society in Times of Climate Crisis | Campus of Change - Zukunftsfähige Gesellschaft in Zeiten der Klimakrise [CS0127BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor/Master	**Language:**	**Duration:**	**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:
Written
Active participation and multiple choice

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Do you want to understand how universities can make a decisive contribution to tackling the climate crisis?
Would you like to learn in a interdisciplinary environment how research, teaching and action intertwine to
create sustainable change? Then this austrian wide lecture series is for you!
This lecture series will explore the role of higher education institutions in times of climate crisis and in light
of the resulting societal problems from a transdisciplinary perspective. What obligations does a university
have in supporting the transformation of society? What can higher education institutions do to help with
current societal problems?
In the summer semester 2024, UniNEtZ and the ÖH Bundesvertretung will present a unique lecture series
that will connect you and your university with universities from all over Austria via live stream. In six

captivating topic blocks, you will not only develop a sound understanding of the climate crisis, but also
reflect on how universities can fulfill their social responsibility. Take this opportunity not only to acquire
exciting content and knowledge, but also to exchange with students from a wide range of disciplines from
all over Austria.

Intended Learning Outcomes:
Students know about the status quo, problems and solutions for socio-ecological transformation. In addition,
students understand the challenges of different disciplines and can understand interrelationships.

Teaching and Learning Methods:
Lecture with active student interaction and discussion.

Media:

Reading List:
Optionenbericht UniNEtZ und Agenda 2030. https://www.uninetz.at/
Ist Großteils noch nicht vorhanden, hängt auch von den Vortragenden ab.

Responsible for Module:
BOKU Institut für Entwicklungsforschung Melcher Andreas, Radinger-Peer Verena, Schinegger Rafaela

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

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

Module Description

CS0128BOK: Authenticity of Foods | Authentizität von Lebensmitteln
[CS0128BOK]

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Oral
oral It is recommended to give a PowerPoint presentation (approx. 20 min) on a selected topic (see list above) related to the “Authenticity of Foods”. ATTENTION: Please send your PowerPoint presentation in due time!!

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
* Introduction; brief insight into the history of adulteration; definitions
* Legal aspects (international and national legal situation; scientific basis; culture and ethos)
* Analytical aspects (sampling; analyses; interpretation, evaluation and presentation of results etc.)
* Review of methodology (physico-chemical, chemical, microbiological, immunological and molecular biological techniques) and their applicability to distinct foods.
* Examples for the control of authenticity of foods (control of composition, authenticity, genuineness, purity, quality, identity, labelling, generic terms, origin, etc.). e.g.:
- Control of composition, nutritional value, ripening index, indication of type, origin and characteristics of foods (e.g. Basmati rice)
- Origin of food (regionality; AMA-Gütesiegel; BIO; SUS + BOS; "A" and "A+A")
- Traceability of foods (legal regulations)
- Designation of origin (e.g. Steir. Kürbiskernöl; Marchfelder Spargel; Wachauer Marille)

- differentiation of proteins and fats of different origin (e.g. cacao butter, olive oil)
- species differentiation of dairy and meat products
- differentiation of rennets (from animals, plants, microorganisms; recombinant rennets)
- identity control of microorganisms (e.g. probiotic lactic acid bacteria)
- Authenticity of wine; beer; fruit juice; aroma; tea, coffee
- Authenticity of honey or maple syrup
- detection of whey and milk protein in foods
- Authenticity of foods by stable isotope ratio mass spectrometry (IRMS)
- detection of gluten, irradiation, genetic modification, heating processes in foods etc.

Intended Learning Outcomes:
After having successfully completed this lecture, students will be familiar with the fundamentals of food authenticity and traceability, and are able to apply this knowledge in practice. They will learn about product-specific aspects of adulteration control, e.g. crucial criteria (physical, chemical, etc.) for the adulteration of foods as well as appropriate methodology for detection and control of potential adulterations in distinct foods. Students will have basic knowledge and competence in the area of food authenticity and traceability, and will be able to use these skills also in the analysis and evaluation of the authenticity of foods.

Teaching and Learning Methods:
Anmeldung zur Prüfung persönlich bei Prof. Mayer unter helmut.mayer@boku.ac.at

Media:

Reading List:
Recommended Reading
Ergänzungsunterlagen (Handouts) werden während der Vorlesung an die HörerInnen ausgegeben!

Responsible for Module:
BOKU Institut für Lebensmittelwissenschaften Mayer Helmut Karl

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

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

Module Description

CS0129BOK: Agricultural Journalism | Agrarpublizistik [CS0129BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Alternatively term paper or own media product Premature termination of the course results in a negative assessment.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
- gute Beherrschung der deutschen Sprache
- pflanzliche und tierische Produktion sowie Agrar- und Ernährungswirtschaft auf Bacherlorniveau

Content:
• basic skills of journalism (investigate, document, interview, formulate, edit, present)
• basic conditions of public relations (copyright and media right, fields of work, advanced training possibilities)
• media and their entelechy (newspapers, magazines, radio, television, internet, social media)
• (agrarian) media scene in Austria
• journalistic formats (news, report, feature, interview, survey; comment, squib, review)
• language (adequate phrasing, dependency of diction and sentence construction on target group)
• principles of design (lead story, headings, fotos, typography, layout)
• practical PR activities (press release, press conferences)

Intended Learning Outcomes:
Objectives:
• create basic knowledge of the tools for agrarian journalism and public relations
• gather first practical journalistic or PR experience
• training of verbal skills

Learning outcomes:
At the end of the course students are able to
• gather and process information appropriate for the respective medium,
• comply with relevant legal provisions,
• indepentently write contributions for print or online media,
• professionally apply media design principles.

Teaching and Learning Methods:
Didaktische Aufbereitung:
Vortrag, Übungsauftritte und Präsentationen, Kritik und Diskussion, Herstellung eines konkreten Medienproduktes

Media:

Reading List:

Responsible for Module:
BOKU Institut für Nachhaltige Wirtschaftsentwicklung Wytrzens Hans Karl

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

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

Module Description

CS0130BOK: Wood Materials Modification | Wood Materials Modification [CS0130BOK]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
written exam, written laboratory report

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Solid knowledge in wood physics, wood chemistry, and wood anatomy is required to follow this course.

Content:
The course provides an in-depth tretament of wood modification with special focus on thermal treatment, modification for wood preservation in archeological context, and chemical modification.

Intended Learning Outcomes:
The course will provide students with the ability to understand wood modification mechanisms and their effects on physical and biological wood properties.

Teaching and Learning Methods:
lecture with exercises

Lectures will be combined with experiments in laboratories. Additional self-study is required

Media:

Reading List:

Responsible for Module:
BOKU Institute of Wood Technology and Renewable Materials Grabner Michael, Hansmann Christian, Janesch Jan

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

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

Module Description

CS0131BOK: Biodiversity and Ecology of Selected Animal Groups | Biodiversität und Ökologie ausgewählter Tiergruppen [CS0131BOK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 60	**Contact Hours:** 60

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

Description of Examination Method:
Project planning, implementation and project presentation. Therefore, presence, participation as well as presentation are included in the assessment.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
None, except interest in ecology and zoological diversity.

Content:
In an introductory course, students learn to identify several selected animal groups (for this season: amphibians, snails, bugs and grasshoppers). After this introductory part students form small groups (2-4 students), each group specializing on one of the presented animal groups. In the following field part, the focus is on the comparison of near-natural habitats and those influenced by humans (comparison of the Vienna Lobau and the Danube Island). The students consider feasible survey methods for their animal group and specific questions. The students evaluate their surveys under expert supervision and present their results to the other students.

Intended Learning Outcomes:
Students are expected to acquire knowledge of the diversity of animal appearances and distribution in the Viennese area. They work out the principles of ecological concepts in the field of biodiversity, landscape use and species distribution.
Students will be able to identify species within the selected animal group, to survey diversity and to present the results in a scientific form.

These skills are the basis for projects in the field of natural conservation. Species knowledge is a prerequisite for assessing environmental impact. In general, the knowledge of the diversity of forms creates an increased readiness for ecological action or interest in the environment.

Teaching and Learning Methods:
On request/if interested, this course can also be held in English.

Media:

Reading List:

Responsible for Module:
BOKU Landler Lukas, Walcher Ronnie Institut für Zoologie

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

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

Module Description

CS0132BOK: International Agriculture | Internationale Landwirtschaft [CS0132BOK]

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Written and oral
Examination will be based on a country profile (environment, main crops, agricultrual trade, development potential) elaborated by each student. Alternatively an oral examination can be taken.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The lecture provides a fundamental understanding of the environmental and socioeconomic basis of international agriculture and related food production systems. The emphasis is on an understanding environment- crop-management interactions underlying adapted cropping systems in different parts of the world.

1st Unit:
Organizational planning
How to understand international agriculture?
=> Working with FAOStat.

2nd Unit:
World agro-environmental zones: Climate, soil and crop production.
=> Working with the Global Agro-ecological Zones Model (GAEZ).

3rd Unit:
Where to go? Economic strategies for world agriculture.
=> WTO and EU agricultural policies.

4th Unit:
Students' contributions: Snap shots of rural diversity.

5th Unit:
Agriculture, climate change and land degradation.

6th Unit
Guest lecture: Indonesia – Sustainable rice intensification.
Guest lecture: Soil health training in Mozambique – an example of research for development.

7th Unit:
Sustainable development goals. Visions and reality.

Intended Learning Outcomes:
Students will have a general overview on international food production systems, become familiar with economic and political strategies for international agriculture, work with online databases and get knowledge on current trends and challenges to sustainable rural management.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Neugschwandtner Reinhard Institut für Pflanzenbau

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

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

Module Description

CS0133BOK: Local Knowledge and Ethnobiology in Organic Farming - Introduction | Local Knowledge and Ethnobiology in Organic Farming - Introduction [CS0133BOK]

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Written
Quality of assignments in BOKUlearn (50%); Quality of mini research project (50%).
No final exam. Assignments to be completed in-between meetings and in BOKUlearn.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
English language skills on Master level.
This lecture is a preparation for the course Local knowledge and ethnobiology in organic farming – methods seminar (933.334), which focuses on the tools and methods that are needed to study local knowledge of organic farmers.

Content:
Organic farming was mainly developed by experiments and innovations of farmers and still today major developments in organic farming are advanced by organic farmers themselves. Such advances frequently stem from locally based knowledge, practice, beliefs, which is altogether called local knowledge.
This lecture introduces the concept of local knowledge, its characteristics, potential, value and its relevance for the sustainable management of natural resources, especially in organic farming. Practical examples will be presented from several ethnobiological subdisciplines such as ethnobotany, ethnomedicine, ethnopedology and ethnoclimatology.

Intended Learning Outcomes:
By completing this course, students will be able

• to explain the concept of local knowledge and the research areas that work with local knowledge;
• to explain the value and practical potential of local knowledge for organic farming;
• to apply an analytical framework for investigating local knowledge

Teaching and Learning Methods:
This course consists of five course units, five written assignments and one mini research project. The course units are composed of lectures, exercises and group discussions. Between course units, students complete assignments, including reflections on scientific papers, videos and talks and online investigations on specific topics, and submit written assignments. Students apply the analytical framework presented in the course to individual mini research projects, write a final report and present their findings in a poster presentation. The total expected workload for this course is 75 working hours (=3 ECTS).

Media:

Reading List:

Responsible for Module:
BOKU Vogl Christian R., Schwarzl Christina, Schunko Christoph Institut für Ökologischen Landbau (IFÖL)

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

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

Module Description

CS0134BOK: Research Reports of Waste Management | Forschungsberichte zur Abfallwirtschaft [CS0134BOK]

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
Written
To obtain a positive evaluation it is required to attend the course at least 4 times and to participate at the discussions at the end of each term.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Presentation and discussion of up-to-date and specific topics in waste management

Intended Learning Outcomes:
Objective: after completing this course participants are able to classify a specific topic and to discuss it on an expert level
The participants of this course get familiar with up-to-date and specific topics in waste management. After completion of this course, they are able to classify waste related topics and to critically discuss the contents of the speech in an expert level discussion.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Huber-Humer Marion, Allesch Astrid Institut für Abfall- und Kreislaufwirtschaft (ABF-BOKU)

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

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

Module Description

CS0149BOK: BOKU music | BOKU Musik

Version of module description: Gültig ab winterterm 2018/19

Module Level: Master	**Language:** German	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 4	**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:
To be able to play (at least) one musical instrument

Content:
Bohemian and Moravian music for brass instruments, traditional marches, optional:symphonic music for brass instruments

Intended Learning Outcomes:
Knowing the interpretation of trained pieces of music
Implementation of the process of interpretation to other pieces of music

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

CS0157BOK: Integrated Landscape Management and Nature Conservation | Integrale Landnutzung, Habitatmanagement & Naturschutz

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
presentation and active participation

Repeat Examination:

(Recommended) Prerequisites:

Content:
introduction to nature conservation issues, rational and motivation for the lecture, different historic aspects of landuse management fragmentation, habitat and game management, edge effect, importance of pasture for biodiversity, management of nationalparks (e.g. NP Neusiedler See, NP Donauauen), adaptive management of NP visitors natural reserves network in Austria, concept of near to nature silviculture, Natura 2000, coarse woody debris management, population viability analysis, hemeroby versus naturalness

Intended Learning Outcomes:
There is a need for professional knowledge about goals and definition of nature conservation, silvicultural treatment plans, requirements of deer populations or aspects for conservation of biodiversity in discussions with NGO's. Students should become aquanted with ecological aspects of several land use practices and habitat management methods to be familar with the basic principles of nature conservation strategies.

Teaching and Learning Methods:
active participation in lecture 45%

content of seminar work 35%
presentation of seminar work 20%

Media:

Reading List:

HAMPIKE, U. 1991: Naturschutz-Ökonomie. UTB 1650. Ulmer, Stuttgart.
JEDICKE, E., 1994: Biotopverbund. Grundlagen und Maßnahmen einer neuen Naturschutzstrategie. 2. Aufl. Ulmer, Stuttgart.
KAULE, G, 1986: Arten- und Biotopschutz. UTB, Große Reihe, Ulmer, Stuttgart.
KIMMINS, H. 1992: Balancing Act: Environmental Issues in Forestry. UBC Press - University of British Columbia, Vancouver.
LEIBUNDGUT, H., 1990: Waldbau als Naturschutz. Haupt, Bern u. Stuttgart.
LEOPOLD, A. , 1992: Am Anfang war die Erde. Plädoyer für Umwelt-Ethik. Knesebeck, München.
MAYER, H. ZUKRIGL, K., SCHREMPF, W., SCHLAGER, G., 1987: Urwaldreste, Naturwaldreservate und schützenswerte Naturwälder in Österreich. Eigenverlag Institut für Waldbau, BOKU.
NOSS, R. F. & COOPERRIDER, A. Y. (1994): Saving Nature´s Legacy. Protecting and Restoring Biodiversity. Island Press. Washington, D.C., Covelo, California.
PLACHTER, H., 1991: Naturschutz. UTB für Wissenschaft: Uni-Taschenbücher; 1563. G. Fischer, Stuttgart.
SCHERZINGER, W. 1996: Naturschutz im Wald : Qualitätsziele einer dynamischen Waldentwicklung. Ulmer, Stuttgart.
SZARO, R. Z. & JOHNSTON, D. W., 1996 (Edit.): Biodiversity in Managed Landscapes. Theory and Practice. Oxford Univesity Press. New York, Oxford.

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

CS0189BOK: Post-harvest Technology | Post-harvest Technology

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** English	**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
Due to the corona situation, the exam takes place as an online exam. The mark results from the evaluation of the written exam. The mark of the lecture will be derived from the reached percentage of the points as followed. 90 – 100 % = 1 78 – 89 % = 2 66 – 77 % = 3 55 – 65 % = 4 0 – 54 % = 5 (failed) Duration of the written examination = 60min. The examiner reserves the right to make oral inquiries about the subject of the examination within the four-week assessment period. For the written exam you can bring calculator, ruler, and the formulary supplied on the bokulearn plattform.The use of any other tools and documents during the online exam is not permitted - this also applies to files on your computer! Please only do the online test using a PC! A working web-camera and a working microphone are required to participate!

Repeat Examination:

(Recommended) Prerequisites:

Content:
Importance of post-harvest technology for the food chain

Biological and physical principles of post harvest technology

Selected post harvest technologies in agriculture:

Treatment of seed (drying, cleaning, sieving,?)

Alternative methods of seed treatments (warm-humid, microwave, high frequency energy)

Drying technology (principles and application; Ddying of agricultural products)

Crop conservation with silage making (principles and processes)

Storage of crops (potato, fruit, vegetable,?); Principles and applications

Special post-harvest technologies in horticulture and viticulture

Intended Learning Outcomes:
Understanding of biological and physical properties of harvested crops and their comprehension

Qualification for systematic analyses of post harvest technology

Qualification for planning of post harvest technology

Evaluation of post-harvest technologies on engineering fundamentals as well as ecological and economic aspects.

Teaching and Learning Methods:
interactive lecture

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

CS0231BOK: Biology of Aging | Biology of Aging

Version of module description: Gültig ab summerterm 2021

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

CS0233BOK: BOKU: Intercultural Competence | BOKU: Intercultural Competence

Version of module description: Gültig ab summerterm 2021

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Totpyi**		

guarantee the success of the course the lecturers reserve the right to choose a group of mixed nationalities.)

First of all you will become familiar with the major concepts of intercultural competence and global learning. This theoretical input will then be immediately put into practice by using the participants' different backgrounds and different experiences of communication styles, behaviours and other cultural practices. Increasing your awareness of your own culture and cultural sensitivity in general will be the first focus (keywords: culture, identity, self-image, stereotypes) followed by your perception of cultural differences (cultural dimensions, values, behaviour, cultural standards). How can you shift perspectives? How can you prevent intercultural conflicts and communicate effectively? How can you deal with culture shocks and have a successful re-entry after your stay abroad? You will learn to re-evaluate and reflect on your own communication styles and behaviours and find the right way to describe your intercultural skills.

Intended Learning Outcomes:
- be aware of and understand how culture affects their and other people's behaviour
- be able to reflect, analyse and interpret cultural differences (cultural dimensions, values, behaviour, standards) and intercultural phenomena
- be able to re-evaluate and reflect their own communication styles and behaviours
- be able to apply strategies to acting in a successful and responsible manner in an international context
- be able to describe their intercultural competence and to integrate it into their future personal and professional life

Teaching and Learning Methods:

The class is designed to be highly interactive. The first sessions will give a general overview, mainly with a focus on discussions, reflection exercises and in-class simulations. In BOKUlearn you will become familiar with theoretical models of intercultural competence and you will link the theoretical input to the personal attitudes and experiences of the participants. In an intercultural group project, you will then apply your newly developed skills and competences. Finally you will reflect on your experiences in a report.

Media:

Reading List:

Responsible for Module:
Liebl, Agnes; Piringer, Ulrike

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

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

Module Description

CS0234BOK: Organic Chemistry | Organische Chemie

Version of module description: Gültig ab summerterm 2021

Module Level: Master	**Language:**	**Duration:**	**Frequency:**
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:

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

CS0236BOK: Chemistry of Biomaterials; LE | Biomaterialchemie; VO

Version of module description: Gültig ab summerterm 2021

Module Level: Master	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

CS105BOK: Public Relations - Fundamental Rules and Conception | Grundregeln und Konzeption der Öffentlichkeitsarbeit

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
a) Presenting a PR-example; necessary for attending the exam; detailed information will be given in the first lesson b) test c) participation / activity

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The public relations concept - terms and definitions, fundamental rules of modern public relations, target groups, conception of public relations, tools of public relations (PR-measurements), crisis-PR, internal PR

Intended Learning Outcomes:
Learning how to create strategic public relations concepts

Teaching and Learning Methods:
lecture with exercises

case studies
problem based learning

Media:

Reading List:

Responsible for Module:
BOKU - Institut für Wald-, Umwelt- und Ressourcenpolitik

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

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

Module Description

WZ9178BOK: Medicinal and Aromatic Plants | Medicinal and Aromatic Plants

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
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:
oral
Verbal examination

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
After informing on definitions, main cultivation areas and economic aspects the specific tasks of medicinal and aromatic plants (MAP) production will be discussed. Special regard will be paid to quality and quality management including the respective factors: genetics and breeding, morpho- and ontogenetic as well as environmental variability, influences by cultivation practices, harvest and post harvest technology. Guidelines for Good Agricultural Practice in MAP production and domestication of wild plants are further focal points. The most important species will be discussed in detail.

Intended Learning Outcomes:
MAPs (medicinal and aromatic plants) are typical specialist minor crops with increasing importance. The aim of the subject is to import knowledge on the diversity of this group of useful plants including their secondary products and their significance as renewable natural resources. Furthermore the frame conditions of MAP production should get known as also the most important species and their specific requirements.

Teaching and Learning Methods:
Examination dates based on personal arrangements.
The topic of the essay will be mutually agreed. The content of the essay will be verbally discussed.

Media:

Reading List:

Responsible for Module:

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

Vorlesung (3 ECTS)
Medicinal and aromatic plants (in Eng.); (LV-Nr. 951316)
2 SWS
Johannes Novak
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9422BOK: Technology Manure Utilisation | Technik der Biomasse und Wirtschaftsdüngernutzung

Version of module description: Gültig ab winterterm 2018/19

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
Assessment criteria:
active participation in the course (active participation in discussions, exercises, excursion)
Assessment: written examination

Repeat Examination:

(Recommended) Prerequisites:

Content:
1 Ecological fundamentals 1.1 Environmentally relevant elements and compounds 1.2 Circulation of substances 1.3 Nutrient and pollutant balances 2 Legal regulations, environmental protection measures 3 Biogenic emissions from agriculture (odours, NH_3, CH_4, N_2O) 3.1 Mechanism of formation, sources, mitigation strategies 3.2 Guidelines on assessment of ambient air from animal husbandry 4 Agricultural manures 4.1 Farmyard manure 4.1.1 Methods of farmyard manure removal 4.1.2 Methods of farmyard manure storage 4.1.3 Methods of farmyard manure treatment 4.1.4 Methods of farmyard manure spreading 4.2 Liquid manure 4.2.1 Liquid manure properties 4.2.2 Methods of liquid manure removal 4.2.3 Methods of liquid manure storage 4.2.4 Methods of liquid manure treatment 4.2.4.1 Mixing and pumping 4.2.4.2 Aeration 4.2.4.3 Separation 4.2.4.4 Liquid manure additives 4.2.5 Methods of liquid manure spreading 4.2.5.1 Tankers and spreading equipment 5. Energy production from biomass 5.1 Biogas production 5.1.1 Potential (manures, organic wastes, energy plants) 5.1.2 Anaerobical, biochemical degradation 5.1.3 Types of biogas plants 5.1.4 Energy efficiency of biogas plants 5.1.5 Energy conversion, electricity and heat from biomass (FC, HPC, MGT) 5.2 Solid fuels 5.2.1 Harvesting and conditioning 5.2.2 Firing systems 5.3 Fuels 5.3.1 Vegetable oils 5.3.2 Ethyl alcohol

Intended Learning Outcomes:
To know areas of problems and conflicts in protection of environment and climate in agriculture, to point out causes of and solutions to problems and conflicts. To know and evaluate the broad range of methods of manure storage, treatment and spreading. To develop methods of manure management with low nutrient losses, high nutrient efficiency and low environmental impact. To apply guidelines on assessment of emissions from animal husbandry. To describe methods of energy production from energy plants and biomass (biogas production, solid fuels, fuels).

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

WZ9423BOK: Energy Economics | Energiewirtschaft

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
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:
Written

Repeat Examination:

(Recommended) Prerequisites:

Content:
Overview about the energy ecenomy. General points of view for the treatment of problems of energy economics. General introduction in circle processes for the production of electric energy, power plants for production of heat and electric energy, combustion of fossil and renewable fuels, technology of combustion and vessels, emissions by combustion.

Energy use in industry. Efficient energy conversion and utilization. Optimization of heating and cooling processes. Problems of optimisation in the energy economy. Calculation of costs in the energy-technology. Energy controlling in industry and trade.

Intended Learning Outcomes:
Basic knowledge about facts and contexts in the energy economy should be arranged. Furthermore an introduction is given in methods, that are absolutely necessary to the judgment of processes of energy economy. In the course some procedures are expounded to estimate the economic conditions of processes in energy technology.

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

WZ9427BOK: BOKU: Chemicals from Biomass | BOKU: Chemikalien aus Biomasse

Version of module description: Gültig ab 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:
W H

Module Description

WZ9428BOK: Technology of Wood Processing | Technologien der Holzverarbeitung

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 1	**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
oral examination

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Characterization of the raw material Wood (grading etc.) and principles of converting the raw material wood into a material and wood-base products. Principles of slicing, sawing, milling, chipping etc. drying and glueing.

Intended Learning Outcomes:
Understanding of the relationship of wood as a raw material and the wood-based materials and products along the process chain wood and the approbiate technologies. Knowlegde of the most common wood based materials, their properties and potential applications incl. relevant Standards.

Teaching and Learning Methods:
Vorlesung interaktiv mit Studierenden

Media:

Reading List:
Wagenführ, A., Scholz, F., Taschenbuch der Holztechnik. Fachbuchverlag Leipzig, Leipzig 2005
Fellner, J., Teischinger, A., Zschokke, W.: Holzsprektrum. proHolz Austria, Wien 2007

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (1 ECTS)
Technologien der Holzverarbeitung (LV-Nr. 891330)
1 SWS
Alfred Teischinger

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

Module Description

WZ9435BOK: Resource and Environmental Economics | Resource and Environmental Economics

Version of module description: Gültig ab winterterm 2017/18

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

WZ9452BOK: Spanish III (A2) | Spanisch III (A2)

Version of module description: Gültig ab winterterm 2017/18

Module Level:	Language:	Duration:	Frequency:
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:

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

WZ9453BOK: English | Englisch

Version of module description: Gültig ab winterterm 2017/18

Module Level:	**Language:**	**Duration:**	**Frequency:**
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:

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

WZ9455BOK: Biorefinery and Products from Renewable Resources | Bioraffinerie und Produkte aus nachwachsenden Rohstoffen

Version of module description: Gültig ab 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

Content:
Biorefinery is a concept towards processing biomass to a variety of products. These products may range from materials, base and fine chemicals, to energy such as gasoline, electrical power or heat. In this lecture the broad range of utilizations of renewable resources are demonstrated, also to introduce main focul points of the german-taught master study "Material and energetic use of renewable resources (NAWARO)" (H 066 471).

Intended Learning Outcomes:
Knowledge on major renewable ressources, including oils, fats, proteins, and carbohydrates. Knowledge on major areas taught in the master study "Material and energetic use of renewable resources (NAWARO)" (H 066 471). Be able to report on different material and energetic uses derived from renewable resources. Ability to give definitions and delineations around "renewable resources".

Teaching and Learning Methods:
class lecture
Introductory lectures by persons who are also engaged with the "Material and energetic use of renewable resources" (NAWARO)" study

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Bioraffinerie und Produkte aus nachwachsenden Rohstoffen (LV-Nr. 970308)
1 SWS
Rupert Wimmer, Alexander Bauer, Sabine Baumgartner, Stefan Böhmdorfer, Andreas Gronauer, Georg Gübitz, Miriam Lettner, Markus Neureiter, Christoph Pfeifer, Tobias Pröll

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

Module Description

WZ9464BOK: Experimental Design | Statistische Versuchsplanung

Version of module description: Gültig ab winterterm 2017/18

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

WZ9470BOK: BOKU: Research Design | BOKU: Research Design

Version of module description: Gültig ab winterterm 2017/18

Module Level:	Language:	Duration:	Frequency:
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:

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

WZ9481BOK: Global Change Ecology | Globaler Wandel und Ökosysteme

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
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:
written

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Overcoming the impact of global, anthropological global changes on organisms and ecosystem will be among our the greatest challenge in the future. In this lecture stuents will learn the theoretical background of the mode of action of selected global changes as greenhouse effect (atmospheric CO2 concentrations, warming, extreme weather events), ozone hole vs. surface ozone and interactions between these factors. Following, methodological approaches for studying global change effects will be discussed. Then, a state-of-the art of global change ecology in terrestrial ecosystems and their feedback mechanisms will be given. At the end, a critical discussion with students about the presentation of this topic in media will be organised.

Intended Learning Outcomes:
1. Getting to know the most important, anthropogenic global changes.
2. Understanding the mechanisms how organisms and ecosystems respond to global change factors.
3. Knowing experimental and methodological approaches to study past and prospected global changes.
4. Explore key research findings on global change effects on organisms and ecosystems.
5. Critical discussion of scientific and pseudo-scientific publications on this topic.

Teaching and Learning Methods:
multimedia-supported

Media:

Reading List:
will be announced in class

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (3 ECTS)
Globaler Wandel und Ökosysteme
2 SWS
Johann Zaller

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

Module Description

WZ9482BOK: Seminar in Global Change and Ecosystems | Seminar in Global Change and Ecosystems

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**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:
Evaluation of student presentation of a scientific publication.
Evaluation of content and form of presentation; details will be announced in course.
For a successful approbation, max. 2 missing dates will be tolerated.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
This seminar complements and extends the lecture VO 833.318 Global Change and Ecosystems. In the focus will be the following anthropogenic, global changes and their effects on organisms and ecosystem: greenhouse effect (atmospheric CO2 concentrations, warming, extreme weather events), ozone hole vs. surface ozone, increasing nitrogen deposition, land use change, decline in biodiversity, light pollution, noise pollution, plastic pollution, genetically modified organisms, pesticide use. In this seminar topics from the lecture will be complemented and deepened by student presentations. Great emphasis will be given on a critical discussion of the relevant scientific literature.

Intended Learning Outcomes:
1. Learn how to utilize relevant scientific data bases.
2. Critical discussion of scientific literature and knowledge.
3. Improvement of presentation skills.

Teaching and Learning Methods:
Presentation of scientific articles

Media:

Reading List:
wird bekanntgegeben

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar (2 ECTS)
Seminar in global change and ecosystems (in Eng.) (LV-Nr. 833319)
1
Johann Zaller
For further information in this module, please click campus.tum.de or here.

Module Description

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

Version of module description: Gültig ab 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.

Module Description

WZ9488BOK: Chemistry and Technology of Polymers | Polymerchemie und Technologie

Version of module description: Gültig ab winterterm 2017/18

Module Level:	**Language:** German/English	**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 and oral
Oral exam which requires in some cases a written explanation of chemical facts, such as by drawing simple chemical structures or reaction equations. If more than 50% of all questions can be answered correcly without help, the exam will be passed with a positive mark. Correct answers that required substantial support of the examiner will contribute at the extent of 50% only to the amount of correct answers required to pass the exam.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
This lecture addresses students of the master courses „Wood technology and management" and "Material and Energetic Exploitation of Renewable Raw Materials".
With regard to the material exploitation of wood or isolated biopolymers – either direct, as composites with synthetic organic polymers or after preceding homogeneous or heterogeneous modification – a secure grasp of the basics in polymer chemistry and technology is imperative for both of these courses.
Accompanied by a permanent repetition of the basics of organic chemistry and guided by a motivating interactive demonstration of practice-orientated interrelations as a key towards pleasure in chemical aspects of our daily life, this lecture imparts at the beginning on overview of the history of polymer research, the current state of plastics production and the most relevant synthetic inorganic and organic polymers, and biopolymers. After that the following topics will be introduced and discussed:

General structure, terminology and classification of polymers
Main types of polymerisation reactions – Part 1: Step-growth polymerisation
Polycondensation
Silicic acid and polysiloxanes
Polyaddition (e.g., epoxy resins, polyurethanes)
Main types of polymerisation reactions – Part 2: Chain growth polymerisation
Radical polymerisation
Ionic polymerisations
Coordination polymerisation
Ring opening polymerisations
Nomenclature of polymers
Processing and shaping of polymers
Polymer morphology
Design of polymers with regard to high-temperature stability, resistance towards chemicals, and fire resistance
Ageing of polymers (by chemical, thermal, and photolytic processes, X-ray or electron irradiation)
Stabilization of polymers (primary and secondary antioxidants, UV stabilizers)
Polymer recycling

Intended Learning Outcomes:
This lecture imparts ready-to-use knowledge in the areas of organic chemistry, permanently repeated throughout the entire lecture which always makes the connections between the basic principles of organic chemistry and the synthesis of complex polymers. This lecture furthermore imparts the participant solid knowledge of the impact of the macromolecular architecture of main technical polymers on their properties and the interrelation between structure and nomenclature of polymeric compounds. The participants get in-depth knowledge about current trends of polymer application, types and properties of mass and special plastics, basic principles of the synthesis and processing of technically important thermoplastic and thermo-set plastics, as well as basic knowledge of the application-oriented design of synthetic polymers on the molecular level.
Topics, such as oxidative or light-induced ageing of plastics, stabilization of plastics towards ageing through addition of additives or recycling of plastics will be discussed in a similar way.
The participants of this lecture will be furthermore qualified to recognize independently important interrelationships between structure and nomenclature of polymers, and between structure and properties of polymers.

Teaching and Learning Methods:
Interactive lecture

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Polymerchemie und Technologie (LV-Nr. 774327)
2 SWS
Falk Liebner

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

Module Description

WZ9497BOK: Engineered Wood Products | Engineered Wood Products

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** German/English	**Duration:** two semesters	**Frequency:** winter/summer 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 and oral
oral exam

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
no

Content:
Material engineering
Material properties of wood composite components
Beam elements (GLT, LVL, LSL, PSL, I-Joist)
Structural plate elements (OSB, Flakeboard, Plywood)
Non-structural plate elements (Particleboard, MDF, Hardboards)
Wood composite materials

Intended Learning Outcomes:
Students have basic knowledge of the properties of materials used for wood composites
Students know to manipulate or engineer the properties of engineered materials
Students have an overview of existing engineered wood products and their properties, the origin of these properties as well as their main application fields.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Vorlesung (2 ECTS)
Engineered wood products (in Eng.); (LV-Nr.891334)
2 SWS
Johannes Konnerth

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

Module Description

WZ9513BOK: Energy Engineering | Energy Engineering

Version of module description: Gültig ab winterterm 2017/18

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

WZ9516BOK: Renewable Energy Resources | Renewable Energy Resources

Version of module description: Gültig ab winterterm 2017/18

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

WZ9523BOK: Seminar on Energy Economics | Energiewirtschaftliches Seminar

Version of module description: Gültig ab winterterm 2017/18

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

WZ9524BOK: Market Research and Market Analysis | Marktforschung und Marktanalyse

Version of module description: Gültig ab summerterm 2017

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

WZ9526BOK: Logistics in forestry and timber industry | Logistik in der Forst- und Holzwirtschaft

Version of module description: Gültig ab winterterm 2017/18

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.

Master's Thesis | Master's Thesis

Module Description

WZ1001: Master's Thesis | Master's Thesis

Version of module description: Gültig ab summerterm 2013

Module Level:	Language:	Duration:	Frequency:
Credits:* 28	**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.

Obligations | Auflagen

Requirement Proof of Proficiency in German | Nachweis Deutschkenntnisse

Module Description

SZ0304: German as a Foreign Language A2.2 | Deutsch als Fremdsprache A2.2

Version of module description: Gültig ab summerterm 2022

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:
In den Prüfungsleistungen werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Die Prüfungsleistungen werden in Form von kompetenz- und handlungsorientierten (Portfolio-) Prüfungsaufgaben erbracht. Hilfsmittel sind erlaubt.
Die Prüfungsleistungen sind in ihrer Gesamtheit so konzipiert, dass die Anwendung von Wortschatz und Grammatik, das Lese- und/oder Hörverstehen sowie die freie Textproduktion geprüft werden.
Mündliche Kommunikationsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft und/oder in Form einer Audio-/Videodatei. Hierzu beachten wir die Datenschutzgrundverordnung (DSGVO, Art. 12 -21).

Repeat Examination:

(Recommended) Prerequisites:
gesicherte Kenntnisse der Stufe A2.1; Einstufungstest mit Ergebnis A2.2

Content:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in einfachen, routinemäßigen Situationen zurechtzufinden, z.B. auf Reisen, beim Arzt, auf Wohnungssuche, im Kaufhaus, unter Kollegen, Freunden und Nachbarn.

Sie wiederholen und ergänzen grundlegendes Vokabular /Ausdrucksmöglichkeiten zu Themen wie Ausbildung, Beruf, Wohnen, Freizeit und Mobilität. Sie lernen/üben ein erweitertes Spektrum an Haupt- und Nebensätzen (z.B. indirekte Frage, temporaler Nebensatz) sowie den Konjunktiv II zu benutzen und sie wiederholen bzw. erweitern den Gebrauch der Präpositionen.
Es werden Möglichkeiten aufgezeigt, den Lernprozess eigenverantwortlich effektiver zu gestalten und damit die eigene Lernfähigkeit zu verbessern. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Intended Learning Outcomes:
Das Modul orientiert sich am Niveau A2 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage im Gespräch einfache Sätze und Redewendungen zu einem erweiterten Spektrum an vertrauten Themen zu verstehen und zu gebrauchen. Dabei handelt es sich um grundlegende Informationen zu alltäglichen, oder studien- bzw. berufsrelevanten Themen unter Einbeziehung landeskundlicher Aspekte.
Sie können beispielsweise sich und andere Personen, die persönliche Wohnsituation, Gesundheitszustand, Freizeitverhalten und berufliche Situation im Präsens oder Perfekt beschreiben. Sie können Vorschläge machen und reagieren, Informationen austauschen und Ratschläge geben.
Die Studierenden können längere Texte und Briefe zu vertrauten Themen verstehen, in denen gängige aber einfache alltags- oder berufsbezogene Sprache verwendet wird und in denen vorhersehbare Informationen zu finden sind. Sie sind in der Lage kurze, informative Texte oder Mitteilungen zu grundlegenden Situationen in Alltag und Studium zu verfassen.

Teaching and L

Dechant S, Detcheva-Knippelmeyer I, Hanke C, Hartkopf D, Knirsch M, Kovacs O, Kummer-Rock A, Schneider S, Steidten R, Thiessen E, Zendath I
For further information in this module, please click campus.tum.de or here.

Module Description

SZ0321: German as a Foreign Language A1.1 plus A1.2 | Deutsch als Fremdsprache A1.1 plus A1.2

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 8	**Total Hours:** 270	**Self-study Hours:** 180	**Contact Hours:** 90

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

Description of Examination Method:
In den Prüfungsleistungen werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Die Prüfungsleistungen werden in Form von kompetenz- und handlungsorientierten (Portfolio-) Prüfungsaufgaben erbracht.
Hilfsmittel sind erlaubt.
Die Prüfungsleistungen sind in ihrer Gesamtheit so konzipiert, dass die Anwendung von Wortschatz und Grammatik, das Lese- und/oder Hörverstehen sowie die freie Textproduktion geprüft werden.
Mündliche Kommunikationsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft und/oder in Form einer Audio-/Videodatei. Hierzu beachten wir die Datenschutzgrundverordnung (DSGVO, Art. 12 -21).

Repeat Examination:

(Recommended) Prerequisites:
keine

Content:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich trotz geringer Sprachkenntnisse z.B. beim Einkaufen, im Restaurant, im öffentlichen Verkehr etc. zurechtzufinden.

Sie lernen/üben grundlegendes Vokabular zu Themen wie Familie, Beruf, Freizeit, Einkaufen, Wohnen, Reisen und Gesundheit, einfache Gespräche in alltäglichen Situationen zu führen und in Hauptsätzen Alltägliches im Präsens und Perfekt zu berichten, unter Verwendung von Nomen,

Verben, Pronomen und Possessivartikeln, Modalverben, Imperativ und grundlegender lokaler und temporaler Präpositionen.
Es werden Möglichkeiten aufgezeigt, den Lernprozess in der Fremdsprache eigenverantwortlich und effektiv zu gestalten. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Intended Learning Outcomes:
Das Modul orientiert sich am Niveau A1 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage alltägliche Ausdrücke und einfache Sätze zu verwenden, die auf die Befriedigung konkreter, in der Bewältigung des Alltags wesentlicher Bedürfnisse zielen:
Sie können einfache Fragen in alltäglichen Situationen stellen und beantworten, Tagesabläufe in Vergangenheit und Gegenwart beschreiben und einfache schriftliche Mitteilungen zur Person machen, Verabredungen treffen und in grundlegenden alltäglichen Situationen beispielsweise beim Einkauf oder im Restaurant ihre Wünsche erfolgreich kommunizieren, wenn die Gesprächspartner langsam und deutlich sprechen und bereit sind zu helfen.

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 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, auch online

Reading List:
Lehrbuch: wird im Kurs bekannt gegeben

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

SZ0337: German as a Foreign Language A1.1 | Deutsch als Fremdsprache A1.1

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor/Master	**Language:** Language taught	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 4	**Total Hours:** 135	**Self-study Hours:** 90	**Contact Hours:** 45

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

Description of Examination Method:
Performance, testing the learning outcomes specified in the module description, is examined by a cumulative portfolio of competence and action-oriented tasks. Aids are permitted.
The examination performances are designed in their entirety to test the use of vocabulary and grammar, reading and/or listening comprehension, and free text production.
Oral communication skills will be tested via the use of appropriate idioms in written dialogue examples and/or in the form of an audio/video file. For this purpose, we observe the Basic Data Protection Regulation (DSGVO, Art. 12 -21).

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
This module teaches basic knowledge of German as a Foreign Language, taking into account intercultural and cultural aspects of the country, which will enable students to find their way around despite their limited knowledge of the language, e.g. when shopping, in restaurants, on public transport, etc.
They will learn/practice basic vocabulary on topics such as family, work, leisure and food, ask and answer simple personal/family questions, understand and use numbers, prices and times and report everyday activities in simple structured main sentences in the present tense, using verbs, nouns, personal pronouns, possessive articles and negation forms.
Students practice teamwork skills by collaborating on tasks in multinational groups.

Intended Learning Outcomes:
The module is oriented towards level A1 of the CEFR. After completing this module, students will be able to use everyday expressions and very simple sentences aimed at meeting specific needs of everyday life: They can introduce themselves and others and ask other people questions about themselves and give answers to questions of this kind. They can describe daily routines in basic structures and give basic information about themselves in writing. They can communicate their needs if interlocutors speak clearly and slowly and are supportive. Students learn how to organize their own learning process of the foreign language independently and effectively.

Teaching and Learning Methods:
The module consists of a seminar in which students study the learning content with targeted listening, reading, writing and speaking exercises. The communicative and action-oriented approach is implemented by combining these exercises in individual, partner and group exercises. Online material for controlled self-study of basic grammatical phenomena and communication patterns is provided to deepen and intensify the content taught during the course. Voluntary homework (for preparation and revision) consolidates what has been learned.

Media:
Textbook, multimedia-supported teaching and learning material, also online

Reading List:
Textbook: will be announced in the course

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Deutsch als Fremdsprache A1.1 (Seminar, 3 SWS)
Bakker S, Burmasova S, Endraß E, Grgic T, Hanke C, Huber D, Keza I, Koch H, Kraut-Schindlbeck S, Lechle K, Pinskaia I, Pletschacher T, Schmidt-Bender S, Selent D, von Caprivi Caprara de Montecucculi A, von Egloffstein A, Witzig B

Deutsch als Fremdsprache A1.1 - EuroTeq Programm (Seminar, 3 SWS)
Lechle K

Blockkurs Deutsch als Fremdsprache A1.1 (Seminar, 3 SWS)
Schlüter J, von Egloffstein A, Zerfass A
For further information in this module, please click campus.tum.de or here.

Module Description

SZ0338: German as a Foreign Language A1.2 | Deutsch als Fremdsprache A1.2

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 4	**Total Hours:** 135	**Self-study Hours:** 90	**Contact Hours:** 45

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

Description of Examination Method:
In den Prüfungsleistungen werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Die Prüfungsleistungen werden in Form von kompetenz- und handlungsorientierten (Portfolio-) Prüfungsaufgaben erbracht.
Hilfsmittel sind erlaubt.
Die Prüfungsleistungen sind in ihrer Gesamtheit so konzipiert, dass die Anwendung von Wortschatz und Grammatik, das Lese- und/oder Hörverstehen sowie die freie Textproduktion geprüft werden.
Mündliche Kommunikationsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft und/oder in Form einer Audio-/Videodatei. Hierzu beachten wir die Datenschutzgrundverordnung (DSGVO, Art. 12 -21).

Repeat Examination:

(Recommended) Prerequisites:
gesicherte Kenntnisse der Stufe A1.1; Einstufungstest mit Ergebnis A1.2

Content:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich trotz geringer Sprachkenntnisse z.B. beim Einkaufen, im Restaurant, im öffentlichen Verkehr etc. zurechtzufinden.
Sie lernen/üben grundlegendes Vokabular zu Themen wie Familie, Studium und Beruf, Freizeit, Wohnen, Gesundheit, Einkaufen und Reisen zu benutzen und in einfach strukturierten Hauptsätzen Alltägliches im Präsens und Perfekt zu berichten, unter Verwendung von

Modalverben, trennbaren Verben, Imperativ und grundlegender lokaler und temporaler Präpositionen.
Es werden Möglichkeiten aufgezeigt, den Lernprozess in der Fremdsprache eigenverantwortlich und effektiv zu gestalten. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Intended Learning Outcomes:
Das Modul orientiert sich am Niveau A1 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage alltägliche Ausdrücke und einfache Sätze zu verwenden, die auf die Befriedigung konkreter, in der Bewältigung des Alltags wesentlicher Bedürfnisse zielen:
Sie können einfache Fragen in alltäglichen Situationen stellen und beantworten, Tagesabläufe in Vergangenheit und Gegenwart beschreiben und einfache schriftliche Mitteilungen zur Person machen, Verabredungen treffen und in grundlegenden alltäglichen Situationen beispielsweise beim Einkauf oder im Restaurant ihre Wünsche erfolgreich kommunizieren, wenn die Gesprächspartner langsam und deutlich sprechen und bereit sind zu helfen.

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 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, auch online

Reading List:
Lehrbuch: wird im Kurs bekannt gegeben

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Deutsch als Fremdsprache A1.2 (Seminar, 3 SWS)
Comparato G, Grgic T, Jennert J, Keza I, Khvintelani N, Pinskaia I, Reulein C, Schimmack B, von Egloffstein A

Blockkurs Deutsch als Fremdsprache A1.2 (Seminar, 3 SWS)
Kretschmann A, Menck-Zwick C, Meuschel G
For further information in this module, please click campus.tum.de or here.

Module Description

SZ0348: German as a Foreign Language A1.1: Dive into the grammar and apply it in practice | Deutsch als Fremdsprache A1.1: Dive into the grammar and apply it in practice

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/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 den Prüfungsleistungen werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Die Prüfungsleistungen werden in Form von kompetenz- und handlungsorientierten (Portfolio-) Prüfungsaufgaben erbracht. Hilfsmittel sind erlaubt.
Die Prüfungsleistungen sind in ihrer Gesamtheit so konzipiert, dass die Anwendung von Wortschatz und Grammatik, das Lese- und/oder Hörverstehen sowie die freie Textproduktion geprüft werden.
Mündliche Kommunikationsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft und/oder in Form einer Audio-/Videodatei. Hierzu beachten wir die Datenschutzgrundverordnung (DSGVO, Art. 12 -21).

Repeat Examination:

(Recommended) Prerequisites:
keine

Content:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache vermittelt, die es den Studierenden ermöglichen, sich trotz geringer Sprachkenntnisse in alltäglichen Situationen zurechtzufinden.
Sie lernen grundlegende Strukturen der Wortbildung und des Satzbaus (Verben, Personalpronomen, Nomen, Präpositionen und Satzstrukturen), die es ermöglichen, Fragen und Antworten zu verstehen und zu formulieren und in einfach strukturierten Sätzen Informationen über sich und andere zu geben.

Es werden Möglichkeiten aufgezeigt grundlegendes Vokabular zu Themen wie Familie, Beruf, Freizeit und Essen eigenverantwortlich zu lernen sowie Zahlen, Preise und Uhrzeiten zu verstehen und zu benutzen. Auf der Basis der erworbenen Kenntnisse werden kommunikative Fertigkeiten in alltagstypischen Situationen angewendet.
Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Intended Learning Outcomes:
Das Modul orientiert sich am Niveau A1 (GER). Nach Abschluss dieses Moduls sind die Studierenden in der Lage, Strukturen der Wortbildung und des Satzbaus zu verstehen und anzuwenden.
Sie können sich und andere vorstellen und anderen Leuten Fragen zu ihrer Person stellen und auf Fragen dieser Art Antwort geben, in einfacher Weise Tagesabläufe beschreiben und einfache schriftliche Mitteilungen zur Person machen. Sie können ihre Wünsche kommunizieren, wenn die Gesprächspartner deutlich und langsam sprechen und bereit sind zu helfen.

Teaching and Learning Methods:
Die LV besteht zum Teil aus Seminaren, zum Teil aus Tutorien. In den Seminaren werden Grammatik und Strukturen präsentiert und von den Studierenden in der Regel schriftlich angewendet. In den Tutorien werden erlernte Strukturen und Vokabular interaktiv eingeübt und in alltagstypischen Situationen angewendet und so die kommunikativen Fertigkeiten entwickelt. Materialien zur Anwendung der erlernten Inhalte werden auf Moodle bereitgestellt. Empfohlene Inhalte des begleitenden Lehrmaterials werden von den Studierenden im Selbststudium erlernt und vertieft. Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte.

Media:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial, auch online

Reading List:
Lehrbuch: wird im Kurs bekannt gegeben

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

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

Version of module description: Gültig ab 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.

Alphabetical Index

A

B

C

D

E

F

G

H

I

L

M

N

O

P

R

S

T

U

W