TUM Campus Straubing for Biotechnology and Sustainability (TUMCS)
Technische Universität München

Module Catalog

B.Sc. Bioeconomy

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 147

Required Modules | Required Modules

Required Modules: Fundamentals | Required Modules: Fundamentals

Module Description

CS0213: Environmental Resources in a Changing World | Environmental Resources in a Changing World

Resource availability, dependency and sustainable usage

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor	**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 the relevance of environmental resources, their limited availability, and approaches for a sustainable usage of resources in form of a written examination (90 minutes). Students deliver definitions, describe and outline relevant processes for selected environmental resources regarding their formation, utilization, supply, and sustainable use.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Knowledge and/or interest in Geology and Physics are valuable.

Content:
The course focuses on the different areas of life in which environmental resources play a critical role, such as drinking and irrigation water supply, energy provision, strategic mineral use, or sand as a building material. Thereby, an introduction to relevant expert knowledge such as formation, deposition, and utilization of relevant resources will be made. After understanding the formation of resources, their availability under current and future use in a changing environment can be assessed with special consideration of current and future demand on the resource production/ provision.

Intended Learning Outcomes:
After successful completion of the module, students understand the ecological and economic value of different environmental resources, the dependency on these resources, and the pressure upon these resources through a changing world, such as climate and societal changes. Students comprehend the assessment of consequences of unsustainable resource use.

Students prepare short, practice-oriented tasks individually or 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 shared with the other participants accordingly with a focus on the successful summary, presentation, and discussion of results.

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

Media:
Lecture, Power Point presentation, blackboard, case examples, topics prepared by participants, and round-table discussions.

Reading List:
H. Hettiarachchi & R. Ardakanian (eds.), 2016: Environmental Resource Management and the Nexus Approach. Managing Water, Soil, and Waste in the Context of Global Change. Springer, Cham.

Dassargues, A. (2018): Hydrogeology: Groundwater Science and Engineering, CRC Press, 1st edition.

Grotzinger, T. & Jordan, T. (2014): Understanding Earth. W.H. Freeman & Company, 7th edition

Responsible for Module:
Prof. Thomas Vienken

Courses (Type of course, Weekly hours per semester), Instructor:
Environmental Resources in a Changing World (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

CS0063: Microeconomics | Microeconomics [Micro I]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 the exam (written, 120 minutes) students should demonstrate their ability to adequately interpret the microeconomic concepts and apply the methods worked on in class. By means of multiple-choice-questions, which are either embedded in a context/case/scenario or require prior computation, students' capacity to apply the learned solution strategies to new settings and draw correct economic implications is assessed. A non-programmable calculator is allowed.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
This course provides an introduction to basic concepts of microeconomics. To understand how a transition towards a more sustainable economy is possible we first have to understand the basic mechanisms in the economy. To this end, this lecture investigates the behavior of individual economic units, such as households, business firms, and public institutions. Another concern is how these units interact to form markets and industries. How can consumer decisions be explained and how can aggregate demand be derived from consumer choice? Which are the factors that determine the production decisions of companies? How do equilibrium prices emerge in competitive markets, how in monopoly markets? What is the effect of government interventions in markets (e.g. green taxes, price controls)? How does market power affect social welfare? Which factors lead to market failure?

Intended Learning Outcomes:
After attending this module, students will be able to describe economic tradeoffs (particularly in choice under scarcity situations of consumers and firms). Moreover, they know strategies to

solve those tradeoffs and are capable of applying them to new situations. Students are able to explain the fundamental economic mechanisms underlying specialisation and trade (particularly in view of technological progress). Students can predict how government interventions (e.g. carbon taxes, price controls) will affect simple competitive markets. They are able to explain why certain industries are prone to market concentration and how market power affects social welfare. They can distinguish which types of goods are efficiently provided on free markets and which not.

Teaching and Learning Methods:
An interactive lecture introduces essential microeconomic concepts and theories and illustrates them with the help of topical empirical examples. Classroom experiments complement the classic bird-eye's perspective by nudging students to put themselves in the positition of particular economic players, thereby requiring them to actively reflect the concepts introduced. Online surveys at the end of each chapter enable students to select which topics they would like to intensify in subsequent classes. In the accompaying exercise class, students practice, on specific problems and examples, the mathematical techniques needed to develop a deeper understanding of the economic concepts. In self-study students use the textbook to repeat the concepts introduced in class and apply them to additional examples.

Media:
Textbook, slides, exercise sheets, classroom experiments, online surveys

Reading List:
Robert S. Pindyck and David L. Rubinfeld, Microeconomics, 8th Edition, Pearson, 2013 (ISBN 13: 978-0-13-285712-3). AND Robert S. Pindyck und David L. Rubinfeld, Mikroökonomie, 8. Aufl., Pearson Studium, 2013 (ISBN-13: 978-3868941678).

Responsible for Module:
Prof. Sebastian Goerg

Courses (Type of course, Weekly hours per semester), Instructor:
Economics I am Campus Straubing (Microeconomics) (Vorlesung, 2 SWS)
Goerg S [L], Goerg S

Economics I - Übung am Campus Straubing (Übung, 2 SWS)
Goerg S [L], Speckner M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0028: Physics | Physics [Phys]

Version of module description: Gültig ab winterterm 2024/25

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

Repeat Examination:
End of Semester

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

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

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

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

Media:
Writing on the board, presentations, slide scripts

Reading List:
Paul P. Urone, Roger Hinrichs: College Physics, OpenStax, Houston, 2022 (https://openstax.org/details/books/College-Physics)

U. Harten: Physik, Einführung für Ingenieure und Naturwissenschaftler (Physics, Introduction for Engineers and Scientists), 4th edition 2009, Springer

Responsible for Module:
Prof. Josef Kainz

Courses (Type of course, Weekly hours per semester), Instructor:
Physics (Lecture) (Vorlesung, 2 SWS)
Kainz J [L], Kainz J

Physics (Exercise) (Übung, 2 SWS)
Kainz J [L], Kainz J, Sun J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0194: Mathematics | Mathematics

Version of module description: Gültig ab winterterm 2023/24

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

Repeat Examination:
End of Semester

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

Content:
Selected mathematical methods required for calculations in the scientific, engineering, and economic areas, as well as areas of sustainability, including analysis (e.g. mathematical induction, differential and integral calculus, sequences and series), calculations with real and complex numbers as well as selected chapters of linear algebra (e.g. linear equation systems, matrices, inverse matrices, determinant, eigenvalues and eigenvectors). The methods are introduced in the lecture. In the exercises, their application is practiced on concrete case studies, including examples with relevance to sustainability.

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

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

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

Reading List:
Calculus and Linear Algebra in Recipes. Christian Karpfinger, Springer-Verlag 2022

Responsible for Module:
Prof. Dominik Grimm

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

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

Required Modules: Scientific Foundations | Required Modules: Scientific Foundations

Module Description

CS0199: Statistics | Statistics

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
Learning outcomes are verified in a written exam. The exam consists of assignments in which the students are to demonstrate that they understand the statistical methods conveyed as part of the module and are able to apply them to specific examples. Exam duration: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Qualification for university entrance; good mathematical knowledge is an advantage.

Content:
Selected statistical methods required in natural sciences, engineering, or economics, especially from the fields of descriptive statistics (e.g., graphical representation of uni- and bivariate data, measures of location and spread, measures of association for bivariate data, descriptive linear regression), probability calculus, and statistical inference (e.g., confidence intervals, hypothesis tests). The methods are presented during the lecture and are applied to specific examples related to sustainability in the exercise classes.

Intended Learning Outcomes:
The students know the most important statistical methods required in natural sciences, engineering, or economics. They have understood these methods, are able to select and perform suitable statistical procedures for specific case studies, and can draw correct conclusions from the results. Furthermore, the students should be aware of the capabilities and limitations of the

presented statistical methods and are able to perform simple statistical analyses using statistical software (e.g., R).

Teaching and Learning Methods:
Lecture using digital presentation and/or blackboard to convey contents and methods. In addition, concrete examples are discussed in the exercise classes through independent work or group work.

Media:
Slides, blackboard, exercise sheets, e-learning

Reading List:
Diez, Cetinkaya-Rundel, Barr: OpenIntro Statistics, 4th edition, https://www.openintro.org/book/os/ (2019).
Fahrmeir, Heumann, Künstler, Pigeot, Tutz: Statistik - Der Weg zur Datenanalyse, 8. Auflage, Springer Spektrum (2016).
Field, Miles, Field: Discovering Statistics Using R, SAGE Publications (2012)
Caputo, Fahrmeir, Künstler, Lang, Pigeot, Tutz: Arbeitsbuch Statistik, 5. Auflage, Springer Verlag (2009).

Responsible for Module:
Prof. Clemens Thielen

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

Statistics (Exercise) (Übung, 2 SWS)
Thielen C [L], Thielen C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0001: Foundations of Programming | Foundations of Programming [FoP]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
Exam achievement shall be done in the form of a 90 minutes written test (either written or e-test). Knowledge questions check the treated basic concepts of programming and algorithms. Small programming and modeling tasks test the ability to apply the learned programming language in order to solve simple problems.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
In the module following contents are treated exemplarily:
Python as a programming language:
- Basic concepts of imperative programming (if, while, for, lists, dictionaries etc.)
- File handling (reading, processing, writing etc.)
- Object-oriented programming (inheritance, interfaces, polymorphism etc.)

Basic algorithms and data structures:
- Recursion
- Search (e.g., binary search, balanced search trees)
- Sorting (e.g., Insertion-sort, selection-sort, quick-sort)

In the lectures and exercises, practical problems on real-world issues and topics related to sustainability are addressed, computer science-based solutions are developed and discussed.

Intended Learning Outcomes:
Upon successful completion of this module, students will be able to understand important fundamental concepts of programming, algorithms, and data structures. They will be able to apply the concepts learned to develop their own code and basic algorithms for scientific data analysis.

Teaching and Learning Methods:
Lectures to provide students with all the necessary programming and algorithmic fundamentals needed to independently develop their own analysis scripts and pipelines for scientific data analysis. In the labs, students will work on various programming tasks and write their own code to analyze specific case studies and real-world data.

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

Reading List:
Learning Scientific Programming with Python, Christian Hill
Data Structures & Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser

Responsible for Module:
Prof. Dr. Dominik Grimm

Courses (Type of course, Weekly hours per semester), Instructor:
Foundations of Programming (Exercise) (Übung, 2 SWS)
Grimm D [L], Eiglsperger J, Martello S

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

Module Description

CS0202: Empirical Research Methods | Empirical Research Methods

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
Grading is based on a 100% multipe-choice exam (120 minutes) with about 50-60 questions at the end of the lecture. The questions will be of different character and allow students to show that they have understood basic concepts of empirical research and that they can analyze and evaluate research design and research outputs on their empirical and conceptual accuracy

Extra credit (Mid term assignment)
Accompanying this class, you will be able to participate in two types of work to earn extra credit toward your grade. This means that completing this work is not mandatory, and full marks can be achieved without participating. The first assignment is a teamwork task and focuses on the comprehension of a chosen empricial paper on either a problem form the management or policy literature. Each student has to write a short summary (1-2 pages). The second assignment is an individual task and is about the systematic creation and processing of a data set. The workload for this task is on average about 4-6 hours. Both extra assignments help to improve class performance and can improve the final grade. Participating successfully in these assignments may improve the final grade by 0,3.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Mathematics, Statistics

Content:
This course aims to enable students to understand empirical research. The course explains how research works and how to identify sources that meet a certain level of academic rigor to be trustworthy. This is important as only trustworthy information should become a source of learning and a foundation of managerial or political decision making.

To reach this goal the course will cover the following topics:
• Research ethics
• Research question and their implications
• Paper reading, positioning, and contributions
• Correlation and causality
• Choosing a research design
• Qualitative research
• Quantitative analysys & quantitative research design
• Using existing scales and data
• Data preparation and descriptive statistics
• Advanced quants

Intended Learning Outcomes:
This module will give you an introduction to empirical research methods, including the higher aims of empirical research, the standards it needs to meet, and a set of methods that you can directly apply. By the end of the module, you will thus be able to understand the scientific proces. They will be able to evaluate whether a result or statement is robust and indeed trustworthy. In doing so, not only will they be able to more critically evaluate everyday information, but they will also be prepared to participate in the scientific process. Students improving their ability to read and understand academic work. This modile prepares for future research seminars or the final thesis.

Knowledge Objectives
After the module students will be able to:
• understand the nature of the scientific process
• explore different approaches toward solving (scientific) problems
• use and apply selected empirical research methods (e.g., for seminar of final theses)
• understand the structure and evaluate the quality of academic papers
• (in parts) create their own research projects

Skills Objectives
• improve diagnostic and analytical skills
• think creatively about how best to solve complex problems
• build up critical thinking as well as judgment and interpretation skills
• learn how to evaluate different strategic options
• work together efficiently and effectively in groups

Learning Objectives
At the end of this module, students will be able to demonstrate understanding, critical assessment and application of the following:
• assess (pseudo-)scientific work
• understand and evaluate potential approaches toward answering academic questions
• utilize tools and techniques of empirical research for their own future studies

Teaching and Learning Methods:
The module consists of lectures and excersises. The lecture is based on slides and blackboard utilizing additional interactive elements. In the exersice, which takes place in the computer pool, students work on their own with data and learn how to utilize different software packages. Students will be very involved in the excersises and deepen their understand of the topics covered in the lectures.

Media:
Powerpoint, Board, Videos, Flipchart, Debates

Reading List:
For each session, practice-sheets will be provided. These sheets will also contain information on reading materials that elaborate on what we cover in class. We recommend the following textbooks (on which we will also draw to some degree for the lecture):
• Singleton, R. A., Straits, B. C., & Straits M. M.1993 (or newer). Approaches to Social Research (≥2nd ed.). Oxford University Press. (Abbreviated “ASR” in preparation sheets)
• In German: Backhaus, K., Erichson, B., Plinke, W., & Weiber, R. 2010 (or newer). Multivariate Analyse¬methoden: Eine anwendungsorientierte Einführung (≥13th ed.). Berlin: Springer.
• Salkind, N.J. 2008 (or newer)). Statistics for people who think they hate statistics (≥ 3rd ed.). Thousand Oaks, CA: Sage.
• Hair, J. F., Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. 2005 (or newer. Multivariate data analysis (≥6th ed.). Upper Saddle River, NJ: Prentice Hall.

Responsible for Module:
Prof. Sebastian Goerg

Courses (Type of course, Weekly hours per semester), Instructor:
Empirical Research Methods (Vorlesung mit integrierten Übungen, 4 SWS)
Goerg S [L], Sakakibara A, Cantner F, Goerg S
For further information in this module, please click campus.tum.de or here.

Required Modules: Engineering and Natural Science | Required Modules: Engineering and Natural Science

Module Description

CS0289: Fundamentals of Thermodynamics | Fundamentals of Thermodynamics

Version of module description: Gültig ab winterterm 2024/25

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Mathematics

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

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

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

Media:
Presentations, slide scripts, exercises

Reading List:
1. Thermodynamics: Basic Principles and Engineering Applications
Whitman, Alan M.
2nd ed. 2023

2. Fundamentals of Technical Thermodynamics: Textbook for Engineering Students
Dehli, Martin ; Doering, Ernst ; Schedwill, Herbert
1st ed. 2023
2023

Responsible for Module:
Prof. Jakob Burger

Courses (Type of course, Weekly hours per semester), Instructor:
Fundamentals of Thermodynamics (Lecture) (Vorlesung, 2 SWS)
Burger J [L], Burger J, Elfaitory H

Fundamentals of Thermodynamics (Exercise) (Übung, 2 SWS)
Burger J [L], Burger J, Elfaitory H, Rosen N, Staudt J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0052: Organic Chemistry | Organic Chemistry [OrgChem]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 performance test will be in the form of a written examination rendered. The students should demonstrate in the exam the understanding of the structure of organic chemical compounds and their typical reactions and chemical conversions. It will also be tested the ability to formulate reaction equations, as well as to transfer the acquired knowledge about the structure and reaction behavior of organic chemical substance groups to new chemical questions. No auxiliary means are allowed in the exam. 90 min examination time

Repeat Examination:
End of Semester

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

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

Intended Learning Outcomes:
The students will know and understand the basic principles of organic chemical reactions and will be able to formulate correct organic reactions. Moreover, they will be able to apply the knowledge acquired with model reactions about chemical transformations of organic chemical substances and substance groups to answer new chemical questions.The successful participation in the module will also enable the students to participate in the practical course and the module advanced organic chemistry.

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

Media:
Blackboard, presentation (using script), exercises

Reading List:
P. Vollhardt, N. Schore, Organic Chemistry, macmillan learning, 2022, ISBN:9781319392857
K.P.C. Vollhardt, N.E. Schore, Organische Chemie, Verlag VCH Weinheim

Responsible for Module:
Prof. Nicolas Plumeré Dr. Alaa Alsheikh Oughli

Courses (Type of course, Weekly hours per semester), Instructor:
Organic Chemistry (Exercise) (Übung, 2 SWS)
Plumeré N [L], Alsheikh Oughli A, Filmon D, Plumeré N, Seveur P

Organic Chemistry (Lecture) (Vorlesung, 2 SWS)
Plumeré N [L], Alsheikh Oughli A, Plumeré N, Vöpel T
For further information in this module, please click campus.tum.de or here.

Module Description

CS0242: Foundations of Biology | Foundations of Biology [FBio]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 a written test in which the students are to call up and remember important principles of biology without using additives. In addition, the students prove that they are able to recognize and solve a problem in a certain time by answering the comprehension questions on covered biological processes. Answering questions requires also the use of own formulations thereby the correct recall of important technical terms is additionally reviewed. Exam duration: 90 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Chemical building blocks of life; Basics of cell biology (cell structure, differences between pro- and eukaryotic organisms, theoretical basics of microscopy); genetic information flow and fundamentals of genetics (e.g. structure of DNA, replication, transcription, translation, Mendelian genetics); basic metabolic processes; evolution and systematics of organisms; introduction to plant sciences; introduction to microorganisms and their use in industrial biotechnology; introduction to molecular biotechnology and genetic engineering; concepts of ecology and sustainability

Intended Learning Outcomes:
After having participated in the module the students possess basic knowledge about the structure and function of biomolecules. They know important elements of pro- and eukaryotic cells, can differentiate between these life forms and grade microorganisms and plants to higher-ranking systematic groups. They know the concepts of the genetic flow of information and have a basic knowledge of the most important techniques in molecular biology. After completion of the module

the participants know fundamental metabolic pathways and have a basic understanding of microbial and plant physiology. Furthermore, the students can reflect biological terms, define processes and are able to use their knowledge to solve problems.

Teaching and Learning Methods:
The teaching contents are imparted by a talk of the lecturer, supported by PowerPoint and blackboard sketches. To a limited extent small exercises are integrated.

Media:
Power point, blackboard

Reading List:
"Campbell Biologie" by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece, Pearson, 11th edition (2019)

Responsible for Module:
Erich Glawischnig

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

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

Module Description

CS0290: Production of Biogenic Resources | Production of biogenic Resources

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
Exam achievement shall be done in the form of a test. In this test it shall be proved that students are capable of describing important requirement for the required biogenic resources and are capable to devlop important rules for the production of the raw materials in a limited time. On the basis of different examples (e.g. algae productions) and scenarios the students shall discuss pros and cons and the possibilities for the transformation of the different biomass to products.
Type of exam: In writing
Exam duration: 90 min.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The module aims at providing in-depth knowledge to the students in the prodution and cultivation of renewable raw materials. Beside the areal-bound production by agriculture and forest, production processes such as Algae bioreactors where integrated. Differences, advantages and disadvantages and possible perspectives are discussed.
Essential crop characteristics shall be discussed for the treated crops and if required differences shall be addressed by various product use (energy and/or industrial crops). As to crops important performance parameters (yields etc.) shall be debated and integration into a concrete cultivation system (farm) be discussed. For this purpose pros and cons shall be worked out and possible actions shall be discussed for optimizing cultivation. For selected topics current main points of research shall be presented and results discussed.

Intended Learning Outcomes:
After having participated in the module units the students know the most important biogenic ressources for renewable raw materials.
- They are capable of describing important requirement for the required biogenic resources and are capable to devlop important rules for the production of the raw materials
- For the desired raw materials, the required starting materials or biomass can be described (e.g. in the form of agricultural crops (example starch production: cereals, maize)). Based on the agricultural and wood procution of raw materials students can characterize the cropping system and cultivation methods
- They are able to describe possible effects on the environment for selected main crops (cereals, corn, oil crops)
- The students know selected research activities in the field of renewable raw materials and are able to analyse their results concerning their relevance and significance

Teaching and Learning Methods:
The module shall primarily be held as a lecture. For different courses it will be completed by individual and group projects. Demonstration of research activities and presentation of the cultivation by practitioners is partly performed by external guests (lecture, presentation). Further reading and questions for follow-up will be made available for different teaching units in moodle.

Media:
Lecture, presentations, (individual and group projects)

Reading List:
Lütke- 2006: Lehrbuch des Pflanzenbaus, Band 2: Kulturpflanzen, Verlag Th. Mann Gelsenkirchen.
Diepenbrock, Ellmauer, Leon, 2009 : Ackerbau, Pflanzenbau und Pflanzenzüchtung. Ulmer Verlag.
Pflanzenbau, Ein Lehrbuch - Biologische Grundlagen und Technik der Pflanzenproduktion,
Gerhard Geisler, Paul Parey Verlag: Parasitäre Krankheiten und Schädlinge an landwirtschaftlichen Kulturpflanzen, Ulmer Verlag, G.-M. Hoffmann und H. Schmutterer
Diepenbrock 2014: Nachwachsende Rohstoffe, Ulmer UTB, Stuttgart
Kaltschmitt etal. 2009: Energie aus Biomasse, Springer, Heidelberg

Responsible for Module:
Alexander Höldrich

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

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

Module Description

CS0086: Wood-based Resources | Wood-based Resources

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor/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:
Exam achievement shall be done in the form of a test. Product pathways of forestry and forest industry shall be reflected here. Classification of economic and ecological aspects of forestry and forest industry from cultivation to material and energetic use shall be explained by using examples of particular cases. Recognition of wood and wood materials shall be shown. The relation of knowledge of forestry and forest industry with regard to knowledge of different woods and wood utilisation will be evaluated at a ratio of 1 to 1. The answers require own formulations from the respective technical jargon of forestry and forest industry.
Type of exam: In writing. Exam duration: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The module aims at providing in-depth knowledge to the students in the field of forestry and forest industry from harvest to the use of wood. Special emphasis is given to the interfaces concerning wood use (sawing, wood materials and paper industry) and energy wood production. In a further aspect differences of woods shall be addressed from a microscopic point of view through to their field of application in the manufacturing industry. Therefore, students learn to classify woods microscopically and macroscopically.

Intended Learning Outcomes:
After attending the module the student shall be able to characterise the product pathways in forestry from crop establishment through to material and energetic use of wood. He distinguishes different forms of economy and is able to classify them according to economic, social and

ecological aspects. He recognises differences of woods, knows various new products produced from wood and understands their production paths and their markets.

Teaching and Learning Methods:
The course attendance of forestry and wood consists of a lecture and exercises. For this purpose powerpoint presentations amd practical training material shall be used. A study trip to wood processing plants including lectures from qualified personnel providing information
from experience on site with common rounds of questions provides in-depth knowledge of the production paths. A socalled wood block determination, i. e. the determination of wood by means of different genuine wood samples, will be performed by a magnifying glass 10x.

Media:
The following forms of media apply: Script, powerpoint, films, for determination exercises also branches and leaves of shrubs to be determined. Study trip to companies with guided tour of processing and treatment of wood. Determination of wood with a magnifying glass 10x.

Reading List:
D. Fengel and G. Wegener: Wood. Publisher: De Gruyter, https://doi.org/10.1515/9783110839654
Jörg van der Heide, 2011: Der Forstwirt. (The Forester) Publisher: Ulmer (Eugen); Auflage: 5th edition. (September
26, 2011)
Language: German
ISBN-10: 3800155702
ISBN-13: 978-3800155705; D. Fengel, G. Wegener: Wood Verlag Kessel, www.forstbuch.de

Responsible for Module:
Prof. Cordt Zollfrank / Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Wood-based Resources (Exercise) (Übung, 2 SWS)
Zollfrank C [L], Röder H, Zollfrank C

Wood-based Resources (Lecture) (Vorlesung, 2 SWS)
Zollfrank C [L], Röder H, Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0066: Introduction to Process Engineering | Introduction to Process Engineering

Version of module description: Gültig ab winterterm 2024/25

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Mathematics

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

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

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

Media:
Presentations, slide scripts, exercises

Reading List:
1. Basic Principles and Calculations in Chemical Engineering, 8th Edition, (David M. Himmelblau, James B. Riggs), Prentice-Hall Inc., New Jersey, 2012.
2. Introduction to Chemical Engineering: Tools for Today and Tomorrow, 5th Edition, (Kenneth A. Solen, John N. Harb), Wiley & Sons Inc., New Jersey, 2010.
3. Elementary Principles of Chemical Processes, 3rd Edition, (Richard M. Felder, Ronald W. Rousseau), Wiley & Sons Inc., New Jersey, 2004.
4. Perry's Chemical Engineers' Handbook, 9th Edition, (Don Green, Marylee Z. Southard), McGraw-Hill Education Ltd., New York, 2018.
5. Chemical Reaction Engineering, 3rd Edition, (Octave Levenspiel), Wiley India Pvt. Ltd., New Delhi, 2017.
6. Thermal Separation Technology: Principles, Methods, Process Design, 1st Edition, (Alfons Mersmann, Matthias Kind, Johann Stichlmair), Springer-Verlag Berlin Heidelberg GmbH, Berlin, 2011.

Responsible for Module:
Prof. Jakob Burger

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Process Engineering (Lecture) (Vorlesung, 3 SWS)
Burger J [L], Burger J, Ibanez M, Staudt J

Introduction to Process Engineering (Exercise) (Übung, 1 SWS)
Burger J [L], Burger J, Ibanez M, Staudt J, Wolf A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0172: Green Chemistry | Green Chemistry [GreenChem]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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:
Students gain knowledge of industrial processes and the principles of Green Chemistry. After passing the exam, students are able to identify essential principles of Green Chemistry in examples of industrial processes. They are able to make simple suggestions on how existing processes could be changed so that they would comply with the principles of Green Chemistry. The written exam has a duration of 90 minutes. Aids are not permitted.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics of chemistry, physics and biology

Content:
The module contains an introduction to the basics of environment-friendly 'green' synthesis routes for chemical products. The 12 basic principles of 'green engineering' will be covered. Sustainably production and treatment, process optimizations and innovative technological approaches and optimized separation methods will be discussed. The different processes will be presented with respect to relevant environment aspects, sustainability and energy- as well as raw materials consumption.

Intended Learning Outcomes:
After completion of the module, the students are able to describe the basic principles of environment-friendly and sustainable production of chemicals and demonstrate them at the examples of selected process chains. They can determine and present specific resource requirements with respect to energy, raw- and auxiliary materials as well as the yields during production, emissions into air, water and soil, as well as amounts of wastewater and solid waste.

They are alse able to couple syntheses to preceding and subsequent processing steps. Thus, they can assess the sustainabilities of production processes autonomously.

Teaching and Learning Methods:
Lecture with blackboard and slide presentations for the development of technical concepts. Seminar with written tests. Self-study is essential to consolidate the course contents.

Media:
Lecture, blackboard, slides, group work

Reading List:
Jiménez-González, Constable, Green Chemistry and Engineering, Wiley-VCH, 2010

Responsible for Module:
Prof. Herbert Riepl

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

Required Modules: Economics | Required Modules: Economics

Module Description

CS0067: Macroeconomics | Macroeconomics [Macro I]

Version of module description: Gültig ab winterterm 2021/22

Module Level: Bachelor	**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 exam will be a written test (120 min.) at the end of the term. The exam is designed to assess the participants' capabilities to apply macroeconomic theory in order to discuss and solve real world problems of the economy as a whole. Participants should demonstrate their capacity for abstraction (thinking in economic models), concretization (calculating, interpreting and applying the results of the model, mathematical processing as well as graphical illustration.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
This module provides an introduction to basic concepts of macroeconomics. It covers:
- key institutions of capitalism as an economic system (private property, firms, markets)
- technological change as a trigger for economic growth
- price-taking and competitive markets
- price-setting, rent-seeking and market disequilibuium
- market successes and failures
- markets, contracts and information
- credit, banks and money
- economic fluctuations and unemployment
- unemployment, inflation, fiscal and monetary policy
- technological progress and living standards
- the Great Depression, the golden age of capitalism and the global financial crisis

Intended Learning Outcomes:
After attending the module, students will able to describe the composition and distribution of the Gross Domestic Product. They can analyze the economic mechanisms underlying unemployment as well as issues regarding monetary policy and inflation. Further, participants will learn to understand the economic crisis and the wealth differences among nations. Students are enabled to think in models and apply mathematical solutions when approaching economic problems.

Teaching and Learning Methods:
The module consists of a lecture and an exercise course. The lecture content will be delivered in a verbal presentation with the help of slides. Since the foundation of the lecture is a textbook including recent economic history, the teaching is full of real life examples. The content of the lecture is put into practice in the exercise course which applies the theoretical knowledge by basic mathematical calculations and graphical illustrations. Therefore, the module aims at encouraging participants to independently think about economic problems discussed in the lecture and in the current literature. Students are enabled to use the instruments (abstract and model thinking) for operationalizing economic problems and solve them in the conventional, mathematical manner.

This module is also offered at TUM Campus Straubing.

Media:
http://www.core-econ.org/

Reading List:
The CORE Project (2016): 'The Economy', in: Azm Premji University, Friends Provident Foundation, HM Treasury, Institute for New Economic Thinking, Open Society Foundations, SciencesPo, UCL (eds.), University College London.

Responsible for Module:
Prof. Andreas Pondorfer

Courses (Type of course, Weekly hours per semester), Instructor:
Übung zur Vorlesung Volkswirtschaftslehre II / Macroeconomics (WI000023 / CS0067) am Campus Straubing (Übung, 2 SWS)
Hoch G

Volkswirtschaftslehre II / Macroeconomics (WI000023 / CS0067) am Campus Straubing (Vorlesung, 2 SWS)
Pondorfer A [L], Pondorfer A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0068: Intermediate Microeconomics | Intermediate Microeconomics [Micro II]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 the exam (written, 120 minutes) students should demonstrate their ability to adequately interpret advanced microeconomic concepts and apply the methods worked on in class. By means of multiple-choice-questions, which are either embedded in a context/case/scenario or require prior computation, students' capacity to apply the learned solution strategies to new settings and draw correct economic implications is assessed. They show their ability to assess and evaluate decisions under uncertainty and asymmetric information as well as strategic interaction of decision makers. Hereby, students demonstrate their capacity for abstraction (thinking in economic models) and concretization (interpreting and applying the results of the model). A non-programmable calculator is allowed.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Microeconomics

Content:
The module imparts advanced concepts and methods of microeconomics, focussing on choice under uncertainty and strategic interaction. It examines markets under asymmetric information and imperfect competition.

Covered topics include Expected Utility Theory, Adverse Selection, Moral Hazard, Game Theory, and Strategic Interaction in Oligopolistic Markets.

These topics will be linked to current issues of climate policy and sustainability.

Intended Learning Outcomes:
After attending this module participants will be able to describe and evaluate decisions under uncertainty and/or asymmetric information. They will be capable of analyzing the functioning of competitive markets and assessing market failure arising from asymmetric information. They understand incentives and can solve problems of incentive compatibility. They know the fundamentals of game theory and are capable of analyzing strategic interaction like social dilemmas and coordination problems. Based on economic theory students can provide policy advice und evaluate concrete policy measures.

Teaching and Learning Methods:
An interactive lecture introduces advanced microeconomic concepts and theories and illustrates them with the help of topical empirical examples. Classroom experiments complement the classic bird-eye's perspective by nudging students to put themselves in the positition of particular economic players, thereby requiring them to actively reflect the concepts introduced. Online surveys at the end of each chapter enable students to select which topics they would like to intensify in subsequent classes. In the accompaying exercise class, students practice, on specific problems and examples, the mathematical techniques needed to develop a deeper understanding of the economic concepts. In self-study students use the textbook to repeat the concepts introduced in class and apply them to additional examples.

Media:
Text books, script, exercises, online polls, videos

Reading List:
- Gravelle, Hugh und Ray Rees (2004): Microeconomics, Pearson
- Jehle, Geoffrey und Philip Reny (2011): Advanced Microeconomic Theory, Pearson
- Kreps, David (1990): A Course in Microeconomic Theory, Princeton University Press
- Osborne, Martin (2004): An Introduction to Game Theory, Oxford University Press
- Shy, Oz (1996): Industrial Organization: Theory and Applications, MIT Press

Responsible for Module:
Prof. Sebastian Goerg

Courses (Type of course, Weekly hours per semester), Instructor:
Intermediate Microeconomics (Exercise) (Vorlesung, 2 SWS)
Goerg S [L], Sakakibara A

Intermediate Microeconomics (Lecture) (Vorlesung, 2 SWS)
Goerg S [L], Sakakibara A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0206: Introduction to Environmental and Resource Economics | Introduction to Environmental and Resource Economics

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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 evaluation and resource economics using national and international examples. Type of examination: written, no additional tools allowed, duration of examination: 60 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Microeconomics,Empirical Research Methods

Content:
Environmental and natural resource economics is a rapidly growing and changing field because many environmental issues are of global importance. This course teaches the theoretical concepts and empirical methods for evaluating environmental assets and ecosystem services (Total Economic Value) as well as the integration of the collected monetary values into a cost-benefit analysis for an investment decision in environmental projects, including discounting of costs and benefits.

Intended Learning Outcomes:
After attending the module, the student has an understanding of how to evaluate existing and future environmental assets and naturally occurring resources in theory and practice. Students have an awareness of the way in which ecosystem services (total economic value) can be valued monetarily if they are not traded in the market (use versus non-use values). The students then learn how such values can be used in cost-benefit analyzes of environmental projects in order to make investment decisions. By conducting a survey of the total economic value of an ecosystem

based on a given example, the students gain knowledge of where difficulties can arise in the practical implementation of the monetary valuation of environmental assets ecosystem services.

Teaching and Learning Methods:
The lecture and tutorial take place using Powerpoint. In addition, current examples of environmental assessment, articles from newspapers and scientific journals are integrated into the lectures. Using the references presented, students discuss concepts and derive hypotheses individually and/or in groups from different perspectives from the literature. In the tutorial, students are instructed to design, carry out and analyze a survey to determine the overall value of an ecosystem.

Media:
Presentations, slide scripts, scientific 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:
Prof. Anja Faße

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Environmental and Resource Economics (Vorlesung, 2 SWS)
Faße A [L], Faße A

Introduction to Environmental and Resource Economics (Tutorial) (Übung, 2 SWS)
Richter S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0072: Policy and Innovation | Policy and Innovation

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 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 basic principles of policy and innovation. They will answer questions about the concepts explaining the strategies and options that policymakers and firms have in order to promote the usage of renewable resources. They will also answer questions about policy effects on the innovation activities of different actors and evaluate the implications for technology development and diffusion.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Entrepreneurship, Introduction to Innovation Management

Content:
The module introduces students into basic principles of the topic of policy and innovation from a global and international perspective. Students will be equiped with basic knowledge on:
- definitions about policy and innovation
- assessment of politcal incentives, especially related to climate change and renewable resources
- relation to sustainability, networks, ecosystems and social innovation.

Beyond that, students will engage in break-out group workshops to personally experience the process of developing business models in the context of climate change / renewable resources. 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 policy effects on the innovation activities of different actors and evaluate the implications for technology development and diffusion
- identify and evaluate business opportunities and design business concepts/plans in the context of renewable resources / climate change
- understand institutional and technological barriers that affect large-scale system transformations and be able to develop scenarios for policy and firms to meet environmental and societal goals

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:
Fagerberg, J.; Mowery, D.C.; Nelson, R.R. (eds.), 2005: The Oxford Handbook of Innovation. Oxford University Press, Oxford.

Responsible for Module:
Claudia Doblinger claudia.doblinger@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Policy and Innovation (Lecture) (Vorlesung, 2 SWS)
Doblinger C [L], Doblinger C

Policy and Innovation (Exercise) (Übung, 2 SWS)
Krinner S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0291: Governance of the Bioeconomy | Governance of the Bioeconomy

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor	**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 will be given in the form of a written examination. The students should be able to name the different actors, measures and potential target conflicts and trade offs based on examples from the lecture and discuss them by means of examples. Type of examination: written, no additional tools allowed, duration of examination: 60 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The bioeconomy requires a structural change in a society's operational and economic thinking. This also requires a suitable overall economic regulatory structure (governance) as a framework for action by all economic actors (consumers, politicians, companies, civil society). The design of such framework conditions requires a mix of different instruments (e.g. bans, taxes, standards, subsidies, information) in order to create incentives for structural change. The political framework includes, among other things, climate policy, environmental policy, economic and agricultural policy measures. The course provides an overview of the various actors in the bioeconomy and measures for shaping structural change as well as their economic, ecological and socio-economic effects and trade offs.

Intended Learning Outcomes:
After the event, the students are able to understand the overall economic regulatory structure and identify the respective responsible actors. The students have an overview of the current and potential political measures to promote structural change. Advantages and disadvantages or

possible conflicts of objectives of the control structures in terms of economic, ecological and socio-economic effects can be assessed.

Teaching and Learning Methods:
The module consists of a lecture and an exercise. The lecture takes place using PowerPoint, in which relevant theories and concepts are presented using current examples of governance. Articles and scientific publications from the scientific literature are integrated into the lectures. In the exercise, students develop political governance systems based on examples developed together, present them and discuss the empirical examples individually and/or in groups from different perspectives of the economy.

Media:
Presentations, slide scripts, articles

Reading List:
Paul Krugman and Robin Wells, Microeconomics, 6th Edition, Worth Publishers, 2020, (ISBN 13: 978-1-319-24528-3)
https://seea.un.org/

Responsible for Module:
Anja Faße a.fasse@tum

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

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

Module Description

CS0252: Project on Public Discourses and Scientific Solutions | Project on Public Discourses and Scientific Solutions

Project on Public Discourses and Scientific Solutions

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor	**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 module examination takes the form of a poster presentation followed by a discussion. The group (max. 5 students) designs a scientific poster on the topic covered. After a short presentation of the poster (total duration: 30 minutes depending on group size; approx. 6 minutes per student), there will be a discussion on the topic and the content of the poster (total duration: 50 minutes depending on group size; approx. 10 minutes per student). Each group member will be asked individual questions. The design, presentation and content of the poster (70 %) and the appropriate answers to the individual questions (30 %) are assessed and form the final grade.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
First four semesters of Bioeconomy ;-)

Content:
In the public debate, current topics from areas such as bioeconomy, sustainability, the energy transition and the mobility transition are widely discussed. Often, "science" is invoked to lend more weight to arguments. Unfortunately, the scientific findings are often abbreviated or selectively reproduced. In this project, groups will deal with current topics from the public debate and try to use their interdisciplinary background to provide a scientific perspective. Which arguments are accurate? Which arguments are false or one-sided? Does science provide universally appropriate solutions to the discussed issue or are solutions depend on different objectives?

Intended Learning Outcomes:
After successfully completing the module, students are able to

- work together in teams with heterogeneous knowledge and backgrounds.
- combine the interdisciplinary skills learned in the Bioeconomy degree program and apply them to a topic.
- present and communicate scientific evidence clearly
- analyze and evaluate scientific arguments in political debates
- identify abbreviated representations of scientific evidence.

Teaching and Learning Methods:
In the project, Bachelor and Master students work together cooperatively on a topic. The team size is 3-6 people, depending on the task. The Master's students coordinate the groups, formulate interim goals together with the Bachelor's students and are responsible for achieving them. The Bachelor's students carry out the scientific research on the topics and summarize the current status from the perspective of various disciplines. They are supported in this by the Master's students. In regular meetings with the lecturers, questions about the scientific literature, the general procedure, and timelines are answered.

Media:
Newspaper articles, radio, TV reports, scientific publications, PowerPoint presentations, posters

Reading List:
Additional literature will be provided based on the current topics covered in the semester.

Responsible for Module:
Prof. Dr. Sebastian J. Goerg (s.goerg@tum.de)

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

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

Required Modules: Management & Sustainability | Required Modules: Management & Sustainability

Module Description

CS0075: Management Science | Management Science [ManSci]

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor	**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:
Students mastery of the content taught in this module is checked with a 60 minutes written and multiple-choice exam. In the written part of the exam students have to answer questions, apply algorithms to solve problems, create mathematical models for small example 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 business planning problems. The multiple-choice questions allow to check if students also understood other parts of the lecture that could not be included in the written part. This will be used to assess if fundamental aspects in Management Science can be evaluated. The overall grade of the module is based on the result obtained in the written and multiple-choice exam. Students are only allowed to use a non-programmable calculator.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Knowledge of Mathematics and Statistics at the level as definend in the German Abitur

Content:
Management Science is about modelling, solving and analysing planning and decision problems using mathematical concepts. Management Science is used across different industries, departments and organizations. The lecture will treat the Management Science approach to decision making in general and the following topics in particular: Linear Programming, Mixed-Integer Programming, Graph Theory, Network Flow, Dynamic Programming and Decision Theory.

Intended Learning Outcomes:
After successful completion of the module, students are capable of modelling planning problems. They are able to solve small business problems manually by using models and methods of linear and integer programming, of graph theory, of network flow, of dynamic programming, and of decision theory.

Teaching and Learning Methods:
The module consists of a lecture and exercise courses, which are provided weekly, as well as a voluntary tutorial offered. 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. The tutorials are delivered by student teaching assistants for smaller groups which gives the student the opportunity to pose questions and receive immediately help from the teaching assistant.

Media:
Script, Presentation slides

Reading List:
Bradley, S.P., A.C. Hax und T.L. Magnanti: Applied Mathematical Programming, Addison-Wesley, 1977.
Domschke W and A. Drexl: Einführung in Operations Research, 9th Ed., Springer, 2015.
Hillier FS and Lieberman GJ: Introduction to Operations Research, 9th ed., McGraw-Hill, 2010.
Winston WL: Operations Research, 5th Ed., Thomson, 2004.

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Management Science Lecture - Campus Straubing (Vorlesung, 2 SWS)
Hübner A [L], Schäfer F

Management Science Exercise - Campus Straubing (Übung, 2 SWS)
Hübner A [L], Schäfer F
For further information in this module, please click campus.tum.de or here.

Module Description

CS0064: Environmental Management | Environmental Management [EM]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
Written exam (90 minutes): By solving problems from the thematic field of the module students have to prove their understanding of the basics of corporate environmental management, their ability to apply environmental management methods in the field. In the solution of the problems they need to demonstrate their ability to identify and analyse environmental impacts of corporate activities, to apply the managerial toolset provided by the ISO 140000 series and the Environmental Management and Audit Scheme (EMAS) to (simplified) practical problems. In addition, they need to show that they are able to describe the application of these methods in practice based on case examples. Learning aids: pocket calculator.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The module contains units covering the following topics:
- Environmental impacts of industrial and business activities,
- Societal, economic and legal frameworks of environmental protection,
- Motivation for businesses for applying environmental management approaches and methods,
- Environmental Management Systems (e.g. ISO 14000 series, EMAS),
- Methods and tools for environmental management (indicators, reporting, life cycle assessment), and
- Recent and emerging topics in environmental management.

Intended Learning Outcomes:
Students understand basics of corporate environmental management and its relevance for companies, application potentials and their implementation. The discuss these in context of business and research, reflect it critically and derive consequences for companies and research.

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
- 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:
- Theodore (2017): Environmental management, Chapman and Hall/CRC.
- Antweiler (2014): Elements of environmental management, Univ. of Toronto Press.
- Belchem (2014): Manual of Environmental Management, Taylor and Francis.
- Amilleri (2017): Corporate sustainability, social responsibility and environmental management, Springer.
- Mitchell (2002): Resource and environmental management, Prentice Hall.
- Mulvihill and Harris (2017): Environmental management: critical thinking and emerging practices, Taylor and Francis.

Responsible for Module:
Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Environmental Management (Lecture) (Vorlesung, 2 SWS)
Röder H [L], Röder H

Environmental Management (Exercise) (Übung, 2 SWS)
Röder H [L], Röder H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0071: Material Flow Analysis and Life Cycle Assessment | Material Flow Analysis and Life Cycle Assessment [MFA&LCA]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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:
Large courses of approx. more than 60 students: Written exam (90 minutes):
Students have to solve basic problems from the MFA, and LCA field. They have to demonstrate that they can analyze systems from a system and life cycle perspective. They have to prove their ability to use the correct terminology. In particular, they need to prove their ability to analyze and model material and energy flows, to determine and apply data, to assess environmental impacts, and to consider uncertainties. In addition they have to demonstrate their ability to interpret MFA and LCA study results and discuss the importance and applicability of the methods in practice.
Learning aids: pocket calculator.

Small to medium sized courses with up to approx. 60 students:
The students demonstrate the above-mentioned capabilities through group work. In groups of 3-5 students they receive case-based problems of material flow analysis and/or life cycle assessment. They have to solve these using the competencies obtained in the course. The results have to be presented and discussed (ca. 20') as well as documented in a report (ca. 20 pages). The individual contributions in both, presentation and report have to be specified.

The form of examination will be announced in class and on the learning platform in the second lecture week of the semester at the latest.

Voluntarily, students have the opportunity to increase their grade by up to 0.3 through extra work in form of individual assignments (hand-in and or presentation). The students either have to discuss a case study or a scientific paper or solve a problem from the topical scope of the lecture. They have to summarize their results in a 10' presentation + discussion or a 2-3 page report. Full mark for the course is obatainable without this voluntary work.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
• Introduction to systems and life cycle thinking
• The four phases of life cycle assessment
o Goal and scope definition
o Life cycle inventory analysis (LCI)
o Life cycle impact assessment (LCIA)
o Interpretation
• Material flow analysis
o Method of material flow analysis
o Material flow networks
o Determination of mass flows and stocks
o Material flow modelling
• Software systems and databases for material flow analysis and life cycle assessment
• Uncertainties and their handling
• Current trends and developments in material flow analysis and life cycle assessment
• Case studies

Intended Learning Outcomes:
At the end of the module students
• define key terms of material flow analysis and life cycle assessment
• explain the concepts of material flow analysis, life cycle assessment and systems analysis regarding their procedures and their theoretical backgrounds
to understand how to apply material flow analysis and life cycle perspective to various contexts and systems in order to assess their environmental performance
• gather necessary information, to choose suitable methods, and to apply these for simple MFA and LCA studies
• carry out simple MFA and LCA calculations by investigating underlying resource and energy flows associated with processes
• interpret MFA and LCA study results
• discuss the importance and applicability of the methods in practice

Teaching and Learning Methods:
Format: lecture and exercises to introduce the content, to repeat and deepen the understanding as well as practice individually and in groups. Some tutorials will be carried out computer-based.

Teaching / learning methods:
• Media-assisted presentations
• Group work/case studies

• Individual tasks
• Reading
• Computer lab exercises using MFA and LCA software systems

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

Reading List:
• Baccini, P. & Brunner, P.H. (2012): Metabolism of the Anthroposphere: Analysis, Evaluation, Design. MIT Press.
• Brunner, P.H. & Rechberger, H. (2016): Handbook of Material Flow Analysis: For Environmental, Resource, and Waste Engineers. CRC Press.
• 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:
Prof. Magnus Fröhling

Courses (Type of course, Weekly hours per semester), Instructor:
Material Flow Analysis and Life Cycle Assessment (Lecture) (Vorlesung, 2 SWS)
Fröhling M [L], Fröhling M, Schirmeister J

Material Flow Analysis and Life Cycle Assessment (Exercise) (Übung, 2 SWS)
Fröhling M [L], Fröhling M, Schirmeister J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0073: Circular Economy | Circular Economy [CEC]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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:
Examination for course sizes of more than approx. 90 students:
Written exam (90 minutes): Students have to analyze, assess and discuss (simplified) circular economy concepts and legislative frameworks on a local, regional, national and global level, determine starting points for an optimization of these concepts and apply them to real-life use cases. Thereby, they have to take different points of view (environmental, product, (material flow) system, macroeconomic, business). In doing so, the students have to prove their ability to use the right vocabulary, and their knowledge on the motivation, and methods of circular economy.

Examination for course sizes of up to approx. 70 students:
The students demonstrate the above-mentioned capabilities through group work. In groups of 3-5 students they receive case-based problems of the CE. They have to solve these using the competencies obtained in the course. The results have to be presented and discussed (ca. 20') and documented in a report (ca. 20 pages). The individual contributions in both, presentation and report have to be specified.

The form of examination will be announced in class and on the learning platform in the second lecture week of the semester at the latest.

Voluntarily, students have the opportunity to increase their grade by up to 0.3 through extra work in form of individual assignments (hand-in and or presentation). The students either have to discuss a case study or a scientific paper or solve a problem from the topical scope of the lecture. They have to summarize their results in a 10' presentation + discussion or a 2-3 page report. Full mark for the course is obatainable without this voluntary work.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The module covers the following topics:
• Introduction
• Circular Economy as a concept to approach sustainability needs
• History and policies related to the development of a circular economy
• Motivation for CE
• Design for Sustainability and Circularity
• Business model innovation for CE
• Closed-loop economic systems
• Sustainability Assessment of CE solutions
• Enablers and barriers, potentials and limits of CE
• Rebound effects
• Special topics and case studies

Intended Learning Outcomes:
Students explain the importance of the circular economy within the context of resource shortages, climate change and further sustainability challenges. They discuss and understand the central concepts of a circular economy against their historical background covering both, traditional waste management and recycling approaches as well as more recent holistic concepts. They asses and discuss CE from an environmental, product, material, and economic perspective. Based on these competences, they can develop action approaches to transfer these concepts from theory into practice. They link independently urgent environmental problems of our time with the concept of the circular economy and design solution approaches based on their results. Regarding value creation in a circular economy, the students identify business opportunities, develop and discuss new innovative business models. They apply these concepts to specific use cases, and assess their implications from different perspectives, considering potentials and limits, enablers and barriers.

Teaching and Learning Methods:
Format: lecture and 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 / reading of scientific publications with presentation
- Individual assignments and presentation to consolidate/repeat the learned contents
- Dismantling and recycling exercises in the CE-lab
- Plenary discussions to reflect the lecture contents

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

Reading List:
Recommended reading:
• Ayres, Robert U. (2002): A handbook of industrial ecology
• Charter, Martin (2019): Designing for the circular economy, Routeledge
• De Angelis, Roberta (2018): Business Models in the Circular Economy: Concepts, Examples and Theory, Palgrave Macmillan
• Franco-García, María-Laura ; Carpio-Aguilar, Jorge Carlos ; Bressers, Hans: Towards Zero Waste: Circular Eocnomy Boost, Waste to Resources, Springer
• Larsson, Mats (2018): Circular Business Models: Developing a Sustainable Future
• Schaub, Georg; Turek, Thomas (2016): Energy Flows, Material Cycles and Global Development: a Process Engineering Approach to the Earth System, Springer
van Erwijk, S.; Stegemann, J. (2023): An Introduction to Waste Management and Circular Economy, UCL Press
• Webster, Ken (2017): The Circular Economy - A Wealth of Flows, Ellen MacArthur Foundation Publishing
• Wiesmeth, H. (2021): Implementing the Circular Economy for Sustainable Development, Elsevier
Further literature will be given in the course.

Responsible for Module:
Prof. Dr. Magnus Fröhling

Courses (Type of course, Weekly hours per semester), Instructor:
Circular Economy (Lecture) (Vorlesung, 2 SWS)
Fröhling M [L], Fröhling M, Heinrich V

Circular Economy (Exercise) (Übung, 2 SWS)
Fröhling M [L], Heinrich V
For further information in this module, please click campus.tum.de or here.

Required Modules: Evidence Based Management and Policy | Required Modules: Evidence Based Management and Policy

Module Description

CS0129: Evidence Based Management and Policy | Evidence Based Management and Policy

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 210	**Contact Hours:** 90

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

Description of Examination Method:
Assessment will be based on a written report (50%) and a written project report based on a research project (50%). Both are about 15 pages long, but can vary depending on the topic.

With the report students will demonstrate that they understand policy evaluations and are able to summarize them effectively. In the report, students work with an academic policy paper, which they replicate, critically evaluate and summarize for an interested lay audience. They may choose from a list of papers discussed in class or they may write about a paper they choose themselves with prior approval from the lecturer.

The project work demonstrates that students can carry out their own interventions or evaluations. The project work is based on a research project in which a team of 2-5 students develops an empirical research question with policy relevance and then carries it out. The grading takes particular account of the quality of the research question, the research design (design of the evaluation), the analysis and the discussion of the results. The project work is designed in such a way that the individual contribution of each student is individually recognizable and assessable. For this purpose, the chapters on the research design and the results may be written together in the group, but the introduction, literature review and discussion of the results must be prepared individually by each student.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Microeconomics, Statistics, Empirical Research Methods

Content:
In this course students learn the fundamental skills of economic policy analysis.
Firstly, students will learn to evaluate the impacts of existing public policies (or natural experiments) by using two widely used econometric techniques, difference-in-difference (DiD) and regression discontinuity design (RDD). Secondly, students will learn about the role of experimental methods, such as randomized controlled trails, field experiments, and lab experiments, for the impact evaluation of economic policies.

Intended Learning Outcomes:
In this module, students will develop the ability to empirically evaluate the economic consequences of interventions and policies.

At the end of the module, have a good understanding on common policy analysis tools and be able to compare the merits and disadvantages of different policies or interventions. They will be able to estimate the likely consequences of proposed policies.

Students will understand the nature of scientific evidence and how to translate this into management and policy advice. They can explain and apply the econometric methods used for economic policy analysis. Students understand the challenges of evidence-based policy advice and are able to critically asses existing studies. They can successfully design and conduct their own independent research projects and derive policy conclusions from their results. In this module students deepen their ability to work efficiently and effectively in groups together and they learn how to communicate their own findings.

Students will understand the nature of scientific evidence and how to translate this into management and policy advice. They can explain and apply the econometric methods used for economic policy analysis. Students understand the challenges of evidence-based policy advice and are able to critically asses existing studies.

Teaching and Learning Methods:
The module consists of a lecture, an exercise, and a seminar.

The lecture is designed as an interactive frontal lesson (PowerPoint, blackboard), as a large number of policy evaluations will be discussed together with the applied methods. Thereby, the lecture will also revisit and combine topics and methods covered in previous modules, e.g. Microeconomics, Environmental Economics, and Empirical Methods. During the exercise, students will gather data, manage datasets, and analyse them. In particular, during each exercise, students will go through a research/policy paper, its publicly available data, and replicate its basic findings (many economic and scientific journals publish their datasets for replication purposes). In

groups, students will write short policy reports summarizing the academic papers and their own replications.

The lecture and exercise are designed to introduce students to the methods of policy evaluations and how to apply them. The seminar is designed to push them a step further by asking them to design and conduct their own research project. In this project, students either identify or develop an intervention and then evaluate its impact. First, students decide on a relevant policy or management question. They develop a suitable (research-)design including an intervention, run a (pilot-)study and formulate policy advice based on the gathered evidence. Thereby, students apply the previously learned methods on a new topic.

In the seminar, students form groups and conduct under the supervision of the lecturer an empirical, experimental or theoretical study. Every step will be presented in class by the students. Thereby, students practice how to effectively communicate their methods and results.

Media:
Presentations, slide scripts, computer, statistic software (STATA)

Reading List:
Will be provided and is based on research and policy papers

Responsible for Module:
Prof. Sebastian Goerg Prof. Andreas Pondorfer

Courses (Type of course, Weekly hours per semester), Instructor:
Evidence Based Management and Policy (Exercise) (Übung, 2 SWS)
Ahmed M

Evidence Based Management and Policy (Lecture) (Vorlesung, 2 SWS)
Basistha A

Seminar Evidence Based Management and Policy (Seminar, 4 SWS)
Goerg S, Pondorfer A

Seminar Evidence Based Management and Policy (Seminar, 4 SWS)
Goerg S, Pondorfer A
For further information in this module, please click campus.tum.de or here.

Elective Modules | Elective Modules

Electives in Foundations of Management | Electives in Foundations of Management

Module Description

CS0211: Supply Chain | Supply Chain [SC]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
The module examination consists of a written exam (60 min). Permitted tools are a non-programmable calculator.

In the written exam, students demonstrate that they can apply various approaches to problem solving, building on their understanding of production and logistics planning in general. Using exemplary tasks from production or logistics planning, students demonstrate that they can interpret planning problems as well as relationships between different problems. Based on this, students will provide recommendations for addressing these problems.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Fundamentals of Mathematics and Management Science are recommended

Content:
This is a basic module in which an overview of planning problems in supply chain management and methodologies for solving them is acquired. The students are familiarized with different planning problems. Heuristics and additionally simple models of linear and mixed integer programming are discussed and applied as methodologies for solving the planning problems. The module includes these parts, among others:
- Strategic planning problems: e.g., site planning.

- Tactical planning: designing the infrastructure of different production systems (workshop, flow production, production centers)
- Operational planning problems: Demand forecasting models, material requirements planning, resource utilization planning: lot-size planning and transportation logistics.

Intended Learning Outcomes:
After participating in this basic module, students will be able to understand interrelationships between various planning problems in supply chain management. Analyze selected planning problems at the strategic, tactical and operational levels (for details, see learning content) and apply solution approaches to deal with them. In doing so, the students know essential management tasks in supply chain management and learn to evaluate the importance of production and logistics-related decisions (e.g. the trade-off between inventory and setup costs).

Teaching and Learning Methods:
The learning methods consist of lectures, tutorials and in-depth literature. The lectures serve to explain the theoretical basics including the processing of exercises. The tutorials which accompany the lectures deepen the contents of the lectures in smaller groups and include calculation of exercises mainly in individual work, occasionally also in group work. Literature for in-depth study will be announced and recommended in the lecture.

Media:
Presentation, script

Reading List:
Günther, H.O., Tempelmeier, H. (2020), Supply Chain Analytics
Ghiani, G., Laporte, G., Musmanno R. (2013), Introduction to Logistics Systems Management, 2. Aufl., Wiley

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Supply Chain (Exercise) (Übung, 1 SWS)
Hübner A [L], Hintermeier L

Supply Chain (Lecture) (Vorlesung, 1 SWS)
Hübner A [L], Schäfer F
For further information in this module, please click campus.tum.de or here.

Module Description

CS0212: Entrepreneurship | Entrepreneurship

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
The examination consists of a 60-minute written exam.
The written exam provides a comprehensive assessment of whether students know and understand the basic principles of entrepreneurship and sustainability. They answer questions about the concepts that explain the mindset of entrepreneurial individuals and the management of entrepreneurial firms. They also answer questions about basic definitions of specific types of entrepreneurship and entrepreneurial behavior related to environmental and social problems.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
This module is an introductory module for bioeconomy and business administration. The module introduces students to the basics of the topic of Entrepreneurship.

Students will be equiped with basic knowledge on:
(1) Definitions, regional aspects, and special forms of entrepreneurship and sustainability
(2) Entrepreneurial individuals, including their personality, creativity, idea development, cognition, opportunity recognition, decision making, affect, and moving forward from failure
(3) Entrepreneurial firms, including their growth strategies, strategic alliances, and resources.

Students will further engage in break-out group workshops to personally experience the process of opportunity recognition and development. In these workshops, teams apply concepts from the academic literature to real-world business issues to solve environmental and/or social problems. Furthermore, students give presentations to the audience and discuss their results.

Intended Learning Outcomes:
After participating in this introductory module, students will be able to:
(1) explain basic concepts of entrepreneurship and sustainability including basic definitions, psychological processes and characteristics of the person of the entrepreneur
(2) identify and explain potential development paths of young firms
(3) transfer basic knowledge to real world cases. Thus, students will be able to solve entrepreneurial problems in real world settings drawing on theoretical frameworks of the entrepreneurial process.

Teaching and Learning Methods:
The module consists of one lecture, which combines several learning methods. The basic knowledge as well as real world examples 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. Workshops in smaller groups enable the students to apply (part of) their theoretical knowledge to real-world problems. This format additionally fosters creativity and team work. Students will gain additional background knowledge from the scientific literature in private reading.

Media:
PowerPoint, films, internet, newspaper articles

Reading List:
Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2010). Entrepreneurship (8th ed.). New York: McGraw-Hill.
Read, S., Sarasvathy, S., Dew, N., Wiltbank, R. & Ohlsson, A.-V. (2010). Effectual Entrepreneurship. New York: Routledge Chapman &
Hall.

Responsible for Module:
Prof. Claudia Doblinger

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

Module Description

CS0256: Innovation Management | Innovation Management [Innovation and Technology Management]

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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:
The grading will be based on a written exam (60 min). By answering multiple choice questions students have to show that they have understood and can apply models and concepts related to markets aspects of innovation and to the organization of the innovation process. The questions may require calculations.
Students may use a nonprogrammable calculator to do these calculations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
Market aspects of innovation:
Innovation: Examples and particularities,
Innovation and the development of industries,
Sources of innovation,
Innovation strategy: Analysis of the market, technology and competition,
Acquisition of technology: Market, cooperation and networks

Organizing the innovation process:
The innovation process within the firm,
R&D, production and marketing,
Cooperation for innovation,
Motivation and incentive systems,
Promotors and champions,

Roles in the innovation process,
Opposition against innovation within the firm,
Integrating customers into the innovation process,
Measuring and controlling innovation.

Intended Learning Outcomes:
At the end of the module, students will be able to (1) recognize and apply models and concepts related to the market aspects of innovation (e.g., modes of acquisition of technology) and to the organization of the innovation process (e.g., promotors and champions in the innovation process), (2) identify how they can be concretely used in companies and in the context of green innovation.

Teaching and Learning Methods:
The module consists of lectures including one or two sessions held by guest speakers to refer to state of the art examples of green innovation. Students will be motivated to read the literature before and after each lecture and relate it to the content taught in class. Furthermore, they will be motivated to discuss the content in online forums that are made available to the students.

Media:
Lecture slides are available via Moodle. Presentation slides, online discussion forum

Reading List:
Afuah Innovation Management. strategies, implementation, and profits
Dodgson, Gann, Salter The Management of Technological Innovation (Chapter 4)
Teece Profiting from Technological Innovation: Implications for integration, collaboration, licensing and public policy
Stamm Structured Processes for Developing New Products
Hauschildt, Kirchmann Teamwork for innovation the ""troika"" of promotors

Responsible for Module:
Doblinger, Claudia; Prof. Dr. rer. pol. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Technology and Innovation Management: Introduction (WI000114, WI000820, englisch) (Bachelor TUM-BWL) (Vorlesung, 2 SWS)
Henkel J, Hanschur L, Hur J
For further information in this module, please click campus.tum.de or here.

Module Description

CS0284: Organizational Behavior | Organizational Behavior

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
The examination takes the form of a written, graded exam (60 min). The exam consists of single-choice questions that test knowledge at different levels: Knowledge questions test recall and reproduction of learned concepts, e.g. by reproducing various change management models; Decision questions test the classification or interpretation of learned content, e.g. Application and scenario questions test whether students can apply the content learned in the lectures to practical problems and challenges. The overall grade is determined by the performance in the written examination. It is allowed to use a non-electronic dictionary (English - native language or English Thesaurus) during the exam. Beyond that, no aids such as lecture notes, personal notes, etc. are allowed. There will be mid-term evaluations, which can be included in the exam grade with 0.3.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Fundamentals of business administration

Content:
In accordance with the learning outcomes formulated above, the most important theories and methods of work and organizational psychology are covered. Basic approaches and models of work and organizational psychology are used to understand the behaviour of individual organizational members, teams and entire organizations. In particular, the following aspects are addressed and made theoretically and practically usable: basics of employee management; effects of individual personality traits and motivation in organizations; ethical and moral behavior in organizations; structures and processes in work teams; change management in national and international organizations; organizational culture in national and international comparison.

Intended Learning Outcomes:
After successfully completing the module, students are able to understand and explain key concepts of work and organizational psychology. In addition, students will be able to apply the knowledge they have acquired to practical challenges and problems. Students will be able to recognize and analyze challenges and problems in the areas of employee motivation, teamwork, decision-making behavior and communication. Finally, they are able to recognize and demonstrate practical solutions to HR, change management and ethical problems by applying the theoretical concepts they have learned.

Teaching and Learning Methods:
In the interactive lectures, the most important concepts, approaches and theories as well as their empirical evidence are conveyed and critically discussed with the students. The theoretical and methodological content of the lectures is illustrated using examples and case studies and made usable for practical application. In addition, students are encouraged to engage intensively with the content and to transfer the theories and methods covered through the analysis of instructional videos and through individual tasks and/or work in small groups. Finally, (self-)study of literature is planned.

Media:
Presentations (slides as download)
Videos
if applicable, current international scientific literature (English)
if applicable, case studies

Reading List:
Landy, F.J., & Conte, J.M. (2013). Work in the 21st century. Hoboken, NJ: Wiley.
Wood, J. M. (2016). Organisational behavior: Core concepts and applications. Milton, Australia: Wiley

Responsible for Module:
Prof. Dr. Sebastian J. Goerg

Courses (Type of course, Weekly hours per semester), Instructor:
Organizational Behavior (WI001121) am Campus Straubing (Vorlesung, 2 SWS)
Goerg S [L], Benzinger D
For further information in this module, please click campus.tum.de or here.

Module Description

CS0288: Strategic and International Management | Strategic and International Management

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The grading will be based on a written exam (60 minutes). The exam consists of multiple-choice questions that assess knowledge at various levels, such as the reproduction of learned concepts, for example, through the comparison and analytical analysis of different strategies employed by internationally operating companies. The overall grade is determined by the performance in the written exam. It is permissible to use a non-electronic dictionary (English - native language or English Thesaurus) during the exam. However, no aids such as lecture materials, personal notes, etc., are allowed. Furthermore, on a voluntary basis, an improvement of 0.3 in the exam grade can be achieved if the questions related to the case studies are answered in writing and presented.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Foundations of Management

Content:
According to the formulated learning outcomes, the key theories and methods of strategic and international management are addressed. Fundamental approaches and models, such as the strategic management process, external and internal analyses with a focus on international activities, are relevant for companies of almost all industries and sizes. Companies operating internationally must incorporate this reality into their strategic considerations. Knowledge of international management is not only necessary in the leadership of cross-border companies, but also in individual business functions, where the international dimension must be taken into account. Therefore, special emphasis is placed on the international dimension of the concepts to be addressed. Specifically, the following aspects are discussed and made theoretically and practically applicable:

Fundamentals and peculiarities of strategic and international management; framework conditions of strategic and international management; theories of international business activities; strategies of internationally operating companies; international dimension of individual business functions; organizational culture in national and international comparison.

Intended Learning Outcomes:
After successful completion of the module, students will be able to understand and explain key concepts of strategic and international management. Additionally, they can apply the acquired knowledge to practical challenges and issues. Students can identify and analyze challenges and issues in the fields of strategic and international management. Ultimately, they are capable of identifying and demonstrating practical solutions to challenges in strategic and international management by applying the learned theoretical concepts.

Teaching and Learning Methods:
In the interactive lectures, the key concepts, approaches, and theories, along with their empirical evidence, are conveyed and critically discussed with the students. Theoretical and methodological lecture contents are illustrated through examples and case studies, making them applicable for practical use. Furthermore, students are encouraged to engage intensively with the content and transfer the discussed theories and methods through the analysis of videos, individual tasks, and/or group work. Finally, self-study of literature is planned as part of the course.

Media:
Lecture slides are available via Moodle.
Current international scientific literature (English)
Case studies
Online discussion forum

Reading List:
Cavusgil, S.T., Knight, G., Riesenberger, J. R. (2008), International Business: strategy, management, and the new realities
Hill, C.W.L. (2014), International business: Competing in the Global Marketplace

Responsible for Module:
Prof. Claudia Doblinger

Courses (Type of course, Weekly hours per semester), Instructor:
Strategic and International Management (Vorlesung, 2 SWS)
Doblinger C [L], Doblinger C, Krinner S
For further information in this module, please click campus.tum.de or here.

Technical Electives | Technical Electives

Module Description

WZ1654: Forest Management and Inventory | Forstmanagement und Waldinventur

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Exam achievement shall be done in the form of a written report. The students calculate the key performance indicators for forestal decisions and illustrate decision-making procedures and alternatives based on case studies. They show in the report that they are able to outline and explain forest management business processes. They demonstrate that they are able to answer problems on forest management and inventory in their own words. Exam achievement shall be completed by a presentation of the students for a specific and clearly defined topic. The report shall be weighted at a ratio of 30/70. Type of exam and exam duration: orally (20 minutes) or writing (60 minutes)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Forestry and Wood WZ 1614, Knowledge about Forestal Processes, Crop Establishment and Timber Harvest, Forest Growth (Basics of Silviculture WZ 1607).

Content:
The module aims at imparting to students in-depth knowledge of forest management. For that purpose it is necessary to explain forest logistics. As well management requirement from forestry such as: Timber trade, wood evaluation and business organisation as a tool for reaching the objective, selection of tree types and risk management in view of rotation period, management objective and climate change, optimisation of biological production using the example of dominant tree species in Bavaria as well as sale of wood as a central process towards products, services

and corresponding sales markets. The module also aims at developing understanding of the most important principles, sustainable management of forests and forestry.
Besides knowledge for practical performance of inventories and use of equipment including commonly used measuring instruments (cruising rod, altimeter, Vertex, Suunto) shall be imparted. Finally inventories are part of the lecture including complete enumeration as well as characterisation of forest resources.

Intended Learning Outcomes:
After attending the module the student will be able to use contents of forest management. He will be able to understand management processes in a forest company and implement principles to determine wood sorting and marketing in view of rotation period and management objective for a forest company.
It is possible for him to take selection decisions in a logical and transparent way by including economic and ecological criteria and thus understand central management processes in a forest company. The conflict of forest and game shall be understood concerning its impacts relevant for forest management. The students understand the use of measuring instruments for forest management and harvest planning. They are able to compare assessment of wood production of forest resources for different variants of timber harvest and implement it in practice.

Teaching and Learning Methods:
Project work using case studies in cooperation with a regional forest enterprise and AELF, practice by teamwork in the forest, presentation

Media:
Expert lecture, powerpoint, exercise sheets, measuring instruments

Reading List:
T. Knoke, Forstbetriebsplanung (Forest Operational Planning), 2012, 408 pages, 125 black-and white illustrations, Dimensions: 17,7 x 23,7 cm, Paperback (TB), German
Hrsg. v. Thomas Knoke ULMER EUGEN ISBN-10: 3800176114
ISBN-13: 9783800176113
H. Kramer, A. Akca, 1995, Leitfaden zur Waldmesslehre (Guide for Forest Mensuration) published by: Sauerländer, J D; edition: 3rd expanded and improved ed.
Burschel, P. & Huss, J. 1987. Grundriss des Waldbaus (Ground Plan of Silviculture). Ein Leitfaden für Studium und Praxis (A Guide for Study d Practice). Parey, Hamburg und Berlin. 352 S.
Elverfeldt, Freiherr von A.
Rittershofer, F. 1999. Waldpflege und Waldbau (Forest Management and Silviculture). Für Studium und Praxis (For Study and Practice). Gisela Rittershofer Verlag, Freising. 492 p.

Responsible for Module:
Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Forstmanagement und Waldinventur Übung (Übung, 3 SWS)

Röder H [L], Füchsl S, Röder H

Forstmanagement und Waldinventur (Vorlesung, 1 SWS)
Röder H [L], Füchsl S, Röder H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0005: Introduction to Development Economics | Introduction to Development Economics

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor	**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 is carried out in the form of a written examination. Students should evaluate fundamental theories, methods and concepts of development economics in detail using examples. In doing so, they demonstrate that they can assess and analyze empirical evidence on economic development.
Type of examination: written, no aids allowed, duration of examination: 60 minutes
Type of examination: written, no additional tools allowed, duration of examination: 60 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Microeconomics (CS0063)
Empirical research Methods

Content:
What does development mean in theory and empirically? How are countries classified and what effects does that have? What is poverty and food security? What role do natural resources play in prosperity in developing countries? What are the determinants of poverty at the micro level? What role do risk, demographics, formal and informal institutions, labor, property rights, access to capital or microfinance play in developing countries? These are some of the questions that decision-makers in both developed and developing countries have to discuss every day. This course provides the theoretical basis and empirical evidence for the analysis of such questions against the background of current development policy issues.

Intended Learning Outcomes:
After attending the module, students can understand what hinders development and what factors lead development to success. You will be able to apply fundamental theories, concepts and analytical techniques associated with microeconomics. Students learn the difference between growth and development, the measurement of inequality, poverty and food security, the importance of agriculture and natural resources in developing countries. Students are able to analyze current empirical evidence on economic development in developing countries and to critically read and question the scientific literature in the field of economic development.

Teaching and Learning Methods:
The module consists of a lecture and an exercise. The interactive lecture takes place using Powerpoint and whiteboard. In addition, scientific articles from specialist journals are integrated into the lectures. In the exercise, students discuss theoretical concepts and their empirical relevance individually and/or in groups from different perspectives for selected countries based on the references presented.

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:
Prof. Anja Faße a.fasse@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Development Economics (Lecture) (Vorlesung, 2 SWS)
Faße A [L], Faße A

Introduction to 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

CS0027: Behavioral Economics | Behavioral Economics

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
There will be a written exam with a duration of 60 minutes, to show that students acquired detailed knowledge of behavioral economics and can apply its insights to relevant problems.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
VWL/Economics

Content:
This course provides a general introduction to behavioural economics and discusses its relevance to problems in the area of environmental policies. The first half of this course covers basic concepts of behavioural economics, discusses the short-comings of the economic standard theory, and illustrates how behavioural economics supplements the standard theory. In the second part of the course, the learned concepts will be applied to environmental policies and topics in environmental economics (e.g., green nudges, eco-labels, defaults,..)

Intended Learning Outcomes:
The students learn the basic concepts in behavioral economics. They will be able to identify possible applications to environmental policies and in the area of sustainability.

Teaching and Learning Methods:
The lecture will be performed as ex-cathedra teaching to provide the students will all necessary fundamentals. Within the tutorial the students learn through example calculations and homework how to transfer and apply this knowledge. Lectures and tutorials will be supplemented with classroom experiments

Media:
Slides, exercise sheets, additional literature (book chapters and articles)

Reading List:
The material in the lecture is sufficient for learning and is provided in the lecture.

Responsible for Module:
Prof. Sebastian Goerg

Courses (Type of course, Weekly hours per semester), Instructor:
Behavioral Economics (München) (Vorlesung mit integrierten Übungen, 4 SWS)
Goerg S [L], Goerg S, Kopsacheilis O
For further information in this module, please click campus.tum.de or here.

Module Description

CS0038: Advanced Mathematics 2 | Höhere Mathematik 2

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Learning outcomes are verified in a written exam. The exam consists of assignments in which the students are to demonstrate that they understand the mathematical methods conveyed as part of the module and are able to apply them to specific examples. Exam duration: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Advanced Mathematics 1

Content:
Selected topics from linear algebra, vector analysis, and ordinary differential equations that are required in engineering. In particular: vector spaces, bases, linear maps, matrix representation of linear maps, functions of several variables, partial and total differentiation, Taylor expansion, basic multivariate integration, basics of ordinary differential equations. The methods are presented during the lecture and are applied to specific examples related to sustainability in the exercise classes.

Intended Learning Outcomes:
After completion of the module, students understand the fundamental concepts and important methods from vector analysis and ordinary differential equations as well as the required prerequisites from linear algebra. They are able to apply mathematical arguments in these fields independently. Moreover, they can apply the central proof techniques and concepts of vector analysis and ordinary differential equations and comprehend their mathematical background.

Teaching and Learning Methods:
Lecture using digital presentation and/or blackboard to convey contents and methods. In addtion, concrete examples are discussed in the exercise classes through independent work and group work in order to practice the adequate expression and independent application of mathematical arguments.

Media:
Blackboard, slides, exercise sheets

Reading List:
K. Königsberger, Analysis 1, 6. Auflage, Springer 2004.
K. Königsberger, Analysis 2, 5. Auflage, Springer 2004.
C. Karpfinger, Höhere Mathematik in Rezepten, 3. Auflage, Springer Spektrum 2017

Responsible for Module:
Prof. Clemens Thielen

Courses (Type of course, Weekly hours per semester), Instructor:
Höhere Mathematik 2 (Übung) (Übung, 2 SWS)
Thielen C [L], Meier F, Thielen C

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

Module Description

CS0061: Seminar in Behavioral Economics | Seminar in Behavioral Economics

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 learning results are tested in form of a written thesis. The students write a theoretical and/ or empirical thesis of a maximum of 15 pages that addresses a current research problem in the area of behavioral economics. They prove that they have understood the content of the current academic literature and are able to understand the required empirical analyses.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Behavioral Economics

Content:
After being introduced to adequate research designs in the area of beahvioral economics, students explore the academic literature on a choosen topic. The topics are typically related to human behavior in an economic context and potential behavioral interventions for more sustainable behavior.
Potential topics are:
-Green Nudges
-Social Comparison
-Choice Architecture

Intended Learning Outcomes:
After sucessful completion of the module the students are able to derive a current academic research questions and to respond to it by using the relevant literature in the area of Behavioral Economics. In addition to the required literature analysis based on peer-reviewed academic

journals, the students are able to interpret the relevant empirical analyses, to critically review studies, and to identify the potential relationship of different strands of research.

Teaching and Learning Methods:
The students will be familiarized with the basics to conduct literature reviews in the area of Behavioral Economics. Students work on a reasearch question and learn to summarize the current state of research. Thereby students learn how to critically review current research results and research designs. The students apply these contents to their own research questions in the thesis. The students present their results in front of the other seminar members, and discuss their results with the group.
The students have to write a seminar thesis in order to learn how to write an academic paper based on a relevant research questions.

Media:
Presentation, Power-Point Slides

Reading List:
Relevant research articles are provided

Responsible for Module:
Prof. Sebastian Goerg

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar in Behavioral Economics (Seminar, 4 SWS)
Goerg S [L], Goerg S, Speckner M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0081: Modelling and Optimization | Modelling and Optimization

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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 is based on an exam (50% of evaluation) and a project work (50% of evaluation).

The 45min written exam tests the understanding of the modeling techniques discussed in the course. In the exam students have to answer questions, apply algorithms to solve problems, create mathematical models for small example 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 business planning problems.

The project paper serves the assessment of the understanding of the modeling 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 OPL
- 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:
Management Science

Content:
This course is about modeling, solving and analyzing planning and decision problems using mathematial concepts. The concepts are used across different industries, departments and organizations. The lecture will treat the Management Science approach to decision making in general and the following topics in particular: Basics of linear optimization, introduction to optimzation and corresponding languages (e.g., OPL), techniques of binary modeling, optimization of graph problems, problems with multiple objective functions, basic techniques of stochastic optimization and interfaces to other applications.

Intended Learning Outcomes:
After successful completion of the module students are capable of modelling planning problems. Students learn to model real life business problems e.g. from production and logistics by applying mathematical programming techniques. They can independently implement mathematical models by using an optimization language (e.g., OPL) on a PC and they are able to solve the models in Optimization Studio and interpret the results. Furthermore, they deepen their knowledge in several different modeling techniques.

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 program 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:
Kallrath, Josef and John M. Wilson: Business Business optimisation using mathematical programming. Macmillan, Basingstoke, 1997
Popp, Andreas: Modellierung und Optimierung mit OPL. epubli, 2015
Taha, Hamdy A.: Operations Research: an introduction. 8th ed., Pearson Prentice Hall, Upper Saddle River (NJ), 2007

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Modeling and Optimization (Lecture) (Vorlesung, 2 SWS)
Schäfer F [L], Schäfer F

Modeling and Optimization (Exercise) (Übung, 2 SWS)
Schäfer F [L], Tuma N
For further information in this module, please click campus.tum.de or here.

Module Description

CS0158: Seminar in Innovation and Technology Management | Seminar in Innovation and Technology Management

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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 learning results are going to be proved in form of a written thesis. The students write a theoretical and/or empirical thesis that addresses a current research problem in the area of Innovation and Technology Management. For this, they create a written paper, which, depending on the topic, ranges between 15 and 20 pages. They prove that they have understood the content of the current academic literature and are able to conduct empirical analyses.

Repeat Examination:

(Recommended) Prerequisites:
Entrepreneurship, Introduction to Innovation Management

Content:
Current research questions from the area of Innovation and Technology Management, e.g., Ecosystems, sustainable innovation, digitization

Intended Learning Outcomes:
After sucessful completion of the module the students are able to derive a current academic research questions and to respond to it by using the relevant literature in the area of innovation and technology management. The research questions are typically related to the promotion of sustainable innovation or entrepreneurship within ecosystems. In addition to the required literature analysis based on peer-reviewed academic journals, the students are able to conduct and interpret relevant empirical analyses such as regressions.

Teaching and Learning Methods:
Teaching methods: The students will be familiarized with the basics to conduct literature reviews in the area of innovation and technology management and to conduct and interpret empirical analyses such as regressions using statistical programs like STATA. The students apply these contents to their own research questions in the thesis. The students present their results in front of the other seminar members, and discuss their results with the group.
The students have to write a seminar thesis in order to learn how to write an academic paper based on a relevant research questions in the area of innovation and technology management.

Media:
Presentation, Power-Point Slides, Case Studies

Reading List:
Relevant research papers will be provided

Responsible for Module:
Prof. Claudia Doblinger

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar in Innovation and Technology Management (Seminar, 4 SWS)
Doblinger C [L], Mess C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0165: Supply Chain II | Supply Chain II

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 15	**Contact Hours:** 60

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

Description of Examination Method:
The examination of the module consists of an exam (written, 60 minutes). Allowed aid is a non-programmable calculator.

In the exam students show that they can apply different approaches to problem solving - based on the understanding of the production and logistics planning in general. By means of exemplary objects from the production or logistics planning the students demonstrate that they can interpret planning problems and connections between different problems. Based on this knowledge students give recommendations to tackle the problems.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
BWL I - Controlling and Supply Chain

Content:
Selected contents deal with subproblems of:
• material requirements planning
• production planning: lot sizing questions, machine scheduling and sequencing in flow lines
• transport logistics: planning problems on the determination of tours, routes and packing schemes
• material logistics: inventory control policies and their extension to the stochastic case are elaborated
• strategic design of the logistics network
• interfaces to the predecessor resp. successor companies
• procurement stage: methods for the selection of suppliers
• distribution stage: installment of a suitable distribution network and the processes in the warehouse

Intended Learning Outcomes:
After participating in this advanced module, that enhances the basic modul in mangement, students will be able to
- understand the relation between different planning problems in production and logistics
- analyse specific planning problems of the strategic, tactical and operational level (for details see course content), as well as on how to apply respective solution approaches
- explain essential managerial tasks in production and logistics planning
- evaluate the economic impact of production and logistics related decisions (e.g. the tradeoff between holding and setup costs or between costs and service).

Teaching and Learning Methods:
The module consists of a lecture and exercise courses, which are provided weekly, as well as a voluntary tutorial offered biweekly. 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. The tutorials are delivered by student teaching assistants for groups of up to 20 students which gives the student the opportunity to pose questions and receive immediately help from the teaching assistant.

The learning methods consist of lectures, (voluntary) tutorials and further literature.
The lectures are used to convey the theoretical foundation and include conducting exercises.
The tutorials accompany the lectures and deepen their content in an environment of small student groups. Students solve exercises on their own for most of the time and sometimes in group work.
During the lecture, further readings are suggested, to get a deeper understanding of the course content.

Media:
Presentation slides, skript (Production and Supply Chain Management)

Reading List:
Günther, H.O., & Tempelmeier, H. (2016), Produktion und Logistik, 9. Auflage, Springer
Ghiani, G., Laporte, G., Musmanno R. (2013), Introduction to Logistics Systems Management, 2. Aufl., Wiley

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Production Management (WI001060, englisch) (TUM-BWL Bachelor) (Vorlesung, 2 SWS)
Grunow M [L], Grunow M, Karimian Hadi Ardebili Y, Vishukumar V

Supply Chain II (Vorlesung, 2 SWS)
Hübner A [L], Hübner A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0180: Concepts of Physics and Chemistry in Nature | Concepts of Physics and Chemistry in Nature

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor	**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 physicochemical principles governing natural systems. They will be asked about
Basic concepts of physical chemistry applied to energy conversion in natural systems and to the structure of biomolecules. 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 basic concepts in Physics, Mechanics, Chemistry, and Mathematics having the focus on Nature examples. As such, basic knowledge in Physics, Chemistry, Mechanics, and Mathematics is required.

Content:
The module aims at providing in-depth knowledge to the students in the field of Physics and Chemistry applied to Biology. The focus on basic physical and chemical laws, concepts, principles and processes, including chemical bonding, chemical kinetics, spectroscopy, thermodynamics, thermochemistry, mechanics, optics, among others. The students will be able to apply them to understand the functionality of biological compounds/materials towards a more practical vision of Nature and its possible technological application.
The course will be divided into several topics related to the chemical structure of proteins, sugars, and other bio compounds, the formation of micro and macro self-assembled structures, light manipulation, heat management, mechanics, and electrical control. Each topic will be addressed refreshing the most important physical and chemical concepts followed by their relevance in the structural and functional aspects of these materials and their possible application in technology.

Intended Learning Outcomes:
At the end of the module students will be able to analyse biological systems using a physicochemical perspective; describe the different ways energy is transformed and used by natural systems (thermally, optically, mechanical etc.). They will be able to analyse the structure of proteins and other biomolecules and to identify the forces that define their functionality. They will be able to apply these concepts to understand bio-based and bio-inspired technologies.

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

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

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:
Prof. Dr. Rubén D. Costa Dr. Juan Pablo Fuenzalida Werner

Courses (Type of course, Weekly hours per semester), Instructor:
Concepts of Physics and Chemistry in Nature (Exercise) (Übung, 2 SWS)
Costa Riquelme R [L], Banda Vazquez J, Costa Riquelme R, Zieleniewska A

Concepts of Physics and Chemistry in Nature (Lecture) (Vorlesung, 2 SWS)
Costa Riquelme R [L], Banda Vazquez J, Costa Riquelme R, Zieleniewska A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0186: Biochemistry | Biochemie [BC]

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
Next semester

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

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

Intended Learning Outcomes:
After sucessful completion of the module the students are able to describe and explain basic concepts, phenomenons and relations in the field of biochemistry. The students know important properties of proteins,understand the significance of kinetic parameters of enzymatic reactions and will be able to calculate them and apply to new issues (e.g. inhibition). Furthermore the students will be able to specify in detail basic metabolic pathways of the most important classes of substances, understand the particular steps and regulation systems of the respective paths. They have come to understand that biochemical reactions are usually reactions with very high sustainability, which can serve as models for sustainable chemical reactions.

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

Media:
Presentations, powerpoint, presentation script, exercise sheets

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

Responsible for Module:
Dr.-Ing. Ammar Al-Shameri

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

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

Module Description

CS0190: Practical Course Bioprocess Engineering | Praktikum Bioverfahrenstechnik [PCBPE]

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
At the beginning of the practical course, there is an oral question to ensure that the students are sufficiently familiar or familiarized with the safety-related facts of the practicum script/ topic and the asscoiated equipment. The service is provided in the form of written logs of the laboratory tests carried out (about two experiments and at least ten pages protocol per test). In these, the students should prove that they are able to understand the theoretical basics of the experiments, to document the execution of the experiments and to evaluate their results. They should also show that they can discuss deviations from the expected results and possible causes. Assessment of the internship as passed/failed. The internship is only passed if the protocol listed above meets the criteria of completeness, correctness, and comprehensibility/clarity to more than 50%, whereby feedback is given on a first draft.

Repeat Examination:

(Recommended) Prerequisites:
Module Bioprocess Engineering

Content:
The practical course serves to deepen the content developed in the lecture Biochemical Engineering. In the internship, the theoretically conveyed basics are deepened by means of selected experiments. These practical experiments include the analysis of typical bioprocess parameters such as the determination of the specific growth rate. In addition, process-relevant offline parameters (e.g. the dry biomass) and online parameters (e.g. O2 and CO2 concentration in the exhaust gas) are recorded experimentally. Through the practical course, the students learn how to develop and optimize sustainable bioprocesses that are more climate-friendly than many conventional processes and help to reduce environmental pollution.

Intended Learning Outcomes:
After participating in the practical course, the students are able to work practically with bioreactors and scientifically evaluate fermentation processes. In addition, the students are able to transfer the calculations and practical experience they have learned to other complex processes and to use the resources of energy, water and raw materials efficiently.

Teaching and Learning Methods:
The practical course is based on carrying out cultivations in shake flasks and bioreactors. Bacteria and/or yeasts are used as the cultivation organism. Particular value is placed on the students' own initiative in order to promote a solution-oriented and independent way of working. The technical process characteristics are calculated and evaluated based on the recorded data.

Media:
slides, scripts, bioreactor

Reading List:
Horst Chmiel, Bioprozesstechnik,
Spektrum Akademischer Verlag Heidelberg 2011

Responsible for Module:
Prof. Dr.-Ing. Michael Zavrel Dennis Beerhalter Nico Geisler

Courses (Type of course, Weekly hours per semester), Instructor:
Praktikum Bioverfahrenstechnik (Praktikum, 5 SWS)
Zavrel M [L], Beerhalter D, Stadelmann T, Zavrel M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0197: Sustainable Investment and Financial Management | Sustainable Investment and Financial Management

Version of module description: Gültig ab winterterm 2021/22

Module Level: Bachelor	**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 grading is based on a written exam with a duration of 120 minutes. To test whether the students acquired the theoretical basics in financial analysis and investment planning, questions are asked, where they have to prove their understanding of the introduced concepts. By using a calculator, the students for example have to analyze investment projects, create the optimal capital structure of projects or firms, evaluate bonds, stocks, or sustainability of investments.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The module will give students a broad understanding of the instruments to analyze and evaluate investment opportunities such as:
- Financial Statement Analysis (balance sheet analysis, analysis of profit and loss account, statement of affairs)
- Investment Analysis (net present value method, actuarial return)
- Capital Budgeting (determination of free cashflows, choosing between alternatives)
- Cost of Capital (equity costs, borrowing costs, capital costs)
- Capital Structure

Furthermore, the students will be introduced to sustainability concepts in financial management such as social responsible investing, developments in finance and sustainability and ESG (Environment, Social, Governance) criteria for investments.

Intended Learning Outcomes:
Upon completion of this module students will be able to: (1) to name and apply important measures of company performance, (2) to analyze and choose investment projects, (3) to create the optimal capital structure of projects and firms, (4) restate and employ concepts of financial mathematics and (5) to evaluate financial instruments. The students will be trained in these methods by applications to sustainable financial management and discuss e.g., green investments. The course will prepare participants to understand major drivers and constraints of transforming the financial system to a more sustainable one. Furthermore, it will familiarize participants with the business, regulatory and technical perspective of sustainable finance and will acquaint them to take an active part in the discussion around the topic.

Teaching and Learning Methods:
The module will combine several teaching methods.
- Weekly Lecture: Presentation of theoretical basics and applied examples, supported by slides. As a better learning effect is reached by a dynamic learning environment, the student can join in live surveys with onlineTED.
- Exercise available on several dates: Calculation of selected exercises from the set of exercises in small groups so the students can directly ask questions about the calculations.
- Set of exercises with applied examples for individual practising of exercises.

Media:
Presentations, exercises with solutions

Reading List:
Berk/DeMarzo (2020), Corporate Finance, 3rd. Edition, Pearson.
Schoenmaker, D (2020): Principles of Sustainable Finance
Thompson (2021): Principles and Practice of Green Finance: Making the Financial System Sustainable

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Sustainable Investment and Financial Management (Lecture) (Vorlesung, 2 SWS)
Hübner A [L], Bodmer U

Sustainable Investment and Financial Management (Exercise) (Übung, 2 SWS)
Hübner A [L], Bodmer U, Kwon S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0204: Project Studies | Project Studies

Version of module description: Gültig ab winterterm 2021/22

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 12	**Total Hours:** 360	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
The project study is a practical task which either a single student or a a team of 2-5 students work on. The students deal with a specific task of a company, agency or any other similar institution (including research projects at university chairs) and work out the state of the current research on the given issue and describe their own specific solution to the given task . Based on scientific knowledge and methodical skills, the students evolve the task. The project study is supported by a professor of the TUM Campus Straubing as well as representatives of the firm, agency, and instituion respectively. The students present the results of their study in a written term paper. Grading will especially take into account the overall working outcome of the project with respect to the initial problem set, the selection and application of the chosen methodology as well as the discussion of the main findings. In case of team work, each student’s individual contribution to the written paper and the project's success must be identifiable and assessable.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowlege in Business Administration and Economics

Content:
In the project study, students acquire hands-on experience by working with companies/institutions/ agencies on a particular assignment, for example:
- sustainability analyses of single activities or projects
- the application of optimization tools for problems out of the logistic sector,
- the description of a marketing strategy.
They structure the project and employ their methods and theories to develop results of practical value for the company/institution/agency. The project is supervised jointly by mentors from the

respective partner company/agency and the professor of the TUM Campus Straubing. The project study should be accomplished in about three to six months.

Intended Learning Outcomes:
After successfully completing the module students are able to work on a project in a systematic and academic manner. In case of team work, students can contribute a significant part to the work output of their team. They accomplish their task within a given time-frame. The students can identify and express problem sets. Furthermore they can term appropriate methodologies for problem solving and transfer them to a proper solution. Finally they can choose and apply the appropriate methodologies to solve the given problem.

Teaching and Learning Methods:
Working on a solution for the given project in a team or individually encourages students to deal soundly with a practical issue. Thus, they can apply their knowledge gained in their study on real issues firms struggle with. Further, they are able both to communicate the evolvment of the project and to present the solution to the supervisors from the company/institution and the university.

Media:
literature, presentations

Reading List:
Relevant literature will be selected and communicated specifically for the project.

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Projektstudium | project studies (Orientierungsveranstaltung, 1 SWS)
Hübner A [L], Hübner A, Lex E
For further information in this module, please click campus.tum.de or here.

Module Description

CS0209: Basics on Renewables Utilization | Grundlagen der Stofflichen Biomassenutzung

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:

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

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

Teaching and Learning Methods:
In the lecture the teaching content is imparted by speech of the lecturer using powerpoint presentations and case studies. Corresponding to the teaching content exercise sheets are

prepared on which the students work in self-study. The solution and discussion of the exercises takes place in the tutorial.

Media:
Presentation, script, examples and solutions

Reading List:
script, sample solutions for exercises

Responsible for Module:
Broder Rühmann

Courses (Type of course, Weekly hours per semester), Instructor:
Grundlagen der stofflichen Biomassenutzung (Übung) (Übung, 2 SWS)
Rühmann B [L], Rühmann B

Grundagen der stofflichen Biomassenutzung (Vorlesung) (Vorlesung, 2 SWS)
Rühmann B [L], Rühmann B
For further information in this module, please click campus.tum.de or here.

Module Description

CS0210: Bioinformatics | Bioinformatik

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Learning outcomes shall be verified in a written test (90 minutes). Knowledge questions check the treated methods, algorithms and concepts in the field of bioinformatics and computational biology.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
CS0001 Foundations of Programming, CS0130 Grundlagen Biologie

Content:
Selected bioinformatic methods required for analyzing biological and bio-chemical data, especially from the area of biological databases (e.g. NCBI, Swissprot), algorithms for sequence alignments (e.g. Needleman-Wunsch, Smith-Waterman, ClustalW, BLAST) as well as methods for phylogenetic analysis. Methods shall be presented during the lecture. Within the scope of the exercise, their application shall be practiced based on specific case studies related to biotechnology and sustainability.

Intended Learning Outcomes:
The students know the most important bioinformatic methods and databases (e.g. NCBI, Swissprot, Needleman-Wunsch, Smith-Waterman, ClustalW, BLAST) for the analysis of biological and biochemical data. They will understand these methods and be able to select and perform appropriate bioinformatic procedures for specific case studies and real data, e.g. when working on biotechnology and sustainability projects.

Teaching and Learning Methods:
Lectures to provide the students with all necessary fundamentals of bioinformatics and its algorithms. In the exercises, the students will work on different analysis and programming tasks

and will develop basic Linux skills to conduct own analysis of biological and bio-chemical problems using bioinformatics tools and algorithms.

Media:
Slide presentation, blackboard, lecture and exercise recording, discussion forums in e-learning platforms, Exercise Sheets

Reading List:
Bioinformatik: Grundlagen, Algorithmen, Anwendungen, Rainer Merkl
Bioinformatics and Functional Genomics, Jonathan Pevsner

Responsible for Module:
Prof. Dr. Dominik Grimm

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

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

Module Description

CS0220: General and Inorganic Chemistry | Allgemeine und Anorganische Chemie [Chem]

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The performance test will be in the form of a written examination rendered. The students should demonstrate in the exam the understanding of the structure of chemical compounds and their typical reactions and chemical conversions. It will also be tested the ability to formulate reaction equations, calculate reaction kinetic and thermodynamic parameters, as well as to transfer the acquired knowledge about the structure and reaction behavior of chemical substance groups to new chemical questions. No auxiliary means are allowed in the exam. 90 min examination time

Repeat Examination:
Next semester

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

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

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

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

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

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

Responsible for Module:
Prof. Herbert Riepl

Courses (Type of course, Weekly hours per semester), Instructor:
Allgemeine und anorganische Chemie (Übung) (Übung, 2 SWS)
Riepl H [L], Riepl H

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

Module Description

CS0226: Corporate Strategy | Corporate Strategy

Version of module description: Gültig ab winterterm 2022/23

Module Level: Bachelor/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:
Group Project and Group Presentations: 60%; Online Exam (60 min.): 40%

Repeat Examination:

(Recommended) Prerequisites:
Basic knowledge of business administration

Content:
Students are introduced into the topic of corporate strategy based on a thorough understanding of what strategy means in the context of corporate management. Further, students learn about key management analysis tools and whose application to real life scenarios by the means of case studies. Subsequently, corporate strategy is looked at from a regional, national and international perspective including the notion of innovation and the formation of competitive advantage.

Intended Learning Outcomes:
The students obtain knowledge in
• gaining a broad understanding about core themes of corporate strategy, related processes and theoretical underpinnings,
• understanding strategic analysis tools in the context of case studies and further examples
• developing a critical understanding of strategy in the context of corporate management with the objective to improve strategic decision making, and
• obtaining the ability to develop managerial reports based on the above.

The student enhance their skills in
• evaluating presented information in a critical manner based on the information presented in the course,

• applying strategic analysis tools and interpret the results of such analysis,
• presenting the results of his/her work in a concise way to a larger audience, and
• connecting local/regional/national corporate strategy topics to an international context.

The student obtain further general qualifications in
• having insights into relevant topics and issues in the context of corporate strategy,
• applying relevant theoretical frame works to case studies and demonstrate an in-depth understanding of the results,
• planning and executing relevant project work in a timely fashion in the context of a group project,
• presenting and contextualizing relevant information, theories and issues of the corporate strategy domain (oral and written),
• discussing relevant information and topics with peers as part of the course, and
• connecting the concept of innovation to corporate strategy and business success

Teaching and Learning Methods:
The basic concepts are presented with slide-based lectures. The models and methods are presented and illustrated by means of exercise examples, including practical applications in corporate strategy management. These contents form the basis for a critical consideration from a theoretical-conceptual and practical-application-oriented point of view. Current research papers, case studies and textbooks are used as the basis for this.

Media:
Core text book, case studies, academic journal articles, lecture slides, relevant online content

Reading List:
Exploring Strategy by Johnson, Whittington and Scholes

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Corporate Strategy (Vorlesung, 4 SWS)
Winkelmann S [L], Lex E, Winkelmann S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0240: Open Circular Innovation | Open Circular Innovation [OCI]

Innovation Challenges from an Industry Perspective

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 135	**Contact Hours:** 45

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

Description of Examination Method:
Individual presentation: Students will prove their understanding of opportunities and challenges in the field of circular economy. They show that they are able to put themselves into the situation of a specific company and quickly identify their focal circular economy topics. They prepare for the presentation by conducting deepdive research on a specific industry, conceptualizing creative circular solutions, and structuring the gained knowledge into a profound presentation.

Group presentation and group discussion (systemic circular innovation): Students will prove their understanding of systemic circular economy correlations and their ability to develop a feasible cross-value-chain concept. They understand different stakeholder perspectives and develop a strong argumentation line in a specific stakeholder role. As preparation for these assignments, they build working groups to practice stakeholder negotiations with their fellow students, research the given stakeholder roles, write an argumentation line for each of them, and structure possible process solutions for the respective systemic circular innovation as a basis for a convincing negotiation.

Group presentation (consulting pitch): Students will prove their ability to identify the need for circular economy analyses in a specific company and to propose a suitable open circular innovation approach. They show their skills to present a convincing consulting pitch in a power point presentation.

The students will be evaluated based on the following assignments:
- Individual presentation of a circular economy analysis in a specific industry (~10 min., based on a structured argumentation line, individual contribution evaluated) (20%)
- Group discussion in a stakeholder role play: conducting negotiations for a circular system innovation from a specific stakeholder perspective (~30 min., individual contribution evaluated) (20%)

- Group presentation and Q&A for a jointly developed circular system innovation (~30-45 min., based on a prototype model, group contribution evaluated, group size: ~3-6) (30%)
- Group presentation and Q&A for a circular innovation consulting pitch (~20-30 min., based on a power point slide deck, group contribution evaluated incl. submitted power point deck, group size: ~2-5) (30%)

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Students of this module should have passed the Bachelor Modules Circular Economy as well as Technology and Innovation Management.

Content:
The module contains units covering the following topics:
- Circular economy opportunities and challenges in different industries
- Circular economy strategy analysis
- Multiple lifecycle thinking
- Material supply risks due to macro-economic influences
- Open circular innovation process
- Cross-value-chain circular systems
- Stakeholder negotiations
- Circular economy consulting pitch
- Industry deepdive for circular electronics
- Literature research and current trends/developments
- Case studies

Intended Learning Outcomes:
At the end of the module, the students are able to analyze strategic circular opportunities and challenges from a corporate perspective. They know different forms of open innovation and can evaluate their suitability for circular economy use cases in practice. Furthermore, they have gained an understanding of systemic correlations in a circular economy including macroeconomic influences such as material supply risks due to geopolitical conflicts. They can identify the conceptual circularity differences between industries and learn how to approach different circular solutions, depending on type of circularity and product characteristics.

The students know how to set up a cross-value-chain circular innovation approach and how to negotiate a circular solution from a specific stakeholder role. They are able to analyze circular opportunities from the perspective of a circular economy consultancy and can write and present a pitch for a circular innovation project. They learn how to develop circular solutions in a company, based on an existing corporate strategy, and how to involve external and internal stakeholders for a successful way toward implementation.

The gained skills contribute to the students' ability to develop circular business models in industry, set up open circular innovation processes, and approach circular economy network solutions in practice.

Teaching and Learning Methods:
The module Open Circular Innovation transfers the theoretical knowledge of the module Circular Economy to practice and reflects the concept from the perspective of different industries. Students are able to connect the fields of circular economy and innovation management in a new dimension and prove their knowledge in practice-oriented circular innovation challenges.

Teaching / learning methods:
- Lectures on circular economy and open innovation
- Methodological excercises for strategy development, presentations, and pitches
- Case reflections in different industries
- Academic and web research
- Workshop with group work on a systemic circular innovation concept
- Group work to build a prototype model for the systemic circular innovation concept
- Role play negotiations in a fictitious stakeholder group
- Workshop with group work on a circular economy consulting pitch
- Power point presentation
- Final group presentations

Media:
Power point, flipchart, online contents, online survey, case studies, prototype modeling, presentations

Reading List:
Ballweg, M., Deiler, F., Eisenreich, A., Gebhard, N., Kirr, K., Mauß, N., Wehinger, M., Zimmer, M., & Gröschl, J. (2024). The business case for a circular economy. https://www.circular-republic.org/ce-business-case-whitepaper.
• Bocken, N. M. P., de Pauw, I., Bakker, C. A., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. Journal of Industrial and Production Engineering, 33(5), 308–320. https://doi.org/10.1080/21681015.2016.1172124
• Binder, J. K., & Braun, M. (2024). The circular business revolution: A practical framework for sustainable business models. Pearson.
• Chesbrough, H. W. (2003). Open Innovation: The new imperative for creating and profiting from technology. Harvard Business School Press.
• Chesbrough, H. W. (2006). Open innovation: A new paradigm for understanding industrial innovation. In H. W. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), Open innovation: Researching a new paradigm (pp. 1–12). Oxford University Press.
• Eisenreich, A., Füller, J., Stuchtey, M., & Gimenez-Jimenez, D. (2022). Toward a circular value chain: Impact of the circular economy on a company's value chain processes. Journal of Cleaner Production, 378, 134375. https://doi.org/10.1016/j.jclepro.2022.134375

• Eisenreich, A., Füller, J., & Stuchtey, M. (2021). Open circular innovation: How companies can develop circular innovations in collaboration with stakeholders. Sustainability, 13(23), 13456. https://doi.org/10.3390/su132313456
• Eisenreich, A., Just, J., Jiménez, D. G., & Füller, J. (2024). Revolution or inflated expectations? Exploring the impact of generative AI on ideation in a practical sustainability context. Technovation, 138, 103123. https://doi.org/10.1016/j.technovation.2024.103123.
• Ellen MacArthur Foundation. (2013). Towards the circular economy: Economic and business rationale for an accelerated transition. https://ellenmacarthurfoundation.org/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an
• Ellen MacArthur Foundation. (2019). Artificial intelligence and the circular economy: AI as a tool to accelerate the transition. https://emf.thirdlight.com/file/24/GgC25OAGBvwdiFGgtzZGVXuZsz/Artificial%20intelligence%20and%20the%20circular%20economy.pdf
• Eapen, T. et al. (2023). How generative AI can augment human creativity. https://hbr.org/2023/07/how-generative-ai-can-augment-human-creativity
• Freeman, R. E., Harrison, J. S., & Zyglidopoulos, S. (2018). Stakeholder theory: Concepts and strategies. Cambridge University Press. https://doi.org/10.1017/9781108539500
• Govindan, K., & Hasanagic, M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: A supply chain perspective. International Journal of Production Research, 56(1-2), 278–311. https://doi.org/10.1080/00207543.2017.1402141
• Füller, J., Hutter, K., & Faullant, R. (2011). Why co#creation experience matters? Creative experience and its impact on the quantity and quality of creative contributions. R&D Management, 41(3), 259–273. https://doi.org/10.1111/j.1467-9310.2011.00640.x

Responsible for Module:
Prof. Magnus Fröhling

Courses (Type of course, Weekly hours per semester), Instructor:
Open Circular Innovation (Lecture) (Vorlesung, 2 SWS)
Fröhling M [L], Eisenreich A

Seminar Open Circular Innovation (Seminar, 1 SWS)
Fröhling M [L], Eisenreich A, Fröhling M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0248: Markets for Renewable Energies and Biobased Products | Märkte für erneuerbare Energien und biobasierte Produkte

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
The exam performance is effected by a written test. Through comprehension questions it is reviewed whether the students have understood principles of market development in the covered markets. The students answer questions regarding the development and current situation on the markets of renewable energies and biogenic products as well as the most important factors that influence this market development. The students prove that they have understood the interest and behaviour of actors being active on these markets by answering corresponding questions.
Exam duration: 90 minutes.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic know-how to the functioning of markets

Content:

A) Introduction and overview

B) Markets for renewable energies
- Regenerative electricity
- Regenerative heat /cooling
- Sustainable mobility
- Sector coupling

C) Markets for biobased products
- Chemical markets

- Building & Living
- Biomaterials
- Other markets (e.g. paper, cardboard, carton, natural cosmetics)

Intended Learning Outcomes:
After attending the module, students will be able to show the developments of markets for energy and biobased products and discuss market development. Students are familiar with the relevance, size, and important influencing factors on the renewable energy markets as well as markets for material use of biogenic resources. They are able to compare these markets, to capture important determinants of market development, and to identify the use of fossile and regenerative energies as well as the use of biomass for material applications in a macroeconomic and societal context thus developing strategies for future use.

Teaching and Learning Methods:
The lecture will be done using Powerpoint with specifically worked out presentation scripts. In addition, published studies and statistical data related to the development and situation on the targeted markets will be integrated into the lectures. Furthermore, current topics are discussed with students.

Media:
Slide presentation, Lecture recordings; Interactions using Moodle; selected journal articles; current topic-related news, videos

Reading List:
Quaschning, Volker (2020): Erneuerbare Energien und Klimaschutz: Hintergründe – Techniken und Planung – Ökonomie und Ökologie – Energiewende. 5. Auflage. Hanser Verlag: München.

FNR (2014): Marktanalyse Nachwachsender Rohstoffe. Schriftenreihe Nachwachsender Rohstoffe 34. Gülzow.

Responsible for Module:
Thomas Decker

Courses (Type of course, Weekly hours per semester), Instructor:
Märkte für erneuerbare Energien und biobasierte Produkte (Vorlesung, 4 SWS)
Menrad K [L], Decker T, Emberger-Klein A, Menrad K
For further information in this module, please click campus.tum.de or here.

Module Description

CS0281: Biopolymers | Biopolymere [Biopol]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
The learning results are going to be proved in form of a written test (90 min). The students answer questions about biopolymers and their physicochemical properties. They prove that they have gained knowledge about the discrimination, classification and extraction of biopolymers within the scope of the module and are able to apply this knowledge. No additives are allowed.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic principles chemistry, physics and biology

Content:
The module deals with the structure and the function of polymers derived from nature (biopolymers). Covered are proteins, polysacharides, biogenic polyester, polyisoprenes and lignin. It is illustrated how bioploymers can be obtained from natural sources and which chemical reactions they are able to perform. Thereby the importance of the microstructure as well as the importance of the physicochemical properties in biological functions for the application-technical relevance of the biopolymers used as raw and functional material are covered.

Intended Learning Outcomes:
By attending the module the students are able to discriminate biopolymers and to classify them application-oriented. They know how and from which natural sources biopolymers can be obtained. The students acquire basic knowledge in the understanding of biopolymers and their physicochemical properties and can describe these properties and compare them among each other. Thereby they are able to differentiate suitable biopolymers application-oriented.

Teaching and Learning Methods:
Teaching methods: in the lecture the technical contents are communicated by a talk of the lecturer, supported by PowerPoint and skectches on the blackboard. In relation to the teaching content written tasks are disbursed on which the students work in self-study before the tutorials. The solution and discussion of the tasks as well as the visulaization of the teaching content by working with molecular models takes place in the tutorials. Learning methods: at the postprocessing of the lecture exspcecially while the exercises are solved the students keep themselves intensive busy with the teaching contents of the lecture and reach in this way a comprehensive knowlegde about biopolymers.

Media:
Lecture, blackboard sketch, foil script, molecular models

Reading List:
Türk, Oliver: Stoffliche Nutzung nachwachsender Rohstoffe
Grundlagen - Werkstoffe - Anwendungen, Springer Verlag

Responsible for Module:
Prof. Cordt Zollfrank

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

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

Module Description

CS0283: Basics Silviculture | Grundlagen Waldbau [BiS]

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
Next semester

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

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

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

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

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

Reading List:
"Burschel, P. & Huss, J. 1987. Grundriss des Waldbaus. Ein Leitfaden für Studium und Praxis. Parey, Hamburg und Berlin. 352 S. Elverfeldt, Freiherr von A.
Rittershofer, F. 1999. Waldpflege und Waldbau. Für Studium und Praxis. Gisela Rittershofer Verlag, Freising. 492 S. "

Responsible for Module:
Dr. Alexander Höldrich

Courses (Type of course, Weekly hours per semester), Instructor:
Grundlagen Waldbau (Vorlesung) (Vorlesung, 2 SWS)
Höldrich A [L], Gmach Y, Höldrich A, Zollfrank C

Grundlagen Waldbau (Übung) (Übung, 1 SWS)
Höldrich A [L], Gmach Y, Höldrich A, Zollfrank C
For further information in this module, please click campus.tum.de or here.

Module Description

CS0296: Seminar in Environmental and Development Economics | Seminar in Environmental and Development Economics

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**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 exam consists of a written seminar paper of a maximum of 15 pages. The students prepare an academic literature and/or practical paper and answer a current question in the field of environmental or development economics. They demonstrate that they have mastered the current literature for the question and, if necessary, can understand smaller empirical evaluations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Introduction to Development Economics, Introduction to Environmental Economics, Empirical Research Methods

Content:
After the basics of good research design in the field of environmental and development economics have been introduced and discussed and the structure of scientific papers has been worked out together, the students work on a chosen topic area. Topics mainly relate to economic context as well
Behavioral interventions for more sustainable behavior.
Possible topics are:
- Agriculture in developing countries - Entrepreneurship in developing countries
- Poverty and nutrition
- Environmental assessment

Intended Learning Outcomes:
After successfully completing the module, students can derive an academic research question and answer it based on a literature review in the field of environmental and development economics. In

addition to the literature work necessary to answer the research questions, they learn to interpret the necessary empirical analyses
Critically question the results of individual studies and recognize connections between different strands of research.

Teaching and Learning Methods:
In the seminar, the basic principles of academic literature work in the field of environmental and development economics are learned. Students deal with a research topic and summarize the current state of academic research on this topic. They learn to critically question current research results and designs and draw connections between individual studies. The students apply these on their own initiative to a question in their seminar paper. The students present the results of their seminar work to their fellow students and discuss them together in the group. By writing a seminar paper, students learn how to prepare and present a scientific paper on a relevant question.

Media:
Research papers; presentation slides

Reading List:
Valerie Matarese (2013). Using strategic, critical reading of research papers to teach scientific writing: the reading–research–writing continuum, Editor(s): Valerie Matarese (2013). In Chandos Information Professional Series, Supporting Research Writing, Chandos Publishing,Pages 73-89. https://doi.org/10.1016/B978-1-84334-666-1.50005-9.)

Yongyan Li, Margaret Cargill, Xin Gao, Xiaoqing Wang, Patrick O'Connor (2019). A scientist in interdisciplinary team-teaching in an English for Research Publication Purposes classroom: Beyond a “cameo role”,
Journal of English for Academic Purposes, Volume 40, Pages 129-140. https://doi.org/10.1016/j.jeap.2019.06.005.

Yongyan Li, John Flowerdew (2020). Teaching English for Research Publication Purposes (ERPP): A review of language teachers’ pedagogical initiatives, English for Specific Purposes, Volume 59, Pages 29-41. https://doi.org/10.1016/j.esp.2020.03.002.

Responsible for Module:
Prof. Anja Faße

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar in Environmental and Development Economics (Seminar, 4 SWS)
Faße A [L], Faße A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0302: Research Internship Bachelor | Research Internship Bachelor

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**Language:** German/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) and/ or an Presentaion (20-30 minutes, 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 and/or presentation 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.

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:
alle prüfungsberechtigten Personen des TUMCS

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Bachelor (Costa) (Forschungspraktikum, 5 SWS)
Costa Riquelme R [L], Atoini Y, Banda Vazquez J, Cavinato L, Costa Riquelme R, Zieleniewska A
For further information in this module, please click campus.tum.de or here.

Module Description

CS0304: Research Excursion Bachelor | Research Excursion Bachelor

B-REX

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Passed/not passed:
The module is passed when the deliver a learning portfolio consisting of the following elements:
1. 2 written pages or 20’ presentationon preparatory work for the excursion. The form and the due date will be specified in the kick-off session.
2. At least two topical contributions to the excursion (topical input, interviews, questions on presentations and during site visits, discussion contributions);
3. 2 written pages reflection after excursion. The due date will be specified in the kick-off session.
All three elements of the learning portfolio have to be delivered to pass the module.

Repeat Examination:

(Recommended) Prerequisites:
Prerequisites may be defined by the professors / lecturers offering the excursion, dependent on the chosen destination / topic. They will be announced with the announcement of the excursion 1 month before the start of lectures in the semester in which the excursion is offered, at the latest.

Content:
The research excursion deals with individual and specific topics from the respective study programmes. On an individual basis, professors and lecturerers from the rerspective study programme offer the research excursion to a topic or place of their choice.

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.

Intended Learning Outcomes:
The excursion aims to support the scientific profile building of students and the acquisition of scientific, practical and social competencies. 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 its tranferability into practice.

In particular, the intended learning outcomes are the following:
- Select relevant scientific and practical information and recall it for visits of industries, organizations, cities and talks with experts and stakeholders,
- Prepare questions regarding the state-of-knowledge, open research questions and practical relevance and discuss these with fellow students,
- Discuss research and practical knowledge with stakeholders,
- Recognize the implementation of research and practical knowledge in the organisations / sites visited,
- Reflect on the state of implementation of theoretical knowledge in practice,
- Discuss with fellow students and supervisors gained insights and compare it with their expectations.

Teaching and Learning Methods:
The research excursion consists typically of the following elements (teaching and learning methods):
- Kick-off session: To achieve a good get-to-know, brief the students about the research excursion contents, related courses and required student performance an interactive in-presence workshop will be carried out. This covers prsentations, and interactive elements such as games, online-tools etc.
- Individual work and feedback: In order to prepare for the on-site visits the students carry out own (literature) research on the excursion topics. To document their learning progress and to be able to share the results they summarize their findings in written form. A presentation of the contents in front of the fellow students is an optional element. In this process, they are supervised, receive materials and continuous feedback.
- On-site visits: 3-5 day research trip with site-visits, presentations, discussions with stakeholders etc.This part will be specified in the specific program of the research 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.

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:
Excursion Wood-based Resources (Exkursion, 2 SWS)
Röder H [L], Röder H, Wagner M
For further information in this module, please click campus.tum.de or here.

Module Description

CS0326: Introduction in Sustainability Management | Introduction in Sustainability Management

Version of module description: Gültig ab summerterm 2025

Module Level: Bachelor	**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 learning outcomes will be assessed by a written examination of 90 minutes. The exam will cover an array of questions covering the various aspects of stakeholder management addressed during the semester. By answering these questions, the students demonstrate on the one hand that they have understood important aspects and concepts of sustainability management by reproducing and explaining them. On the other hand, students show that they can independently apply acquired knowledge and tools to specific contexts and analyse their components and conditions.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in business and management studies is recommended

Content:
The module aims to acquaint students with the theory and practice of sustainability management, focusing on the business perspective. It provides students with concepts, knowledge, skills, and application experience regarding
sustainability management.
It first lays a conceptual foundation for sustainability as a goal for business and society:
- Sustainability in the past and today
- Concepts and justification of sustainability and sustainable development
- Reasons and strategies for sustainability management
It then introduces the concept of stakeholder management, and discusses sustainability management along several key stakeholders, in particular:
- Employees

- Governmental actors
- Civil society
- Investors
- Consumers

Intended Learning Outcomes:
On successful completion of the module, students will have developed a basic knowledge and understanding of the multifaceted field of sustainability management. Specifically, students will be able to explain what sustainable development means, understand key concepts and elements of (corporate) sustainability management, and discuss the various stakeholders in sustainable development and their influence on (corporate) sustainability management. In addition, the students will be able to critically reflect on areas of application, opportunities and limits of sustainability management. They will be equipped with the knowledge, skills and tools to analyse and respond to business and sustainability problems, to analyse options and recommend courses of action, and to use information and data effectively. Students will enhance personal effectiveness through self-reflection and self-management, sensitivity to diversity, paradoxes and ethical dilemmas, and the ability to continuously learn through comparison of concepts and practice.

Teaching and Learning Methods:
The module is delivered as a weekly lecture with integrated exercises and interactive elements. The lecture presents concepts, tools, and reasoning mainly through slides. Despite its teacher-centred nature, students are given a floor for questions and small exercises and food for thought to check and ensure their learning progress. The integrated exercises and case studies repeat and reinforce parts of the lecture content by using examples. These interactive elements open spaces for independent analysis, application, and reflection. They allow interaction in small groups and participation in moderated classroom discussions. The combination of teacher-centred and interactive teaching approaches will enable students to develop knowledge, skills, and application experience in relation to sustainability management.

Media:
Presentation slides, text book, video clips, cases and exercises, blackboard.

Reading List:
Hahn, R. (2022). Sustainability Management: Global Perspectives on Concepts, Instruments, and Stakeholders. ISBN: 978-3-9823211-1-0

Further readings will be provided during the lecture.

Responsible for Module:
Stefan Gold

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction in Sustainability Management (Vorlesung mit integrierten Übungen, 4 SWS)
Gold S [L], Gold S

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

Module Description

CS0328: Nobel Concepts toward Sustainable Future | Nobel Concepts toward Sustainable Future

Version of module description: Gültig ab summerterm 2025

Module Level: Bachelor	**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 in the exam the understanding of the physicochemical, biological, and engineering concepts of high relevance for a sustainable future. They will be asked about basic concepts of biology, chemistry, physics, and engineering applied to technology, building, management, economy, etc. 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 basic concepts in Physics, Biology, Chemistry, Management, Engineering and Mathematics having the focus on examples highlighted by the Nobel Laurates. As such, basic knowledge in Physics, Biology, Chemistry, Engineering, Management, Economics, and Mathematics is required.

Content:
The module aims at providing in-depth knowledge to the students in the field of Physics, Chemistry, Biology, Materials Science applied to technologies (energy transformation, thermal management, storage, lighting, etc.). The focus on basic physical, mathematical, biological and chemical laws, concepts, principles and processes, including chemical bonding, chemical kinetics, spectroscopy, thermodynamics, thermochemistry, mechanics, optics, among others. The students will be able to apply them to understand the functionality of concepts highlighted by the Nobel Laureate toward the transformation of a more sustainable society under the frame of the United Nations Global Sustainable Development Goals.
The course will be divided into several topics related to the chemical transformation, biological transformation, evolution, climate change, management and supply, physical concepts,

engineering, mechanics, and electrical control. Each topic will be addressed refreshing the most important physical, biological, management, engineering and chemical concepts followed by their relevance in the structural and functional aspects towards the sustainable transition of our society.

Intended Learning Outcomes:
Increase students' knowledge of the 17 Global Goals and show the contributions of several Nobel Laureates to sustainable development. At the end of the module students will be able to analyse chemical, mathematical, physical, and biological concepts that are relevant for sustainable transformation of our current technologies; describe the different ways our society is transformed using sustainable concepts (thermally, optically, mechanical, chemistry, biology, water, economics, etc.) that have been highlighted as relevant Nobel Laureates. They will be able to apply these concepts to understand the limitations and challenges related to the sustainable transformation of our technological society. This course will enable students to discuss the United Nations Global Sustainable Development Goals from an interdisciplinary perspective.

Teaching and Learning Methods:
This course attendance includes lectures and exercises. 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 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. Concept Mapping 4 Concepts of Nobel Prize in Physics 2018, ISBN: 1729234488

Responsible for Module:
Prof. Dr. Rubén D. Costa

Courses (Type of course, Weekly hours per semester), Instructor:
Nobel Concepts toward Sustainable Future (Lecture) (Vorlesung, 2 SWS)
Atoini Y, Banda Vazquez J, Costa Riquelme R, Lipinski S

Nobel Concepts toward Sustainable Future (Exercise) (Übung, 2 SWS)
Atoini Y, Banda Vazquez J, Costa Riquelme R, Lipinski S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0333: LCA Lab – Practical Tools and Methods in Life Cycle Assessment | LCA Lab – Practical Tools and Methods in Life Cycle Assessment

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 45	**Contact Hours:** 45

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

Description of Examination Method:
A 60 minute supervised, open-book, computer-based exam in the PC lab, where students perform LCA-related tasks using Activity Browser and Ecoinvent.
Thereby the students have to prove that they achieved the module's intended learning outcomes. They have to show that they understood how the LCA methodology is implemented in open source LCA software like Brightway2 / Activity Browser and commercial LCI data bases like Ecoinvent. They have to demonstrate that they are versed in the use of these software systems, especially in carrying out LCA related tasks, running the model and interpreting the results. Students have to show that they are able to reflect the state of software development of the systems dealt with against general demands for scientifically valid LCA studies and practical requirements.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of LCA principles and terminology is expected. Thus, it is strongly recommended that students have completed the module "Material Flow Analysis and Life Cycle Assessment" or an equivalent course that introduces LCA concepts and systems thinking in environmental assessment.

Content:
Life Cycle Assessment (LCA) has become an essential tool for supporting sustainability in industry, policy, and engineering. This module provides students with both a theoretical and practical foundation in LCA methodology and its application through open-source software tools.
The course repeats LCA methodology according to the ISO Standards 14040/14044 and deepens it for practical applications. This covers all core phases: goal and scope definition, life cycle

inventory, impact assessment, and interpretation. Students are introduced to the structure and functions of LCA software tools, including both commercial and open-source options as well as types of data and data sources, with a specific focus on the Ecoinvent database.
A deep focus is placed on the Python-based Brightway2 framework and the Activity Browser interface as an example for a state-of-the art open LCA environment. Students explore the basics of LCA modeling and gain insights into common challenges such as handling cut-off criteria, multi-output processes, allocation, and uncertainty. The theoretical content is supplemented by recent peer-reviewed scientific LCA studies.
The main application component of the course involves modeling a simplified LCA of a simplified example in Activity Browser / Brightway2. In this phase, students learn to set up a project, model the considered system, select datasets, perform impact assessments, and interpret the results critically.

Intended Learning Outcomes:
The module enables students to apply Life Cycle Assessment (LCA) to evaluate the environmental impacts of products and systems using standardized LCA methods, open-source digital tools and commercial data bases. Through a combination of theoretical input, practical software training, and the analysis of case studies, students develop both conceptual understanding and applied competencies in conducting LCA studies.
In particular, the intended learning outcomes are the following: Students
• Recall and explain the fundamental concepts and methods of an LCA study
• Identify and differentiate between common LCA software tools and life cycle inventory databases
• Apply LCA methodology to a simplified case study using the open LCA environment of Activity Browser / Brightway2 in combination with the commercial Ecoinvent Life Cycle Inventory database
• Interpret and critically assess LCA results, including system boundaries, LCA model, inventory data quality, and Life Cycle Impact Assessment
• Independently perform basic LCA modeling tasks using Activity Browser / Brightway2.
• Researching and selecting suitable relevant datasets in literature and Ecoinvent.

Teaching and Learning Methods:
The core of the course is a one-week intensive block session in the PC lab. It is designed to integrate theoretical foundations, literature-based learning, and guided practical application in a coherent sequence of teaching methods.
The module begins with a structured kick-off including three topical units:
1. A refresher unit on the fundamentals of LCA methodology, serving as a conceptual entry point
2. A unit introducing available LCA software tools and databases and how the LCA methodology is integrated in it.
3. A deep-dive unit into the open-source tool Activity Browser / Brightway2 and the Ecoinvent database, preparing students for hands-on application
Following these sessions, students engage in guided individual work. They are provided with LCA models from own works of the Chair of Circular Economy and Sustainability Assessment or (open) peer-reviewed scientific LCA studies using Acitvity Browser / Brightway2 to learn how LCA in that system environment works.

In addition, students work hands-on in Activity Browser to model a simplified industrial case study. The exercises are guided by the instructor, but students are encouraged to explore and test modeling decisions on their own to build competence in independent application.
To reinforce understanding the course is accompanied by multi-media learning materials such as multiple-choice quizzes, Mentimeter surveys and AI tools such as OneTutor.

Media:
Computer lab with LCA software (Brightway2, Activity Browser, Ecoinvent Database), digital projector, board, flipchart, online content, and recent scientific journal publications.

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. 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

CS0338: Sustainable Value Creation: Integrating ESG into Operations and Supply Chain Management | Sustainable Value Creation: Integrating ESG into Operations and Supply Chain Management [ESG OSCM]

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor	**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:
To assess students' learning outcomes, a written exam of 90 minutes will be carried out. The exam will be tailored to comprehensively cover the content of the lecture. Consequently, students will have the opportunity to demonstrate that they can understand, explain, and synthesize a range of concepts related to Environmental, Social, and Governance (ESG) as well as sustainability within the context of operations and supply chain management. Furthermore, the exam will enable students to reflect on ESG issues and how sustainability can be further enhanced. Hence, students will have the opportunity to showcase their knowledge by analyzing the three dimensions of sustainability while proposing key solutions in a given case. The exam will be conducted in an essay format, allowing students to demonstrate their critical thinking, analytical writing skills, and ability to elaborate on complex topics in a structured and coherent manner.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in business and management studies, sustainability management, or operations and supply chain management is required, as taught in the introductory BSc. courses.

Content:
Environmental, Social, and Governance (ESG) considerations are paramount in enhancing the overall sustainability performance of operations and supply chains. In following a comprehensive ESG framework, firms not only improve their competitive advantage but also promote the well-being of people and the planet. This lecture will guide students in further comprehending the pillars of ESG and their integration into different operations and supply chain contexts. Core topics include, but are not limited to:

- ESG frameworks
- Social, environmental, and economic sustainability indicators
- Strategic operations and supply chain management with a focus on sustainability
- Risks in operations and supply chain management and impacts on sustainability
- The role of people and the planet in sustainable operations and supply chains

Intended Learning Outcomes:
Upon successful completion of the module, students will be able to comprehend and apply a comprehensive sustainability framework to various operations and supply chain contexts. Specifically, they will have developed a critical understanding of how social, environmental, and economic value is created and how this value can be effectively integrated into operations and supply chain management. They will also be able to examine how firms could further improve their Environmental, Social, and Governance (ESG) principles based on key tools, strategies, and practices. Students will be able to identify and assess practices that undermine sustainable value creation and propose solutions to enhance sustainability. Moreover, students will have acquired a variety of skills, including group work, critical thinking, and writing in assessing sustainability, as well as time management and providing/receiving feedback to their peers.

Teaching and Learning Methods:
This module is conducted as a weekly lecture with interactive presentations by the lecturer. Students will also be encouraged to apply the acquired conceptual foundation to discuss business cases and critically examine existing theories and practices on the topic. The core content is mainly presented through slides and teaching cases. The content is based on key textbooks and scientific articles that intersect sustainability, operations, and supply chain management. Students' learning progress will be regularly assessed through reflective discussions and real-world business cases. Students will have the opportunity to enhance their critical thinking skills when evaluating ESG issues in the discussed cases. They will be able to propose solutions to enhance sustainability in operations and supply chain management. They will also be able to deepen their knowledge when reading the recommended materials and practicing the suggested exercises.

Media:
Presentation slides, board, textbooks, scientific articles, video documentaries, business cases, practical exercises, and interactive discussions.

Reading List:
Some of the key textbooks include, but are not limited to:
- Bouchery, Y., Corbett, C. J., Fransoo, J. C., & Tan, T. (2024). Sustainable Supply Chains: A Research-Based Textbook on Operations and Strategy (2nd ed.). Springer.
- Slack, N., & Brandon-Jones, A. (2019). Operations Management (9th ed.). Pearson.

Key examples of scientific articles:
- Beske, P., & Seuring, S. (2014). Putting sustainability into supply chain management. Supply Chain Management: An International Journal, 19(3), 322-331.

- Saeed, M. A., & Kersten, W. (2017). Supply chain sustainability performance indicators: A content analysis based on published standards and guidelines. Logistics Research, 10(12), 1-19.

Responsible for Module:
Dr. Felipe Alexandre de Lima

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

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

Module Description

MGT001393: Sustainability and Law | Sustainability and Law

Version of module description: Gültig ab summerterm 2023

Module Level: Bachelor	**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:
In the final assessment students will need to demonstrate to what extent they have met the Learning Objectives. This assessment will be held as a written exam of 120 minutes in which students are allowed to use the applicable statutory law. The exam consists of two parts which count for approximately 50 per cent each.
In the first part, students will be asked theoretical questions. Students will also be asked to apply their knowledge to known and fictional cases. This second part demonstrates if students have developed the required legal analytical skills. Students also need to demonstrate their ability to apply their knowledge to fact settings not discussed in the literature and to evaluate the legal consequences.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
No specific prerequisites.

Content:
The module provides an overview on how the law accommodates sustainability.
The lecture is divided into three parts:

The first part covers the introduction of the concept of sustainability into the legal system and discusses whether sustainability can be considered as a general legal principle.

The second part elaborates on the integration of sustainability aspects into the sphere of public law. For that purpose, various fields of law related to the management of specific natural resources are being assessed in detail (environmental law, construction law, energy law).

The third part examines the relevance of sustainability issues between private entities, including the topics of climate litigation, sustainability within supply chains and corporate governance (ESG).

The lecture follows a case-based approach. Each unit supplements the theoretical part with case studies based on the relevant legal provisions.

Intended Learning Outcomes:
At the end of the class students will be able to:
1. understand how sustainability is integrated in the body of law,
2. grasp the legal framework of sustainability within various fields of private and public law,
3. identify and analyse specific legal instruments utilized to enhance / prevent sustainable development,
4. assess legal provisions with regard to their implications on sustainability

Teaching and Learning Methods:
The lecture will cover the theoretical aspects of the module in a discussion with the lecturer. It will provide the opportunity to work individually or in groups on case scenarios, covering issues of sustainability in various fields of law. The purpose is to repeat and to intensify the content discussed in the lecture and to review and evaluate legal issues. Students will develop the ability to present these findings in a concise and well-structured written analysis.

Media:
Reader, Presentations (PPT), Cases.

Reading List:
Kahl/Weller, Climate Change Litigation (1st ed., 2021)
Schlacke, Umweltrecht (8th ed., 2021)

Responsible for Module:
Ann, Christoph; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Sustainability and Law - Exercise (Campus Straubing) (MGT001393, englisch) (Übung, 2 SWS)
Geigenberger S, Reiner M

Sustainability and Law (Campus Straubing) (MGT001393, englisch) (Vorlesung, 2 SWS)
Geigenberger S, Reiner M
For further information in this module, please click campus.tum.de or here.

General Electives | General Electives

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

Module Description

CS0272: Experimental Lab - Architecture, Science & Design | Experimental Lab - Architektur, Wissenschaft & Design

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
Over the course of the semester, students are expected to complete a project assignment. The focus is on developing an understanding of architecture and design in the context of scientific topics – students develop their own ideas for the public urban space. The final grade is based on the project work and a concluding semester presentation. The evaluation takes into account the idea, function, context, creative development of the concepts, and the manner of presentation. Type of examination: oral (presentation); Duration: 30 minutes.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The content of this module is divided into three main focus areas:

The first focus is an introduction and a joint “Mind Opening Workshop” exploring the interplay between architecture, science, and design. In addition, students are introduced to the fundamentals of visual communication, which are intended to support them in developing and delivering their own presentations in the future.

A second focus is the teaching of basic knowledge and an overview of the broad spectrum of the field of architecture. This is achieved through lectures as well as by applying transfer techniques in the students' own project work. The complex perception of renewable raw materials in both private and public spaces is addressed, along with the wide range of possible applications. The aim is to stimulate students’ creativity and encourage them to place science and research in the context of

other disciplines. This synergy effect is intended to inspire innovative approaches and open up new areas of tension and research.

The third focus is the implementation of the learned methods and approaches in the students' own project in public space, where the diverse possibilities for the use of renewable raw materials are to be made tangible. Communication about the insights and outcomes within the course and to the public is another key component of the module. The goal is to enhance students' presentation skills and techniques in order to effectively realize and communicate their own ideas.

Intended Learning Outcomes:
After completing the module, students are able to understand the fundamentals and methods of architecture and design and relate them to scientific topics. The experiences gained through the coursework and project work enable students to develop their own creative solutions with an interdisciplinary approach. Through regular feedback during the course, students learn various techniques and methods for planning engaging presentations and delivering them convincingly.

Teaching and Learning Methods:
Depending on the size of the course, students complete and present a project on a specific topic either individually or in groups. The results are presented within the course and/or in a public setting. Additional methods include lectures on architecture and design, project work involving constructive, mutual exchange, and a final presentation.

Media:
Use of all available multimedia resources

Reading List:
The most up-to-date literature recommendations will be provided to students during the module introduction.

Responsible for Module:
Verena Stierstorfer

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

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

Module Description

CS0282: Scientific Working | Wissenschaftliches Arbeiten

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
Next semester

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

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

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

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

Media:
Presentations, slide scripts

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

Responsible for Module:
Dr. Daniel van Opdenbosch

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

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

Module Description

SOT82701: EuroTeQ Collider. Enhancing Connections for Sustainable Futures (BSc) | EuroTeQ Collider. Enhancing Connections for Sustainable Futures (BSc)

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**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:
During this module, students must complete following tasks: producing a presentation that provides information on the project concept development and implementation, as well as a final report, charting the progress of their work/research over time. These assessments will evaluate a) the success of the project and b) the learning success of the students in oral and written form. Students will be graded based on the active participation in a group project (20%), a final presentation of project results (60%) and a final project report (20%). These examination requirements will assess the success of the project, but also examine the learning success of the students in oral and written form.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
This module is aimed at all students enrolled in a Bachelor or Master program at the TUM; it is thus designed as an interdisciplinary venue, which brings together a range of scientific perspectives. No specific prior knowledge is required; however, its project-based character requires high levels of intrinsic motivation and the willingness to actively participate in a project. Please register for this course via TUM Online. If you have any questions or problems to register, please write an email to euroteq@ja.tum.de

Content:
"Enhancing Connections for Sustainable Futures" aims to promote an integrated approach based on three main areas: People, Nature, and Technology. In the "People" domain, the focus is on empowering and enabling communities. This involves connecting people's needs and aspirations through technology, including digital solutions, in various areas such as wellbeing,

health, culture, etc. In the "Nature" realm, the call concentrates on the conscious use of nature and the consideration of its resources. This includes examining interactions in ecosystems, safeguarding biodiversity and nature conservation, as well as utilizing renewable energies. Within the "Technology" sphere, the emphasis is on establishing efficient connections through technology, both digital and physical. This encompasses various fields such as information technology, logistics, transportation, manufacturing, communication, etc. Overall, the call aims to promote sustainable connections that enable meeting human needs, protecting the environment, and leveraging innovative technologies to achieve these goals.
The module is a seminar that gives students the opportunity to apply their knowledge on topics related to the theme “Enhancing connections for sustainable Futures”. Within this overarching theme, we are offering challenges on three different topic-domains, namely:

• People – e.g., empowering and enabling communities, connecting people's needs and aspirations through technology (including digital solutions) in different areas such as wellbeing, health, culture, etc.
• Nature – e.g., on the conscious use of nature, taking into account environmental resources and the relationship of organisms to the environment: interactions in the ecosystem, safeguarding biodiversity and nature conservation, use of renewable energies, etc.
• Technology – e.g., efficient connections through technology, both digital and physical, in various areas such as information technology, logistics, transportation, manufacturing, communication, etc.

Within every topic domain, interdisciplinary (and international) teams of students, vocational trainees and professional learners are formed to develop solutions towards a desirable future, test and validate tools and create prototypes of their solutions. A selection of the best projects will be presented in a major high-level event, the EuroTeQaThon.

Intended Learning Outcomes:
After completion, all EuroTeQ Collider participants will be able to:
- Use disciplinary knowledge and expertise in an inter-disciplinary team to address challenges in a European context.
- Search for appropriate design, engineering and business approaches and tools to build solutions to a real-life challenge.
- Communicate your results, via several mediums in an international context.

Teaching and Learning Methods:
A range of teaching & learning techniques will be applied:
- (pre-recorded) videos and online presentations, with podcasts and interviews, Q&A Sessions with experts
- This module is focusing on service-learning and project-based learning
- After a set of introductory sessions, which provide input on the core topics but also project management, students will work on their projects in groups. Progress will be determined through project presentations during the semester, continuous feedback from the instructors, as well as peer-to-peer feedback.

- Presentational skills will be further facilitated through the requirement to present the final results
- As students and professionals will work together in a joint effort, all participants will not only improve their technical skills but also enhance their soft skills such as team spirit, flexibility to work in multicultural environments, and design thinking, which are also very important in professional life.

Media:

Reading List:

Responsible for Module:
Wester, Angela; M.A.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT82701, SOT86701) EuroTeQ Collider. Enhance Connections for Sustainable Futures (Seminar, 4 SWS)
Wester A (Finger P, Lehmann D, Schmid H), Baumer D, Lau K, Miller N, Onyango F, Rufino M, Wang Y, Zhang Y
For further information in this module, please click campus.tum.de or here.

Bachelor's Thesis | Bachelor's Thesis

Module Description

CS0054: Bachelor's Thesis | Bachelor's Thesis

Version of module description: Gültig ab winterterm 2020/21

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 10	**Total Hours:** 360	**Self-study Hours:** 180	**Contact Hours:** 180

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

Description of Examination Method:
The Bachelor's Thesis is a three-month thesis in which students deal scientifically with a study program specific topic. For this purpose, the students formulate the state of scientific knowledge and discourse in writing and develop a specific question based on this. Students deal with this topic with the technical and methodological knowledge acquired during their studies. The module is completed with the preparation and positive evaluation of the Bachelor´s Thesis (depending on selection of topics 10 to 100 pages).

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
120 credits, including all compulsory modules from the first four semesters, according to the module plan of the respective bachelor's program

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

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

Teaching and Learning Methods:
During the Bachelor´s Thesis, the students work on a scientific problem. At this juncture amongst others literature research as well as lab work and presentations are used. The actual teaching and learning methods depend on the respective problem and have to be discussed with the supervisor for each single case.

Media:
Specialist literature, software and so on

Reading List:
in consultation with the supervisor

Responsible for Module:
Prof. Cordt Zollfrank

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

E

F

G

I

L

M

N

O

P

R

S

T

W