Module Catalog

B.Sc. Sustainable Management and Technology

Degree Program B.Sc. Sustainable Management and Technology

Technische Universität München

www.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 346

Required Modules | Required Modules

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

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 Exercise - Campus Straubing (Übung, 2 SWS)
Hübner A [L], Schäfer F

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

Module Description

CS0193: Foundations of Sustainable, Entrepreneurial & Ethical Business | Foundations of Sustainable, Entrepreneurial & Ethical Business

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:
The examination performance will be in the form of a written exam (120 minutes). 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. In addition, students will be assessed on their knowledge of basic principles and models of ethical economic behavior and their ability to use and develop knowledge of entrepreneurship. They answer questions on basic definitions and theories of ethical behavior and evaluate ethical behavior in an economic context.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The module introduces students into basic principles of the topic of entrepreneurship from a global and sustainability perspective. Students will be equipped with basic knowledge on:
- definitions, regional aspects, and special forms of entrepreneurship
- understanding of ecological and social problems and entrepreneurial approaches to solving them
- entrepreneurial individuals, including their personality, creativity, idea development, cognition, opportunity recognition, decision making, affect, and moving forward from failure
- entrepreneurial firms, including their growth strategies, strategic alliances, and resources.

Beyond that, students will 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.
In addition, the module introduces basic problems, arguments, and theoretical approaches of business ethics. It investigates the chances of realizing moral norms at the interception of entrepreneurship/economics and ethics. Basic is the analysis of ethical decision processes in corporations and the detailed investigation of situations and alternatives of action. Topics involve reputation, trust and social capital as well as corruption, environmental protection, and global ethical concepts. This part ends with a critical discussion of different research approaches in the debate on business ethics.

Intended Learning Outcomes:
Students know basic concepts of entrepreneurship and sustainability including basic definitions, psychological processes and characteristics of entrepreneurs as well as possible development paths of entrepreneurial firms and are able to explain them. Furthermore, students transform and apply this knowledge to real cases. They are able to find entrepreneurial solutions for ecological and/or social problems in real cases, taking into account the theories of entrepreneurial processes.

Furthermore, students understand the ethical significance of economic theories, reflect on ethical aspects in economics and apply ethical theories in an economic, social and ecological context. Students are able to draw conclusions from the known theories and concepts and to behave ethically in everyday business life.

Teaching and Learning Methods:
The module 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 get additional background knowledge from the scientific literature in private reading.

Media:
Presentations and PowerPoint slides

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.
Lütge, C., Uhl, M. (2018). Wirtschaftsethik. München: Vahlen.
Crane, A., Matten, D., Glozer, S., Spence, L. (2019): Business Ethics. Oxford: Oxford University Press

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, Eichinger K

Introduction to Business Ethics (Vorlesung, 2 SWS)
Doblinger C [L], Krinner S
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 (Lecture) (Vorlesung, 2 SWS)
Grimm D [L], Grimm D

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

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
Aids: a non-programmable calculator + one A4 sheet (written on both sides) with any handwritten notes

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

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:

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

Module Description

CS0196: Sustainable Operations | Sustainable Operations

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 module examination consists of a written exam (90 min.). Permitted tool is 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 a solution to 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 production and logistics and methodologies for solving them will be developed. Students are familiarized with different levels of planning hierarchy (strategic, tactical, operational) and the planning problems at each level. Heuristics and additionally simple models of linear and mixed-integer programming are discussed and applied as methodologies for solving the planning problems in the area of production and in the area of logistics. The module includes these parts, among others:
- Strategic planning problems: e.g. location planning
- Tactical planning: designing the infrastructure of different production systems (workshop production, flow production, production centers)
- Operational planning problems: Demand forecasting models, main production program planning
- Material requirements planning

- Resource scheduling and control: lot size planning, machine scheduling planning, line-up sequences for flow production
- Transportation logistics: planning problems for determining tours, routes and packing schemes
- Material logistics: policies for inventory management and their extension to stochastic demands; strategic design of the logistics network; interfaces with predecessor or successor companies
- Procurement logistics: methods for the selection of suppliers
- Distribution logistics: setting up a suitable supply network; processes in the warehouse

Intended Learning Outcomes:
After participating in this basic module, students are able to understand interrelationships between various planning problems in production and logistics. Analyze selected planning problems of the strategic, tactical and operational level (for details see learning content) and apply potential solutions to manage them. In doing so, the students know essential management tasks in production and logistics planning and learn to evaluate the economic and sustainability-relevant significance of production and logistics-related decisions (e.g. the trade-off between inventory and setup costs or between costs, service and environmental protection).

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

Media:
Presentations, 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:

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 obtainable 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:

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

Module Description

CS0192: Accounting | Accounting

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:
The examination of the students success consists of a written exam (90 min). Both submodules are equally important. Students may use a non-programmable calculator and a Handelsgesetzbuch (HGB) without additional notes as helping material.
• In the exam related to financial accounting, students show that they are able to correctly conduct individual financial statements, understand consolidated financial statements and apply consolidation principles as well as understand and apply balance sheet policy and analysis. This is done by means of conducting consolidations, and by solving arithmetic problems as well as theoretical problems regarding financial statements.
• In the exam related to controlling, students show that they can apply different approaches to problem solving - based on the understanding of controlling. By means of exemplary objects from controlling the students demonstrate that they can interpret planning problems and connections between different problems and that they are able to interpret their results and apply the learnt instruments.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
None

Content:
The module on financial accounting gives an overview over basic financial accounting, focusing on regulations regarding commercial accounting in individual and consolidated financial statements. In the first part of the module, basic principles of financial accounting are introduced, dealing with general economic accounting and special financial accounting. In the second part, individual financial statements in terms of commercial law are explained and regulations for annual accounts and annual reports are discussed in detail. The third part deals with consolidated financial

statements and consolidation principles as well as corresponding postings in accounting. In the fourth part of the module, fundamentals of balance sheet policy and analysis are discussed.

The module on controlling introduces students to the basics and instruments of Controlling. It covers the following
topics:
(a) Description of controlling functions, tools of operative and strategic controlling
(b) Identification and application of key performance indicators
(c) Planning and monitoring: Operative, tactical and strategic planning and monitoring
(d) Case examples especially in business administration, environmental management and corporate social responsibility (CSR)

Intended Learning Outcomes:
The modul consists of two parts:
(1) Upon successful completion of the module on financial accounting, students are able to understand the construction of individual and consolidated financial statements and to apply the accounting regulations practically. They can read and draw up balance sheets. Students are also able to evaluate which enterprises have to put up consolidated financial statements and which subsidiaries have to be included. Furthermore, they can independently carry out different consolidations correctly.
(2) After participating in this introductory module on controlling, students will be able to remember and understand the basic concepts, tasks and conception of controlling systems and coordination systems, to analyze problems concerning the coordination of planning and control in management systems and to apply the newly acquired knowledge to solve these problems.

Teaching and Learning Methods:
The financial accounting module consists of a lecture and a corresponding exercise, which is integrated into the lecture. In the exercise the content of the lecture and its understanding is deepened and extended by exercises and case studies. The lectures content is conveyed by means of presentation, while in the tutorial parts students can practise how to apply theoretical concepts practically.

The controlling module consists of lectures, exercises and tutorials. During the lectures, the contents are delivered by presentations and discussions. The lectures are used to convey the theoretical. In the exercises, students apply the acquired knowledge in solving exercises and implementing case studies. Students deepen their understanding through working in small student groups as well as solving exercises on their own.

Media:
Presentations, text books, lecture notes, exercises, lecture notes

Reading List:
Buchholz, Rainer: Grundzüge des Jahresabschlusses nach HGB und IFRS, 7. Aufl., München 2011
Meyer, Klaus: Bilanzierung nach Handels- und Steuerrecht, 22. Auflage, Herne 201
Einführung in das Controlling, Weber/Schäffer, Schäffer-Poeschel, 13. Auflage;
Controlling, Horvàth, Vahlen Verlag, 13. Auflage;
Globales Life Cycle Controlling, Stibbe, Springer Gabler Verlag, 1. Auflage;
Corporate Social Responibility und wirtschaftliches Handeln, Bruton, Erich Schmidt Verlag, 1. Auflage

Responsible for Module:
Prof. Alexander Hübner Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Financial Accounting (Vorlesung, 2 SWS)
David G

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

Module Description

CS0200: Strategic and International Management & Organizational Behavior | Strategic and International Management & Organizational Behavior

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:
The examination is provided in the form of a written, graded written exam (120 min). The written 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 different change management models; Decision questions test the classification or interpretation of learned content, e.g. by contrasting and comparatively analyzing different strategies of internationally active companies; Application and scenario questions test whether students can apply the content learned in the lectures to practical problems and challenges, e.g. by developing proposed solutions in the context of a case description on the topic of conflict management. The overall grade will be determined through the performance in the written examination. Students are permitted 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 that may be included in the exam grade by 0.3.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basics in Management

Content:
In accordance with the learning outcomes formulated above, the most important theories and methods of industrial and organizational psychology as well as strategic and international management are covered. Basic approaches and models of industrial and organizational psychology are used to understand the behavior of individual organizational members, teams and entire organizations. In addition, as globalization increases, companies in almost all industries

and of all sizes are operating internationally and must incorporate this reality into their strategic considerations. Not only is knowledge of international management necessary in the management of companies operating across borders, but the international dimension must also be taken into account in individual business functions. Therefore, a special focus is placed on the international dimension of the concepts to be dealt with. In detail, the following aspects will be addressed and made theoretically and practically useful: basics of employee management; basics and characteristics of strategic and international management; framework conditions of strategic and international 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; theories of international corporate activity; strategies of internationally active companies; international dimension of individual business management functions; organizational culture in national and international comparison.

Intended Learning Outcomes:
After successful participation in the module, students will be able to understand and explain key concepts of industrial and organizational psychology as well as strategic and international management. In addition, students will be able to apply the gained knowledge to practical challenges and problems. Students will be able to identify and analyze challenges and problems in the areas of employee motivation, teamwork, decision-making behavior and communication with a special focus on international companies. Ultimately, they will be able to identify and demonstrate practical solutions to conflict management, change management, ethical problems and challenges in strategic and international management by applying the theoretical concepts learned.

Teaching and Learning Methods:
In the interactive lectures, the most important concepts, approaches and theories as well as their empirical evidence are taught and critically discussed with the students. The theoretical and methodological lecture contents are illustrated by examples and case studies and applied to practical problems. In addition, students are encouraged to engage intensively with the content and transfer the theories and methods covered through the analysis of instructional videos as well as individual assignments and/or work in small groups. Finally, the (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:
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
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. Claudia Doblinger

Courses (Type of course, Weekly hours per semester), Instructor:
Strategic and International Management (Vorlesung, 2 SWS)
Doblinger C [L], Krinner S

Organizational Behavior (WI001121) am Campus Straubing (Vorlesung, 2 SWS)
Goerg S [L], Cantner F
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.
Aids: A handwritten A4 cheat sheet (it is not allowed to write on the iPad and print! It must be handwritten); non-programmable calculator; We will also collect the A4 cheat sheet after the exam. Please write your name on it!

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, Genze N

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

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:

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

Module Description

CS0198: Green Marketing and Innovation Management | Green Marketing and Innovation 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 will be based on a written exam (120 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 also assess whether students remember and understand green marketing basics (including key terms, theories, frameworks, the use of marketing strategies and marketing mix instruments, and their interrelationship with core concepts in marketing). The questions may require calculations. Students may use a nonprogrammable calculator to do these calculations. Bonus points can be gained by participating in the optional course group work.

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.

Marketing Management:
Principles of marketing,
Marketing strategy and environment in green business environments,
Creating customer value, satisfaction, and loyalty in green markets,
Information management and market research,
Analyzing green consumer and business markets,
Competition and differentiation from competitors,
Segmenting, targeting, and positioning,
Creating and managing products and services, brand management,
Pricing,
Marketing communications,
Marketing channels,
Services

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, (3) remember and understand the key terms used in green marketing, (4) explain common marketing theories and frameworks in this context, (5) describe and justify the use of both marketing strategies and marketing mix instruments, and (6) relate the strategies and use of instruments to core concepts in marketing, such as customer lifetime value, segmenting, targeting, and positioning, decision making styles, customerperceived value, satisfaction, and loyalty, as well as branding in the context of green marketing.

Teaching and Learning Methods:
The module consists of two lectures including one or two sessions held by guest speakers to refer to state of the art examples of green marketing and 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.

Learning activities: Literature research, (optional) group project

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
Kotler/Keller/Brady/Goldman/Hansen (2016): Marketing Management, 3nd European ed., Pearson: Harlow.
Kotler/Armstrong (2018): Principles of Marketing, 17th ed., Pearson: Harlow.
Homburg (2017): Marketingmanagement. Strategie – Instrumente – Umsetzung – Unternehmensführung, 6. Aufl., Gabler: Wiesbaden.

Responsible for Module:
Prof. Klaus Menrad

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

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:

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:

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

CS0195: Applications in Sustainable Management and Technology | Applications in Sustainable Management and Technology [Applic. in SMT]

Version of module description: Gültig ab winterterm 2021/22

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

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

Description of Examination Method:
The students work together in teams and deal with a specific question from practice. For this purpose, the students explain the current state of science and describe the specifics of their own research work. They also formulate the procedure for dealing with their practical problem and outline the solution steps. The results are documented in a written project work.

Repeat Examination:

(Recommended) Prerequisites:
None

Content:
The course conveys skills to develop solutions to specific problems in real business in case studies in the area of sustainability and enterprise planning. These relate to topics such as performance evaluation of supply chains, controlling, human resource or other functions.

Intended Learning Outcomes:
At the end of the module, students are able to understand basic and advanced problems of sustainable management and technologies. The intended learning outcomes of this course are to be able (1) to obtain insights from practice,
(2) understand the motivation and barriers of sustainability within a business context, (3) learn to assess appropriate approaches to solve a sustainability issue in practice and (4) to communicate and discuss solutions in spoken and written language.

Teaching and Learning Methods:
The course combines different learning methods: (1) presentations by the instructor and practioneers to brush up and deepen the participants' knowledge on sustainable management and technologies; (2) papers and presentations by the participants to document and communicate the problem and their solution; (3) coaching for the participants by experienced researchers to convey methodological skills to them; (4) written reports on peers' papers to develop the particpants' coummunication skills and for critical reflection.

Media:
Current literature, lectures, presentations

Reading List:
Petra Molthan-Hill (2017), The Business Student's Guide to Sustainable Management: Principles and Practice (The Principles for Responsible Management Education Series)

Responsible for Module:
Prof. Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Applications in Sustainable Management and Technology (Vorlesung, 2 SWS)
Hübner A [L], Hintermeier L, Hübner A, Kwon S, Lex E
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:

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

Module Description

CS0203: Communication Skills | Communication Skills

Version of module description: Gültig ab winterterm 2021/22

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

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

Description of Examination Method:
Students can choose between a number of courses addressing different communicative challenges. The examination is not graded (Studienleistung) and can be an oral assessment or a written exam. Please find detailed information regarding course examinations, content, learning outcomes, literature and teaching and learning methods in the individual course description (Lehrveranstaltungsbeschreibung) in TUMonline.

For example:
The oral assessment or presentation assess students' ability to transport their point of view in a comprehensible and well-structured manner. Students show that they can communicate scientific or business issues in a careful but effective way. They communicatively create a situation of mutuality independent of culture-specific particularities. Answering questions students show that they can advocate their angle on a topic using communication methods.

A list of up-to-date information in which courses students may earn credits will be provided by the program management (Studienkoordination) at the beginning of the semester.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Students can choose between a number of courses addressing different communicative challenges:

(1) Presentation & Moderation Techniques:

- use and effect of voice, language and body language
- managing the impact on employees and customers
- defining explicit goals and objectives
- responsibilities, role and self-perception of an facilitator
- strategies how to conduct a fruitful discussion

(2) Conflict Management & Conduct of Negotiations
- conflict types
- causes and development of conflicts
- systematic conflict analysis (e.g. stages of escalation after Glasl)
- conflict patterns
- concepts of negotiation strategies,
- conflict de-escalation

(3) Business Plan
- developing a business plan
- assessment of business ideas
- analyzing market & competition
- pitching business idea

(4) Intercultural Communication
- share information across different cultures and social groups
- interact with people from other cultures
- understand customs from people of different countries

(5) Language Courses
(offered by TUM Language Center or courses completed abroad equivalent to 3 ECTS)
- learn a foreign language
- be more open to another culture
- assessment of business ideas; analysing market & competition

Intended Learning Outcomes:
Upon successful completion of the module students are able to (1) efficiently and appropriately communicate business and scientific topics to others such as employees or an audience. (2) They are able to present and discuss complex issues referring to a scientific basis within groups or in front of an audience and (3) lead a discussion. Furthermore, they are able to (4) tackle conflict situations and (5) manage to communicatively find a solution.

Teaching and Learning Methods:
To sharpen their communication skills the focus in these courses is to practice in different situations and settings. Depending on the selected course, students will e.g. hold short presentations, pitches or exercise in role-plays. To deepen and strengthen these learning experiences peers and instructors will give immediate feedback.

Media:
PowerPoint slides, moodle, videos, online learning materials

Reading List:
- Ant, Marc; Nimmerfroh, Maria Christina; Reinhard, Christina (2014); Effiziente Kommunikation - Theorie und Praxis am Beispiel "Die 12 Geschworenen"; Springer Gabler
- Alan Barker (2013); Improve Your Communication Skills; Kogan Page Publishers

Responsible for Module:
Prof. Alexander Hübner

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

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

Module Description

WI001119: Business Law | Business Law [BusLaw]

Version of module description: Gültig ab summerterm 2022

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 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. This will demonstrate to what extent they have memorised and understood principles of the law of contracts (formation, discharge, and liability), torts, and company law under German, European and Common Law. 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 lecture, and to evaluate the legal consequences.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
This module covers the legal essentials of running a business. It includes an overview of the legal framework in Germany and Europe, the formation and termination of contracts, selected types of contract (in particular, sale of goods), torts, property law, and company law. The module covers aspects of the German legal framework as well as the common law. It cannot be replaced with "Wirtschaftsprivatrecht 1".

Intended Learning Outcomes:
At the end of this module students will be able

(1.) to name and understand the rules and principles of both German business law and the common law which are most important for businesses,
(2.) to grasp and apply the legal principles regulating business activity, in particular regarding liability under tort, contract and company law;
(3.) to analyse legal implications of typical business situations and to identify their options;
(4.) to present the results of their analysis in a written analysis.

Teaching and Learning Methods:
The lecture will cover the theoretical aspects of the module in a discussion with the lecturer. The tutorial will focus on case studies. It will provide the opportunity to work individually or in groups on case scenarios (known and unknown), covering various issues of German and the common law. The purpose is to repeat and to intensify the content discussed in the lecture and to review and evaluate legal issues from different areas of law in everyday situations. Students will develop the ability to present these findings in a concise and well-structured written analysis.

Media:
Reader, Presentations (PPT), Cases

Reading List:
Robbers, An Introduction to German Law (6th ed., 2017)

Responsible for Module:
Maume, Philipp; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Business Law 1 (WI001119, englisch) am Campus Straubing - Exercise (Übung, 2 SWS)
Reiner M, Reiner N

Business Law 1 (WI001119, englisch) am Campus Straubing (Vorlesung, 2 SWS)
Reiner M, Reiner N
For further information in this module, please click campus.tum.de or here.

Elective Modules | Elective Modules

Electives in Management and Technology | Electives in Management and Technology

Module Description

CS0005: Introduction to Development Economics | Introduction to Development Economics

Version of module description: Gültig ab winterterm 2024/25

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

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:

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
- Individual assignments and presentation

The teaching and learning methods are combinded specifically for the treated topics. Typically, a thematic impulse or overview is given with a media-assisted presentation. Individual or group work assignments provide the possibility to apply the acquired competencies, to repeat and deepen these as well as to prepare the transfer to other fields.

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

Reading List:
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

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 (Lecture) (Vorlesung, 2 SWS)
Goerg S [L], Sakakibara A

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

Module Description

CS0127: Methods for Evidence Based Policy and Management | Methods for Evidence Based Policy and Management

Version of module description: Gültig ab summerterm 2022

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:
Assessment will be based on a written report. 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.

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.
The methods will be introduced based on research papers which cover areas of development economics, environmental economics, behavioural economics, labor economics, managerial economics, public economics, and political economics. For example, papers could cover diverse topics such as the impact of subsidies for renewable and low-carbon energy technologies or behavioural intervention like nudges to reduce energy consumption of private households.

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.

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

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 with STATA. 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.

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. Andreas Pondorfer

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

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:

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:

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

CS0246: Practical Research Experience | Practical Research Experience

Version of module description: Gültig ab winterterm 2021/22

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:
Grading is based on a project work. The project work consists of a written project report. The student works on a specific problem set. The student runs through several project stages: problem definition, division of work/tasks, decision making processes, and realization. Throughout this process, the student shows that she/he can develop appropriate strategies to cope with the set of problems. She/he shows the ability able to compose the state of research. In addition she/he demonstrates the ability to develop their own specific approach for a solution based on scientific knowledge as well as methodical skills.
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 analyses and discussion of the main findings. The project work is set up in a way which enables the identification and evaluation of each student's individual contribution to the project's success.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge in Business Administration and Management
Management Science (CS0075)
Sustainable Operations (CS0196)
Case Study Seminar in SCM (CS0080)

Content:
The research study consists of a specific problem statement or challenge. This challenge may have a research related or practical character. The research project and its findings regarding the outlined problem set are based on students' academic knowledge gained through their Bachelor study programs. Examples of topics covered in the context of a include (non-exhaustive list) for

example analyzing potential sales volumes with data mining techniques, identifying potential optimization actions or applying algorithms for certain business problems.

Intended Learning Outcomes:
After successful participation in the module, students obtain basic knowledge to work on research projects in an academic manner. Students understand on how to complete a research project in particular in identification research gaps, developing research questions, selecting appropriate research methods and apply them to actual research problem. Students obtain capabilities to deepen and apply theoretical concepts to the identified problem set and apply analytical solution finding skills. Students become able to manage resources, and deadlines through timely submission of the enumerated tasks in stages throughout their research projects.

Teaching and Learning Methods:
The development of the solution of the research question encourages the students to deal soundly with an academic subject based on their previously acquired academic knowledge. The project may happen at the premises of a respective company/institution or from a remote location. Participants are able to communicate the evolvement of the project by composing a project report and preparing a presentation of their solutions to the supervisors. With regards to content the research study takes an approximate time of 12-14 weeks.

Media:
literature, presentations

Reading List:
Project Management Institute (2013): A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fifth Edition
Further literature based on the specific topic

Responsible for Module:
Prof. Alexander Hübner

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

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

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

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:

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

Module Description

CS0317: Policy and Sustainable Innovation Management | Policy and Sustainable Innovation Management

Version of module description: Gültig ab winterterm 2024/25

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 (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.
-Furthermore, a strategic management game is used in the exercise, which enables students to jointly develop geopolitical strategies for the transition to renewable energies.
- Students will get additional background knowledge from the scientific literature in private reading.

Media:
Präsentationen, Power-Point-Folien, 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:

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:

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:
LCA Lab – Practical Tools and Methods in Life Cycle Assessment (Vorlesung mit integrierten Übungen, 3 SWS)
Fröhling M [L], Gezen M
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:
Sustainable Value Creation: Integrating ESG into Operations and Supply Chain Management (Vorlesung mit integrierten Übungen, 4 SWS)
Alexandre de Lima F
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:

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

Electives in Engineering and Natural Sciences | Electives in Engineering and Natural Sciences

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:

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.
Aids: Formulary (printout of provided formulary), non-programmable calculator

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 (Exercise) (Übung, 2 SWS)
Kainz J [L], Gu A, Kainz J

Physics (Lecture) (Vorlesung, 2 SWS)
Kainz J [L], Kainz J
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:

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:

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

Module Description

CS0065: Fundamentals of Thermodynamics | Grundlagen Thermodynamik

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

Responsible for Module:
Jakob Burger burger@tum.de

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

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 1

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:

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], Gmach Y, 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

CS0087: Electrical engineering | Elektrotechnik

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Modules Mathematics I and II

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

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

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

Media:
beamer presentation, cloze lecture notes, demonstration experiments

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

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

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

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

Module Description

CS0101: Renewables Utilization | Renewables Utilization

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester

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

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

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

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

Media:
Presentation, script, examples and solutions

Reading List:

Responsible for Module:
Broder Rühmann

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

Renewables Utilization (Lecture) (Vorlesung, 2 SWS)
Sieber V [L], Schieder D, Sieber V
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], Atoini Y, Banda Vazquez J, Costa Riquelme R, Gutierrez Armayor D, Lipinski S

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

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:

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

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

CS0220: General Chemistry | Allgemeine Chemie [Chem]

Version of module description: Gültig ab winterterm 2021/22

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 / Angleichung Chemie (Vorlesung) (Vorlesung, 2 SWS)
Riepl H [L], Riepl H

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

Module Description

CS0230: Applied Electrochemistry | Angewandte Elektrochemie [Appl. EC]

Version of module description: Gültig ab summerterm 2025

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 achievement of the learning objective is checked by a oral examination (examination time: 30min). Up to 10% of the total number of points can be added to the grade of this oral examination as bonus points. The results of the online tests held during the semester determine the amount of bonus points. At least 65% of the points in the online test must be achieved in order to receive bonus points. It is not possible to raise the grade from 4.3 or worse to 4.0. This should encourage the students to continuously participate in the lectures and exercises that are very important for them. By means of questions on electrochemical aspects, the students prove that they know the relevant technical terms, designations and contents, have understood the basic interrelationships and can apply their knowledge of the processes taking place within the framework of electrocatalysis, local electrochemistry as well as spectroelectrochemistry. Concrete computational tasks are set for this purpose.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Allgemeine Chemie and Physikalische Chemie, Mathematik, Physik, Einführung in die Elektrochemie or other introductory lectures to electrochemistry.

Content:
- Electrochemistry of surface-bound species: The ideal case (Langmuir isotherm) and deviations (Frumkin isotherm). Heterogeneous electron transfer (Laviron formalism) to surface-bound species.
- Local electrochemistry: electrochemistry at microelectrodes, scanning electrochemical microscopy.

- Electrochemistry at the nanoscale: mass transfer & kinetics at heterogeneous electrodes. Applications of nanoparticle-modified electrodes. Single nanoparticle electrochemistry.
- Electrocatalysis: Molecular electrochemistry - theory and practice. Heterogeneous electrocatalysis - theory and practice. Methods in electrocatalysis research (DEMS, ICP-MS, FTIR, Raman, etc). Applications (electrochemistry and electrocatalysis of CO_2, O_2 and H_2).
- Spectro-electrochemistry: coupling of EPR, UV-Vis, IR, Raman spectroscopy with electrochemistry. Electropolymerisation/conducting polymers. Correlation between optical properties, energy levels and redox potentials.

Intended Learning Outcomes:
The students learn the advanced knowledge of fundamental concepts of electrocatalysis, local electrochemistry and spectroelectrochemistry with reference to specific application examples. They are able to deal with the general principles of electrocatalysis and local electrochemistry and apply them to simplified problems of real electrochemical systems. A special focus is put on the understanding of the general and temporal interplay of electron transfer, chemical reactions and mass transport, in different electrocatalytic systems. Special focus will be on the theory of surface bound species, as well as molecular, heterogeneous and nanoparticle electrocatalysts. Furthermore, students will be familiar with electrochemical characterisation methods and will be able to apply their theoretical knowledge to these areas. Furthermore, students are familiar with industrially relevant processes, renewable energy conversion, green electrosynthesis and sustainable energy production and storage and can apply their theoretical knowledge to these areas. In addition, they know electrochemical characterisation methods and can apply them to real examples to design and optimise processes in research and industry.

Teaching and Learning Methods:
In this lecture, the course content is delivered through lectures by the lecturer using a fluent PDF script, PowerPoint slides and blackboard images. This allows for a detailed presentation of the course content and students are able to ask and discuss questions as they arise. PDF-script, PowerPoint slides and blackboard images provide visual support to help students understand the complexities of electrochemistry. In addition, students are provided with exercises to consolidate the content learned in the lecture. The solutions to these exercises are later presented and discussed by the students in an exercise lesson.

Media:
Presentations, PowerPoint, script.

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

Responsible for Module:
Prof. Nicolas Plumeré Dr. Ben Johnson Dawit Tedros Filmon

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

Angewandte Elektrochemie (Vorlesung) (Vorlesung, 2 SWS)
Plumeré N [L], Moore Y, Plumeré N
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:
Foundations of Biology (Vorlesung mit integrierten Übungen, 3 SWS)
Glawischnig E
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:

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 (Exercise) (Übung, 2 SWS)
Atoini Y, Banda Vazquez J, Costa Riquelme R, Lipinski S

Nobel Concepts toward Sustainable Future (Lecture) (Vorlesung, 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

WZ1947: Introduction to Electrochemistry | Einführung in die Elektrochemie

Version of module description: Gültig ab winterterm 2023/24

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter/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:
Das Erreichen des Lernziels wird durch eine Klausur überprüft (Prüfungszeit: 60min). Auf die Note dieser schriftlichen Prüfung können bis zu 10% der Gesamtpunktzahl als Bonuspunkte angerechnet werden. Dabei legen die Ergebnisse der Onlinetests, die während des Semesters abgehalten werden, die Höhe der Bonuspunkte fest. Es müssen mindestens 65% der Punkte im Onlinetest erreicht werden, um Bonuspunkte zu erhalten. Dabei ist die Anhebung der Note von 4,3 oder schlechter auf 4,0 nicht möglich. Dies soll die Studierenden animieren kontinuierlich an den für sie sehr wichtigen Vorlesungen und Übungen teilzunehmen. Anhand von Fragen zu elektrochemischen Aspekten weisen die Studierenden nach, dass sie die entsprechenden Fachbegriffe, Bezeichnungen und Inhalte kennen, die grundlegenden Zusammenhänge verstanden haben und ihr Wissen über die ablaufenden Reaktionen im Rahmen der kinetischen und thermodynamischen Zusammenhänge anwenden können. Dazu werden konkrete rechnerische Aufgaben gestellt.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Erfolgreiche Teilnahme am Modul „Allgemeine Chemie“, „Physikalische Chemie“, „Mathematik“ und „Physik“ oder vergleichbare Kenntnisse.

Content:
- Konzepte der Elektrochemie: elektrochemische Thermodynamik (elektrochemisches Potential, Elektrodenpotential, Nernst Gleichung), Transport in Lösungen (Migration, Diffusion und Konvektion), Thermodynamik von Grenzflächen (die elektrochemische Doppelschicht), elektrochemische Kinetik.

- Aufbau einer elektrochemischen Messung und das Funktionsprinzip eines Potentiostats (Aufbau, Funktion und Anwendung).
- Stationäre Voltammetrie (Potentialsprung, lineare und zyklische Voltammetrie an Makro- und Mikroelektroden) für die Bestimmung von thermodynamischen und kinetischen Parametern.
- Mechanismen gekoppelter homogener Reaktion zur Energiekonversion und Elektrosynthese.
- Beispiele für die Anwendungen von Elektrochemie in realen Systemen (Gewinnung und Konversion erneuerbarer Energien, grüne Elektrosynthese).

Intended Learning Outcomes:
Die Studierenden erinnern das Basiswissen über fundamentale Konzepte der Elektrochemie und elektroanalytischen Chemie. Sie sind in der Lage, mit den generellen Prinzipien der Elektrochemie umzugehen und diese auf vereinfachte Probleme von realen elektrochemischen Systemen anzuwenden. Ein besonderer Fokus liegt hierbei auf dem Verständnis des allgemeinen und zeitlichen Zusammenspiels von Elektronentransfer, chemischen Reaktionen und Massentransport, welche die elektrochemische Antwort des Systems definieren. Des Weiteren sind die Studierenden vertraut mit industriell relevanten Prozessen und wie die Elektrochemie bei nachhaltiger Energiegewinnung und -speicherung helfen kann. Zusätzlich können sie die erlernte Theorie auf reale Beispiele aus Forschung und Industrie anwenden.

Teaching and Learning Methods:
In dieser Vorlesung werden die Lehrinhalte durch Vorträge des Dozenten anhand von Textdokumenten, PowerPoint-Präsentationen und Tafelbildern vermittelt. Dies ermöglicht eine detaillierte Darstellung des Lehrinhaltes und die Studierenden sind in der Lage Fragen zu stellen und zu diskutieren, sobald diese entstehen. PowerPoint Folien und Tafelbilder helfen als visuelle Unterstützung, um die komplexen Zusammenhänge in der Elektrochemie zu verstehen. Zusätzlich werden den Studierenden Übungsaufgaben zur Festigung des in der Vorlesung gelernten Inhaltes bereitgestellt. Die Lösungen dieser Übungsaufgaben werden später in einer Übungsstunde von den Studierenden präsentiert und diskutiert.

Media:
Präsentationen, Moodlekurs mit Onlinetests, Übungsblätter, Fragenkatalog, PowerPoint, Skript

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

Responsible for Module:
Prof. Nicolas Plumeré

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die Elektrochemie (Übung) (Übung, 1 SWS)
Plumeré N [L], Moore Y

Einführung in die Elektrochemie (Übung) (Übung, 1 SWS)
Plumeré N [L], Moore Y

Einführung in die Elektrochemie (Vorlesung) (Vorlesung, 2 SWS)
Plumeré N [L], Moore Y, Plumeré N

Einführung in die Elektrochemie (Vorlesung) (Vorlesung, 2 SWS)
Plumeré N [L], Moore Y, Plumeré N
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1978: Green Chemistry | Green Chemistry

Version of module description: Gültig ab winterterm 2021/22

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

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

Description of Examination Method:
The achievement of the learning outcomes will be tested in a written exam and in a seminar. The students are expected to be able to reproduce the course contents correctly and transfer them to different contexts in written form.
The written exam has a duration of 90 minutes. Aids are not permitted. In addition, the contents of the course will be enhanced in a seminar. The proportion of the written exam to the module grade is 80 %. In the seminar, students analyze selected case studies from current literature in the context of Green Chemistry with respect to their sustainability and present these to their co-students and instructor in an oral presentation with short discussion and a brief written composition. The proportion of the seminar grade to the module grade is 20 %.

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:

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

Module Description

WZ1980: Production of Biogenic Resources | Produktion biogener Ressourcen

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:
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:
Prof. Cordt Zollfrank

Courses (Type of course, Weekly hours per semester), Instructor:
Production of biogenic Resources (Vorlesung, 4 SWS)
Höldrich A [L], Höldrich A
For further information in this module, please click campus.tum.de or here.

General Electives | General Electives

Module Description

WI000285: Innovative Entrepreneurs - Leadership of High-Tech Companies | Innovative Entrepreneurs - Leadership of High-Tech Companies

Version of module description: Gültig ab summerterm 2021

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

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

Description of Examination Method:
The examination performance is achieved through individual project work, which is divided into three phases. In the first phase, the students intensely engage themselves over a period of six to eight weeks with a self-chosen "Inner Development Challenge" from one of the following topic areas: Relationship to Self, Cognitive Skills, Caring for Others and the World, Social Skills, and Driving Change. Subsequently, in the reflection phase, a written reflection paper is produced in which the students critically reflect on their experiences and draw conclusions for their future.
In the Peer feedback phase, the students read and analyze five reflection papers of their fellow students. This fosters the students' ability to critically analyze their own works as well as the works of others and to give and receive effective feedback.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
- Knowledge: No special requirements, willingness to participate
- Abilities: Identifying opportunities; proactiveness; communication; commitment
- Skills: openness; analytical thinking; visual thinking; self-motivation; networking

Content:
The objective of the module is to inspire and motivate the participants coming from various disciplines for an entrepreneurial career, and to give them a basic understanding about founding and managing technology- and growth-oriented companies. To serve this purpose, the module

provides an introduction to the topic of (effectual) entrepreneurship, as well as guest lectures by outstanding founders, entrepreneurs, managers, and investors on selected topics, such as:

1. The entrepreneurial ecosystem
2. Founding of companies for students and scientists
3. How to develop an idea into a market-ready product
4. Financing of startups
5. Corporate growth
6. Creating and managing an entrepreneurial culture
7. Strategic business management
8. Innovation management
9. Corporate finance
10. Business succession

Moreover, for self-motivated participants, there is ample opportunity for personal development through interactive workshops, closed networking events.

Intended Learning Outcomes:
Upon successful completion of this module, participants will be able to...
- understand the entrepreneurial mindset
- recognize and develop personal strengths
- develop and implement personal ideas
- understand Design Thinking methodology

Moreover through guest speakers’ lectures and optional workshops participants will be empowered to:
- realize opportunities and challenges associated with the founding and managing of technology- and growth-oriented companies;
- create a personal roadmap for entrepreneurial success.

Thus, students familiarize with topics like opportunity recognition, innovation management, growth, leadership, and the facets of entrepreneurship. In doing that, they are enabled to see, realize, and experience the multiplicity in the everyday life of an entrepreneur, entrepreneurial personalities, as well as entrepreneurial skills and motivations.

Teaching and Learning Methods:
As guest lecturers, each week an outstanding founder, entrepreneur, manager, or investor, spanning a wide-ranging industrial spectrum, is hosted to report on their individual entrepreneurial careers.

At the end of each lecture, the participants can actively engage in discussions with the guest speaker during an open session.

Moreover, in context of a workshop, the participants venture their own personal qualities and skills to understand in a structured way their own entrepreneurial identity. In doing that, they focus on their individual strengths and resources to develop a plan to be entrepreneurial.

The module also provides participants with ample opportunity to network with people from the entrepreneurial environment of TUM.

Media:
- Lecture slides downloadable
- Online discussion forum (e.g., for questions and feedback on guest lectures)
- Handouts (distributed online)

Reading List:
Read, S., S arasvathy, S., Dew, N., Wiltbank, R., & Ohlsson, A. V. (2016). Effectual Entrepreneurship. Taylor & Francis

Responsible for Module:
Schönenberger, Helmut; Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Innovative Entrepreneurs - Leadership of High-Tech Companies (WI000285, englisch) (Vorlesung, 2 SWS)
Schönenberger H [L], Schönenberger H, Schuster C
For further information in this module, please click campus.tum.de or here.

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, Eder M, Dörfler K, Weber-Blaschke G, Zollfrank C, van de Kuilen J, Benz J, Winter S, Fink G, Birk S, Nagler F
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:
Experimental Lab - Spannungsfeld Architektur, Wissenschaft & Design (Projekt, 2 SWS)
Stierstorfer V
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:

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

Module Description

MGT001348: Innovation Sprint | Innovation Sprint

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 140	**Contact Hours:** 40

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

Description of Examination Method:
Combination of group and individual project assignment - final examination consists of two components, each carrying 50% of the final course grade: (1) a 5 minute group presentation plus 10 minutes Q&A and feedback at the end of the course and (2) an individual reflection paper of ca. 2,500 words.
Students will present to the class, the lecturer and the partner how the team identified an attractive opportunity in a suitable market, understood the customers' / users' needs in the process and, as a result, proposed a sustainable business model that balances people, planet and profit.

In a written reflection paper, every student will reflect upon and consolidate their individual learnings from (1) the reading package and (2) their entrepreneurial experience on three different levels - self, team and entrepreneurship.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Interest in entrepreneurship and sustainability, ability to work in a team

Content:
Supported by the reading package students will work on five intensive days in Campus only in interdisciplinary teams on a challenge from a partner and learn why and how to develop customer and user centric business ideas through applying an entrepreneurial mindset and innovative methods - always considering the triple bottom line.
Taking on an embedded view on the interrelatedness of economic, social and environmental systems, students will develop an ecosystem map to get an overview of relevant stakeholders and potential customers as well as important relationships and value streams. Input on Empathy

Research will prepare them to collect qualitative insights from potential customers and users through interviews, immersion and contextual observations.
After conducting their Empathy Research they will step by step learn how to synthesize their insights and define opportunities for sustainable innovation. With a concrete how-might-we-question they will start into ideation. Through different creativity methods they will develop and prioritize ideas and build a simple prototype. This prototype is being tested again through qualitative tests with potential customers and users. When they come back after testing they do a first iteration based on the feedback they got and derive assumptions on a potential business model. After input on pitching they will prepare slides or other material and pitch in front of the group, partner and external guests. After the pitch event they will be led through a reflection of the learnings they gained during the week. The reading package will support the transfer of these learnings.

Intended Learning Outcomes:
After participating in this module students will be able to understand and apply life-centered design principles in the early stages of an entrepreneurial process: from identifying an entrepreneurial opportunity and understanding its environmental and social impact to validating assumptions by applying qualitative research methods and interpreting data as well as using prototyping as a tool for communication and learning. They will be able to apply creativity methods, take over collective responsibility and know how to effectively communicate their business opportunities.
Taking decisions under uncertainty, ambiguity and risk in newly formed teams will foster their collaboration and communication skills and prepare them for future team work in appreciating and accommodating team members' individual personalities and boundaries.
At the same time the reading package enables students to gain a broader understanding of the methods learned in the course providing them with the ability to apply them beyond the context of innovation.

Teaching and Learning Methods:
This module relies on a combination of readings, input sessions, workshops, teamwork and individual feedback and support. While input sessions will stimulate students’ engagement with relevant tools and topics, workshops and team discussions will support the implementation of the knowledge in their projects and facilitate students’ learning of the soft and intricate aspects of adopting an entrepreneurial mindset and skills. Working on a design challenge that a partner (e.g. TUM Venture Labs) provides stimulates peer competition and allows students to directly apply what they learn in a real life setting. The reading package will strengthen students' understanding of the methods and allow them to make sense of their practical experience.

Media:
Presentations, canvas, handywork

Reading List:
Each semester students will be provided with a mandatory reading package.

Responsible for Module:
Alexy, Oliver; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Innovation Sprint (MGT001348, englisch) (Seminar, 4 SWS)
Alexy O [L], Hartmann B, Baur C
For further information in this module, please click campus.tum.de or here.

PiM2025: Plug-in Modules | Plug-in-Module

Module Description

MGT001410: ChangeMakers: Entrepreneurial and Design Competencies for Societal Transformation | ChangeMakers: Entrepreneurial and Design Competencies for Societal Transformation

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
This module's learning objectives are examined via exercises ("Übungsleistung") comprising the three elements outlined below. There is no written exam.

(1) Group final presentation (50%): In the final session, you will present your team's approach and solution for a societally relevant challenge identified at the beginning of the course. The presentation format can be chosen by your team and should include the presentation of a design artifact. Design artifacts can include a 3-dimensional object, a visual representation, a video, a storyline, a systems map, and many other forms of storytelling and visualization. Presentations will last approximately 5 minutes, followed by a 5-10 minute Q&A and feedback round. Each team member must actively participate so your individual contribution is identifiable and appraisable. The final group presentation will showcase that you have acquired and can demonstrate essential entrepreneurial and design competencies: focus – you can identify whether a problem is worth solving; courage – you understand your role in creating change; imagination – you are capable of developing and articulating a vision; and action – you know how to take next steps.

(2) Individually written reflection paper (20%): At the end of the course, you will submit a short paper (2 pages excl. sources) reflecting on
(a) your overall experience with and synthesis of the course's format (considering both the experiential learning immersion and the reading package)
(b) your critical reflection on the design solution you and your team created
(c) whether and how the course allows and will allow you to generate hope in the face of critical societal challenges

(3) Daily course exercises (30%)
In each session during the project week, you will be asked to submit a small reflection exercise related to the day's content and learning objectives via Moodle. We will dedicate 10-15 minutes of each session to this exercise using a set of questions. You will be guided through the exercise by the course instructors. This will demonstrate that you have engaged with, understood, and critically reflected on the day's topic.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fluency in English; interest in entrepreneurship, design, and a sustainable future; willingness to work in a team;

Due to the nature of the assessments and the ongoing team-based work in this course, consistent participation is mandatory. If you need to miss a session for health reasons or other valid circumstances, please inform us in advance via email. We may provide an opportunity to make up the missed material or, in cases of documented illness, assign a "Q" grade (indicating a missed exam with an accepted medical certificate).

Please note: Conflicts such as overlapping courses or work commitments are considered planning issues and should be resolved before enrolling in the course.

Content:
In this module, students will acquire entrepreneurial and design competencies through experiential and scenario-based learning: Set in a future scenario, students will be confronted with signals (based on scientific projections) that make clear what circumstances we may live in in the future. The Impulse Symposium ahead of the project week will provide inspiration and insight to stimulate students' imagination of the future we might live in. During the immersive project week, participants will work in small teams to create a real-life practical solution for a larger societal problem: The first day of the project week creates space to explore what challenges students find relevant and care about, and to explore through design and entrepreneurial methods whether these challenges appear to be worth solving. Throughout the week, students will learn and apply creative problem-solving methods, entrepreneurial thinking and decision-making to work through that challenge they chose. Students will be encouraged to leverage Generative AI tools to illustrate the ideas they create. Students will be guided to apply visualization and prototyping methods as well as reflection techniques that will support them in producing a shareable vision of a livable and lovable future and identify why and how they can contribute to realizing it.
The module is intentionally structured to include an impulse before, as well as iteration and reflection after an immersive project week. In addition, students will receive a reading package. Combining these elements will allow students to start well-prepared, reactive their prior knowledge, inform themselves about relevant methods, and process and appraise new information.

Intended Learning Outcomes:
After successful completion of this module, students will be able to:

● Understand and apply basic entrepreneurial and design competencies, including: Focus for sophisticated problem identification; Courage to take an active role in creating change; Imagination to develop and articulate ideas; Action to take an idea forward towards implementation
● Leverage these competencies to retain hope in the face of critical societal challenges

While developing and articulating solutions in interdisciplinary project teams, students will learn how to plan, manage and conduct a project, mobilize scarce resources, act in the face of uncertainty, collaborate in a team, and present, discuss, and reflect upon their own solutions convincingly. In addition, working with future scenarios will strengthen students' creative confidence and analytical and strategic skills.

Teaching and Learning Methods:
This module relies on six core elements:

● Impulse – a university-wide public mini-symposium that includes high-quality inspirational speakers who will set the tone and give context.
● Project Week – an immersive one-week project-based experience including theory-driven and methodological impulses, team activities, interactive discussions, flipped classroom elements, and guided project work inside and outside the classroom.
● Iteration – a review of the work that has been created during the project week in small teams accompanied by feedback and support from peers and subsequent further development.
● Presentation – a celebratory moment where participating teams share their work with each other and discuss their process and results.
● Reflection – a moment to reflect on the experience and, importantly, plan for possible next steps of integrating the newly acquired skills into one's work.
● Reading package - a collection of supporting course material, links, and articles to strengthen the understanding and sensemaking of the applied methods.

Media:
Presentations, videos, flipchart, whiteboard, digital tools, Zoom for feedback sessions, prototyping materials

Reading List:
Each semester students will be provided with a reading list relevant to the course.
Inspirational readings include (students will be asked to engage with a selection of inspirational readings):
*Arend, R. J. (2020). The roles of thought and affect on entrepreneurship – A new hope. Journal of Business Venturing Insights, 14. DOI: 10.1016/j.jbvi.2020.e00188.
* Brown, T., Carey, S.,& Wyatt, J.(2021). The next chapter in design for social innovation. Stanford Social Innovation Review.

* Giudice, M., & Ireland, C. (2023). Changemakers: How leaders can design change in an insanely complex world. Two Waves Books.
* Hari, J. (2023). Stolen focus: Why you can't pay attention--and how to think deeply again. Crown.
* Holiday, R. (2021). Courage is calling: Fortune favors the brave. Penguin.
* Hoppe, M., & Namdar, K. (2023). Towards entrepreneurship for a cause: educating transformative entrepreneurial selves for a better world. Entrepreneurship Education and Pedagogy, 6(4), 590-607.
*. Lans, T., Blok, V., & Wesselink, R. (2014). Learning apart and together: towards an integrated competence framework for sustainable entrepreneurship in higher education. Journal of Cleaner Production, 62, 37-47.
* Markovitz, D. (2020). How to avoid rushing to solutions when problem-solving. Harvard Business Review Digital Articles, 2–6.
* Mauch, C. (2019). Slow hope: Rethinking ecologies of crisis and fear. RCC Perspectives: Transformations in Environment and Society, 1. doi.org/10.5282/rcc/8556.
* Noel, L. A. (2023). Design social change: Take action, work toward equity, and challenge the status quo. Ten Speed Press.
* Thackara, J. (2005): In the Bubble: Designing in a complex world; The MIT Press.
* Wedell-Wedellsborg, T. (2017). Are you solving the right problems? Harvard Business Review, 95(1), 76–83.
* Weiss, L. (2017). Stop mindlessly going through your work day. Harvard Business Review Digital Articles, 2–4.

Responsible for Module:
Tryba, Anne; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
ChangeMakers: Entrepreneurial and Design Competencies for Societal Transformation (MGT001410, englisch) (Seminar, 4 SWS)
Tryba A, Diefenthaler A, Löhe T, Mayer C
For further information in this module, please click campus.tum.de or here.

Module Description

MCTS0051: Core Topic: Gender & Diversity | Core Topic: Gender & Diversity

Version of module description: Gültig ab winterterm 2018/19

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

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

Description of Examination Method:
Students are required to write a research paper (2000-3000 words) in which they demonstrate
- their knowledge on gender and diversity as topoi in highly technologized societies
- their ability to understand and categorize key concepts and sources stemming from gender studies and STS
- their ability to discuss issues of gender and diversity in scientific and technological contexts

Furthermore, students are required to give a presentation (15-20 minutes) in which they demonstrate that they are able to present their ideas to an audience in a clear and concise manner and react to questions and feedback from both the lecturer and their peers.

Grading: The presentation counts for 30%, the essay for 70% of the final grade.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The module introduces students to the following topics
- sociological, historical and philosophical perspectives on gender and diversity politics of technoscience
- gendering of technologies
- embeddedness of gender in institutions of technoscience

Intended Learning Outcomes:
Upon successful completion of this module students are able to

- describe and discuss the interrelation of gender, diversity, science and technology
- understand and categorize key concepts and sources stemming from gender studies and STS
- discuss ways of dealing with difference and inequality in technological societies
- use these abilities to formulate research questions on these issues

Teaching and Learning Methods:
Students are expected to read and critically engage with introductory readings in order to understand and categorize key concepts and sources stemming from gender studies and STS. By discussing these texts and working on case studies they learn to analyze and discuss ways of dealing with difference and inequality in technological societies. Presenting and discussing their findings trains students to structure their arguments and to defend them in academic debate.

Media:
Texts, slide presentations, flipchart/whiteboard, worksheets, Moodle

Reading List:
Wajcman, Judy (2010): "Feminist theories of technology", in Cambridge Journal of Economics, Vol. 34, No.1., pp.143-152;

Plus additional literature specified at the beginning of the course

Responsible for Module:
Sultan, Aysel; Dr. phil.

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

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

Module Description

MGT001485: Value Creation with AI at Scale: Strategy, Tech, People and Governance | Value Creation with AI at Scale: Strategy, Tech, People and Governance

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
The assessment is conducted as group work with around six students per team and consists of:

a) a written project report (in form of a slide deck of about 60 content slides) - 70%
b) a presentation to a decision-making audience followed by a Q&A session - 30%

Each group presents its concept in a 10 minute presentation, followed by a Q&A session of up to 5 minutes. The presentation is addressed to a fictional senior management audience and follows the format of a management pitch.

Optionally, guest speakers from industry or consulting may be invited to join the jury.

The objective is to transfer the insights from scientific studies short and precise to senior management and analyze real AI case studies and develop a viable AI value creation concept. The presentation aims to train target group-oriented communication and the confident defense of results in front of a decision-making audience.

Evaluation criteria:
Written report – analytical depth, consistency of value logic, consideration of responsible AI aspects, clarity of argumentation, clarity and effectiveness of slides, and professionalism.
Presentation – persuasiveness of the pitch, quality of answers during the Q&A, and professional delivery.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
For successful participation in the module, students are expected to have a basic understanding of business strategy or digital transformation in order to contextualize AI use cases within value creation frameworks. In addition, very good English skills (at least B2 level) are required.

Beneficial – but not mandatory – are basic knowledge of artificial intelligence and machine learning, as well as fundamentals of statistics (e.g. descriptive statistics, regression analysis).

Content:
1) AI Strategy & Value Potential
Analysis of business models, value narratives, and strategic target visions for AI; evaluation of value creation logic and success metrics.

2) AI Platform & Ecosystem Strategy
Technological architecture decisions (e.g., cloud, MLOps) and design of partner ecosystems to enable scalable AI solutions.

3) People Strategy & AI Leadership
Success factors for talent development, change management, organizational structure, and leadership behavior in AI adoption.

4) Responsible AI & Execution Strategy
Integration of regulatory requirements (incl. EU AI Act), ethical principles, and governance structures into AI execution plans.

5) Generative AI in Practice (BCG Excursion)
Live demonstrations of current GenAI applications, discussion of impact measurement, scaling strategies, and lessons learned from real-world transformation projects.

Intended Learning Outcomes:
After completing the course, students can

1) analyse real-world AI adoption cases to distil recurring success and failure patterns in value creation
2) evaluate strategic, technological, organisational and ethical drivers (incl. EU AI Act) that determine whether AI initiatives deliver business impact
3) design a coherent AI value-creation playbook for a chosen company, covering strategy, tech stack, people and governance
4) justify and communicate the expected value and risk-mitigation logic clearly in a professional report and executive-level presentation

Teaching and Learning Methods:
Lectures: provide a compact theoretical foundation for AI value creation.
Case studies: apply concepts to real company examples, fostering analytical thinking.

Guest lectures: offer current industry insights and highlight success and failure patterns.
Group work: enables students to develop their own value creation playbook, strengthening teamwork, conceptual, and presentation skills.

Media:
The course uses presentation slides as the primary teaching medium. In addition, video recordings of selected interviews with industry experts are shown to provide real-world insights. For certain guest lectures or Q&A sessions, Zoom is used as needed to flexibly integrate external speakers.

Reading List:
No prior reading is required. Optional readings and case materials will be shared during the course to support in-depth understanding and follow-up work.

Responsible for Module:
Welpe, Isabell M.; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Value Creation with AI at Scale: Strategy, Tech, People and Governance (MGT001485, englisch) (Seminar, 2 SWS)
Feldmann S, Merl S, Scheuer A, Tamme T, Treffers T
For further information in this module, please click campus.tum.de or here.

Module Description

SOT53404: Academic Prompt Engineering and Management: a Reflexive Introduction | Academic Prompt Engineering and Management: a Reflexive Introduction

Academic Use of Generative AI: a Lecture on Mastering Techniques, Understanding Background, Embracing Responsibility in Prompt and Bot Engineering and Management

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 75	**Contact Hours:** 15

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

Description of Examination Method:
The module is completed with a written examination as the module examination. The written exam covers the topics and learning outcomes of the module.
In the written exam, students must demonstrate that they can:
• Describe and apply techniques for prompt engineering with large language models, including methods for measuring prompt effectiveness and strategies for ensuring accuracy
• Explain the importance of responsible development and deployment of LLMs
• Analyze human-computer interaction with LLMs and discuss applications in academic research
• Evaluate the design and performance of large language models in terms of fairness, transparency and robustness
• Identify legal and ethical issues related to LLM-generated text
• Assess the transformative potential and progress of LLMs across various domains
The written examination is in the form of short questions and multiple choice questions. Students must complete the exam individually under supervision within a time limit of 30 minutes. Permitted resources are specified by the examiner and communicated to students in advance. The exam is graded according to the grading scale defined in the examination regulations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
There are no prerequisites.

Content:
This module provides students from all parts of Technical University Munich with a comprehensive introduction to prompt and bot engineering for generating text with large language models (LLMs). The course combines hands-on training in effective prompting techniques with an exploration of the legal, ethical, and societal responsibility issues surrounding the use of LLMs for text generation.
Through a series of 10 lectures, students will gain practical skills in prompt engineering while developing a nuanced understanding of the broader implications of this rapidly evolving technology. Topics covered include:
• Overview of techniques for prompt engineering in text generation using LLMs, including methods for measuring prompt effectiveness, advanced techniques, and addressing issues like hallucinations and ensuring accuracy.
• Emphasis on responsible development and deployment of LLMs, focusing on selecting appropriate models, identifying and mitigating biases, ensuring transparency, and evaluating decision-making capacity.
• Exploration of human-computer interaction with LLMs, including decision-making processes, the future of work in the context of LLM-powered text generation, and their applications in academic research.
• Considerations for designing and evaluating large language models, focusing on performance, fairness, transparency, and robustness.
• Discussion on intellectual property, copyright, and other legal and ethical issues related to LLM-generated text.
• The transformative potential and rapid progress of LLMs, highlighting their ability to reshape interactions with technology and information across various domains.

Intended Learning Outcomes:
Upon successful completion of this module, students will be able to:

• Describe and apply techniques for prompt engineering in text generation using large language models (LLMs), including methods for measuring prompt effectiveness, advanced techniques, and strategies for addressing issues like hallucinations and ensuring accuracy.
• Explain the importance of responsible development and deployment of LLMs, and demonstrate the ability to select appropriate models, identify and mitigate biases, ensure transparency, and evaluate the decision-making capacity of LLMs.
• Analyze human-computer interaction with LLMs, including decision-making processes, and discuss the future of work in the context of LLM-powered text generation and their applications in academic research.
• Evaluate the design and performance of large language models, focusing on key considerations such as fairness, transparency, and robustness.
• Identify and discuss intellectual property, copyright, and other legal and ethical issues related to LLM-generated text.
• Assess the transformative potential and rapid progress of LLMs, and explain their ability to reshape interactions with technology and information across various domains.

Teaching and Learning Methods:
Teaching and learning is structured in two dimensions with appropriate methods:
1. Introductions by Lecturer
• Traditional lectures delivered by the instructor, providing foundational knowledge and key concepts
• Guest lectures by leading experts and practitioners in the field of LLMs and prompt engineering, offering diverse perspectives and real-world insights
• Engaging video lectures for asynchronous learning, allowing students to review complex topics at their own pace
• Interactive in-class discussions and debates on the ethical, legal, and societal implications of LLMs, encouraging critical thinking and active participation

2. Exercises
• Educational games and gamified exercises to reinforce learning and promote engagement with course material
• Regular quizzes and short tests to assess understanding and provide formative feedback
• Peer and self-assessment activities, fostering a collaborative learning environment and developing skills in giving and receiving constructive feedback

Media:
Online lectures, collaborative databases, whiteboards, student polls, slide presentations, quizzes, educational games

Reading List:
Anthropic. (2023). Prompt engineering. https://docs.anthropic.com/en/docs/prompt-engineering
Duan, S. et al. (2023). Denevil: Towards Deciphering and Navigating the Ethical Values of Large Language Models via Instruction Learning. arXiv. https://arxiv.org/abs/2310.11053
Fabiano, N. (2024). AI Act and Large Language Models (LLMs): When critical issues and privacy impact require human and ethical oversight. arXiv. https://arxiv.org/abs/2404.00600
Fabiano, N. (2024). AI Act and Large Language Models (LLMs): When critical issues and privacy impact require human and ethical oversight. arXiv. https://arxiv.org/abs/2404.00600
Gan, W. et al. (2023). Large Language Models in Law: A Survey. arXiv. https://arxiv.org/abs/2312.03718
Harrer, S. (2023). Attention is not all you need: the complicated case of ethically using large language models in healthcare and medicine. Science Direct. https://www.sciencedirect.com/science/article/pii/S2352396423000774
Mökander, J. et al. (2023). Auditing large language models: a three-layered approach. AI Ethics. https://doi.org/10.1007/s43681-023-00289-2
Prompt Engineering Guide. (2023). Prompting Techniques. https://www.promptingguide.ai/techniques
Quan, X. (2024). Enhancing Ethical Explanations of Large Language Models through Iterative Symbolic Refinement. arXiv. https://arxiv.org/abs/2402.00745
Weidinger, L. et al. (2021). Ethical and social risks of harm from Language Models. arXiv. https://arxiv.org/abs/2112.04359

Yan, L. (2023). Practical and Ethical Challenges of Large Language Models in Education: A Systematic Scoping Review. arXiv. https://arxiv.org/abs/2303.13379
Zhang, J. (2023). Ethical Considerations and Policy Implications for Large Language Models: Guiding Responsible Development and Deployment. arXiv. https://arxiv.org/abs/2308.02678

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Academic Prompt Engineering and Management: a Reflexive Introduction (Vorlesung mit integrierten Übungen, 1 SWS)
Djeffal C
For further information in this module, please click campus.tum.de or here.

Module Description

SOT53405: Academic Prompt Engineering and Management: Responsible Use in Action | Academic Prompt Engineering and Management: Responsible Use in Action

Academic Use of Generative AI: a Seminar on Mastering Techniques, Understanding Background, Embracing Responsibility in Prompt and Bot Engineering and Management

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 75	**Contact Hours:** 15

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

Description of Examination Method:
The module is completed with a written examination as the module examination. The written exam covers the topics and learning outcomes of the module.
In the written exam, students must demonstrate that they can:
• Describe and apply techniques for prompt engineering with large language models, including methods for measuring prompt effectiveness and strategies for ensuring accuracy
• Explain the importance of responsible development and deployment of LLMs
• Analyze human-computer interaction with LLMs and discuss applications in academic research
• Evaluate the design and performance of large language models in terms of fairness, transparency and robustness
• Identify legal and ethical issues related to LLM-generated text
• Assess the transformative potential and progress of LLMs across various domains
The written examination is in the form of short questions and multiple choice questions. Students must complete the exam individually under supervision within a time limit of 30 minutes. Permitted resources are specified by the examiner and communicated to students in advance. The exam is graded according to the grading scale defined in the examination regulations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Students should be familiar with the contents of the introductory module SOT53404.

Content:
This module builds on the lecture and provides students from all parts of Technical University Munich with a solidification of knowledge concerning the use of generative AI. The course combines hands-on training in effective prompting techniques with an exploration of the legal, ethical, and societal responsibility issues surrounding the use of LLMs for text generation. Through a two-day interactive seminar, students will deepen their knowledge by using practical skills in prompt engineering while developing a nuanced understanding of the broader implications of this rapidly evolving technology. Topics covered include:
• Application of techniques for prompt engineering in text generation using LLMs, including methods for measuring prompt effectiveness, advanced techniques, and addressing issues like hallucinations and ensuring accuracy.
• Implementation of responsible development and deployment of LLMs, focusing on selecting appropriate models, identifying and mitigating biases, ensuring transparency, and evaluating decision-making capacity.
• In-depth exploration of human-computer interaction with LLMs, including decision-making processes, the future of work in the context of LLM-powered text generation, and their applications in academic research.
• Considerations for designing and evaluating large language models, focusing on performance, fairness, transparency, and robustness.
• Application of requirements of intellectual property, copyright, fairness, diversity and other legal and ethical issues related to LLM-generated text.
• The transformative potential and rapid progress of LLMs, highlighting their ability to reshape interactions with technology and information across various domains.

Intended Learning Outcomes:
Upon successful completion of this module, students will be able to:
- Design and implement advanced prompt engineering strategies for complex academic tasks, including systematic approaches to chain-of-thought reasoning, few-shot learning, and context optimization.
- Develop and execute comprehensive prompt testing frameworks to evaluate and improve prompt effectiveness, including quantitative metrics and qualitative assessment methods.
- Create and manage automated workflows for academic research using LLMs, incorporating proper documentation, version control, and quality assurance measures.
- Construct and validate bias detection and mitigation strategies in LLM applications, with particular focus on academic integrity and research validity.
- Synthesize and apply ethical frameworks for responsible AI use in academic settings, including developing guidelines for appropriate LLM integration in research methodologies.
- Lead and coordinate collaborative projects involving LLM integration, demonstrating the ability to manage stakeholder expectations and ensure compliance with academic standards.

Teaching and Learning Methods:
Workshop
• Based on the learnings of the lecture

• Hands-on design workshop and maker sessions, allowing students to experiment with prompt engineering techniques and develop practical skills in a supportive environment
• Open-ended problem-solving exercises, challenging students to apply their knowledge to real-world scenarios and develop creative solutions
• Pair programming and code review activities, promoting collaboration, knowledge sharing, and the development of best practices in prompt engineering and responsible AI development.
• Possibility for successful teams to be represented in an online plattform built for that purpose

Media:
collaborative databases, whiteboards, student polls, slide presentations, quizzes, educational games

Reading List:
Anthropic. (2023). Prompt engineering. https://docs.anthropic.com/en/docs/prompt-engineering
Duan, S. et al. (2023). Denevil: Towards Deciphering and Navigating the Ethical Values of Large Language Models via Instruction Learning. arXiv. https://arxiv.org/abs/2310.11053
Fabiano, N. (2024). AI Act and Large Language Models (LLMs): When critical issues and privacy impact require human and ethical oversight. arXiv. https://arxiv.org/abs/2404.00600
Fabiano, N. (2024). AI Act and Large Language Models (LLMs): When critical issues and privacy impact require human and ethical oversight. arXiv. https://arxiv.org/abs/2404.00600
Gan, W. et al. (2023). Large Language Models in Law: A Survey. arXiv. https://arxiv.org/abs/2312.03718
Harrer, S. (2023). Attention is not all you need: the complicated case of ethically using large language models in healthcare and medicine. Science Direct. https://www.sciencedirect.com/science/article/pii/S2352396423000774
Mökander, J. et al. (2023). Auditing large language models: a three-layered approach. AI Ethics. https://doi.org/10.1007/s43681-023-00289-2
Prompt Engineering Guide. (2023). Prompting Techniques. https://www.promptingguide.ai/techniques
Quan, X. (2024). Enhancing Ethical Explanations of Large Language Models through Iterative Symbolic Refinement. arXiv. https://arxiv.org/abs/2402.00745
Weidinger, L. et al. (2021). Ethical and social risks of harm from Language Models. arXiv. https://arxiv.org/abs/2112.04359
Yan, L. (2023). Practical and Ethical Challenges of Large Language Models in Education: A Systematic Scoping Review. arXiv. https://arxiv.org/abs/2303.13379
Zhang, J. (2023). Ethical Considerations and Policy Implications for Large Language Models: Guiding Responsible Development and Deployment. arXiv. https://arxiv.org/abs/2308.02678

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Academic Prompt Engineering and Management: Responsible Use in Action (Workshop, 1 SWS)
Djeffal C

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

Module Description

SOT53406: Open Data - Open Science (Introduction) | Open Data - Open Science (Introduction)

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module will be assessed in a 90-minute written exam. The exam allows students to demonstrate their knowledge of principles of open science and open research and illustrate their evaluation skills of political and economic dimensions in knowledge production, as well as their ability to analyze the impact of different initiatives on a variety of fields.

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
The module is designed to provide students with a comprehensive understanding of the principles and practices of openness in scientific research and data management. The course is structured to highlight the transformative potential of open science, in particular open access to publications, open research data, and open source for science in society, emphasizing not only aspects of research integrity or innovation (such as reproducibility), but also aspects of democratizing access and use of knowledge. It also aims to foster students' understanding of the Open Science movement, its impact on science and society, and, more generally, current transformation in research practices and governance. The module builds around the research conducted within the PHIL_OS project (www.opensciencestudies.eu), one of the leading research groups worldwide working on these issues, and therefore focuses on the cutting-edge of research on Open Science. Through case studies, students will explore foundational concepts such as the political economy of scientific knowledge production and the significance of open science initiatives. The course will also cover key topics including open source projects, open infrastructures, and citizen science, illustrated with real-world case studies to demonstrate their impact on various fields.

In terms of disciplinary domain, we will discuss emerging research within the fields of philosophy, history and social studies of science and technology, as well as meta-research (sometimes also referred to as “research on research”). Topics encompass, but are not be limited to: the reproducibility crisis; information quality; inequity and injustice across research environments; data-intensive technologies and AI; data management; cooperation and coordination within and across scientific institutions; citizen science and public science; science governance; scientific modelling and epistemology. See the detailed schedule for more details. Attendees are required to attend sessions regularly, study the readings for each week in advance of the meeting, and come prepared for discussion.

Intended Learning Outcomes:
By the end of this module, students will be able to:
- describe the principles of open science and open (research) data.
- understand the impact of open initiatives like the Human Genome Project across several societal domains, such as research, politics, education, economy, security
- apply open science practices in their own research fields

Teaching and Learning Methods:
The module will consist of a lecture, which introduces participants to the principles and the importance of Open Data for research and industry and to the political economy of knowledge production. This will be done with case studies as the human genome project or examples of open infrastructure and citizen science. Attendees are required to attend sessions regularly, study the readings for each week in advance of the meeting, and come prepared for discussion.

Media:
Reader, PowerPoint

Reading List:
Fecher, B., & Friesike, S. (2014). Open science: one term, five schools of thought (pp. 17-47). Springer International Publishing.
Gold, E. R. (2021). The fall of the innovation empire and its possible rise through open science. Research Policy, 50(5), 104226.
Heimstädt, M., & Friesike, S. (2021). The odd couple: Contrasting openness in innovation and science. Innovation, 23(3), 425-438.
Leonelli, S. (2023) Philosophy of Open Science. Cambridge University Press.
Levin, N. and Leonelli, S. (2016) How Does One “Open” Science? Questions of Value in Biological Research. Science, Technology and Human Values 42 (2): 280-305. DOI: 10.1177/0162243916672071
Maxson Jones, K., Ankeny, R. A., & Cook-Deegan, R. (2018). The Bermuda Triangle: The pragmatics, policies, and principles for data sharing in the history of the human genome project. Journal of the History of Biology, 51(4), 693-805.
Ross-Hellauer, T., Reichmann, S., Cole, N. L., Fessl, A., Klebel, T., & Pontika, N. (2022). Dynamics of cumulative advantage and threats to equity in open science: a scoping review. Royal Society open science, 9(1), 211032.

Salazar, A., Wentzel, B., Schimmler, S., Gläser, R., Hanf, S., & Schunk, S. A. (2023). How Research Data Management Plans Can Help in Harmonizing Open Science and Approaches in the Digital Economy. Chemistry–A European Journal, 29(9), e202202720.
Tyfield, D., Lave, R., Randalls, S., & Thorpe, C. (Eds.). (2017). The routledge handbook of the political economy of science (pp. 21-31). London, UK: Routledge.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Open Data - Open Science (Vorlesung, 2 SWS)
Jones E, Leonelli S
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86060: Data Regulation & Law (3 ECTS) | Data Regulation & Law (3 ECTS)

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module exam is a written examination.
The written examination will cover topics from the field of privacy regulation (especially GDPR). The examination will last 60 minutes and will consist of various questions (essay and/or multiple choice).
The aim of the written examination is to demonstrate knowledge in privacy and data protection law. With the processing of the examination students demonstrate that they are able to remember and name the fundamental principles of privacy and data protection law. Furthermore, they will show that they are able to identify and explain important questions and current challenges in the field of privacy and data protection law and regulation with an international perspective.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The module covers the following topics.
GDPR & Foundations: policy, fundamental rights, history and relevance; Scope; Data subjects, controller, Joint controller, processors, third parties; Principles; Principle of Lawfulness; Data subject rights; Obligations of controllers und processors; Third country transfers; Enforcement, remedies, liability athorities, damages. Data protection legislation for specific sectors and conflicts.

Intended Learning Outcomes:
After the completition of the module the students will be able to remember the basics concepts and implicatons of privacy and data protection law. This includes the policy, fundamental rights, history and relevance of GDPR, as well as the material und territorial scope. Furthermore the students will be able to repeat basic principals of data subjects rights, in particular with respect to access, erasure, object as well as in obligations of data controllers and processors.

Teaching and Learning Methods:
The module consists of a master´s lecture. The topics of the module are presented via slides and presentations in the lecture hall or a hybrid format. The teaching aim to stimulate discussions based on presentations and questions. In addition the module will equip students with the necessary skills to identify and discuss current research on privacy and data protection law and regulation, as well as to communicate their effectiveness and implications, and shed light on their impact on society. During the lecture parts, new topics will be presented and explained.

Media:
PowerPoint presentations

Reading List:
Handbook on European data protection law, author(s): Council of Europe , European Court of Human Rights , European Data Protection Supervisor , European Union Agency for Fundamental Rights (EU body or agency), Link: https://op.europa.eu/en/publication-detail/-/publication/5b0cfa83-63f3-11e8-ab9c-01aa75ed71a1

Responsible for Module:
Paal, Boris; Prof. Prof. Dr. Dr. jur.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86060, SOT86061) Data Regulation & Law (Vorlesung, 2 SWS)
Paal B (Djebbari S, Krikis K)
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86061: Data Regulation & Law (6 ECTS) | Data Regulation & Law (6 ECTS)

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module examination consists of an exercise. The exercise consisting of two graded exercise sheets (Homework) and a written test.
The two equally weighted exercise sheets (Homework) account for 40% of the final grade; the written test at the end of the semester for another 60%.
Both, the written test as well as the two written homework exercises will cover topics from the field of privacy and data economy regulation.
The written test will last 60 minutes and will consist of various questions (essay and/or multiple choice). The aim of the written test is to demonstrate knowledge in privacy and data protection law and data economy regulation. The two written homework exercises will be discussed and presented in class.
The module examination demonstrates that they are able to remember and name the fundamental principles of privacy and data protection law and data economy regulation. Furthermore, they will show that they are able to compare, use and explain legal principles with respect to current challenges in the field of privacy and data protection law and regulation.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The module covers the following topics.

Data Governance Act: Data sharing; Data altruism; Data intermediaries
Data Act: Access to data; cloud switching; interoperability
GDPR & Foundations: policy, fundamental rights, history and relevance; Scope; Data subjects, controller, Joint controller, processors, third parties; Principles; Principle of Lawfulness; Data subject rights; Obligations of controllers und processors; Third country transfers; Enforcement, remedies, liability athorities, damages. Data protection legislation for specific sectors and conflicts

Intended Learning Outcomes:
After the completition of the module the students will be able to understand the core concepts and implicatons of data, privacy and data protection law. This includes the policy, fundamental rights, history and relevance of GDPR, as well as the material und territorial scope. Additionally the students will be able to understand the core principles of the European Data Act. Furthermore the students will be able to discuss basic principles of data subjects rights, in particular with respect to access, erasure, object as well as in obligations of data controllers and processors. Additionally students will be able to understand, analyze and discuss current research on data, privacy and data protection law and regulation. After completion students will also be able to assess the impact data protection law and regulation have on society.

Teaching and Learning Methods:
The module consists of a master´s lecture and associated case studies. The topics of the module are presented via slides and presentations in the lecture hall or a hybrid format. Both the teaching format and the associated in-class exercises aim to stimulate discussions based on presentations and questions. In addition the module will equip students with the necessary skills to understand and critically discuss current research on data, privacy and data protection law and regulation, as well as to communicate their effectiveness and implications, and shed light on the respective impact on society. During the lecture parts, new topics will be presented and explained. In the in-class exercises, these concepts will be implemented and applied in case studies.

Media:
PowerPoint presentations

Reading List:
Handbook on European data protection law, author(s): Council of Europe , European Court of Human Rights , European Data Protection Supervisor , European Union Agency for Fundamental Rights (EU body or agency), Link: https://op.europa.eu/en/publication-detail/-/publication/5b0cfa83-63f3-11e8-ab9c-01aa75ed71a1

Responsible for Module:
Paal, Boris; Prof. Prof. Dr. Dr. jur.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86061) Data Regulation & Law (part of 6 ECTS module) (Übung, 2 SWS)
Paal B (Djebbari S, Krikis K)

(SOT86060, SOT86061) Data Regulation & Law (Vorlesung, 2 SWS)
Paal B (Djebbari S, Krikis K)
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86074: Aligning Generative AI to Social Values (6 ECTS) | Aligning Generative AI to Social Values (6 ECTS)

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module examination consists of a project work. The project involves group work, a written report (10-15 pages), and a final presentation (5 minutes). The written report counts for 90 % of the module grade, and the presentation for 10 %. The project will be worked on in teams, and a responsible machine learning project will be pursued in a key area of their interest. Through the project, students will demonstrate their ability to identify and mitigate biases in generative AI models and showcase their skill in designing and implementing AI models, prioritizing ethical standards, and reflecting diverse social values. With the written report, the students show their understanding of the principles and frameworks for aligning generative AI systems with societal values and ethical considerations. They further demonstrate their ability to critically evaluate the impact of generative AI technologies on different social dimensions. Through the presentation, students prove that they are able to present and discuss their results to a specialist audience understandably and appropriately.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of machine learning concepts and algorithms is recommended, though not strictly required. The same applies for coding skills. An interest in ethics, social science, and policy aspects related to technology would be advantageous for engaging with the course content.

Content:
This module explores the intersection of generative AI and social values, focusing on ethical considerations, bias mitigation, and the development of AI systems that reflect diverse societal

values. Students will engage with theoretical frameworks, practical tools, and case studies to understand and address the ethical challenges in generative AI.
Course Content:
1. Introduction to Generative AI and Social Values
Overview of generative AI technologies
Importance of aligning AI with societal values
Ethical principles in AI (fairness, accountability, transparency, inclusivity)
2. Ethical Frameworks and Principles
Key ethical theories and their application to AI
Existing frameworks for ethical AI
Case studies on ethical AI failures and successes
3. Understanding and Mitigating Bias in Generative AI
Types and sources of bias in AI models
Methods for detecting and mitigating bias
Practical exercises in bias identification and mitigation
4. Transparency and Accountability in AI
Importance of transparency in AI systems
Techniques for improving transparency
Ensuring accountability in AI deployment
5. Auditing and Red Teaming Approaches
Introduction to auditing AI systems
Red teaming methodologies for stress-testing AI models
Hands-on projects in auditing and red teaming generative AI
6. Aligning Large Language Models with Societal Values
Challenges specific to large language models (e.g., GPT, BERT)
Techniques for aligning language models with ethical standards
Practical projects in fine-tuning and aligning language models
7. Balancing Innovation and Ethical Responsibility
Case studies on innovation vs. ethical dilemmas in AI
Strategies for responsible AI development
Policy implications and regulatory considerations

Intended Learning Outcomes:
Upon successful completion of this module, students will: Develop a thorough understanding of the principles and frameworks for aligning generative AI systems with societal values and ethical considerations. Be able to critically evaluate the impact of generative AI technologies on various social dimensions, including fairness, accountability, transparency, and inclusivity. Acquire skills to identify and mitigate biases in generative AI models, ensuring more equitable and just outcomes.Gain practical experience in designing and implementing AI models that prioritize ethical standards and reflect diverse social values.Understand the challenges and complexities of balancing innovation with ethical responsibility in the deployment of generative AI. Learn to collaborate effectively in interdisciplinary teams to conceptualize, design, and execute projects focused on aligning AI with societal needs.

Teaching and Learning Methods:
The module consists of a lecture and a seminar.
In the lecture students will be introduced to key concepts in Generative AI & Social Values. During the lecture, there will be slides and presentations, which will describe different parts key concepts. Students will be answer questions and perform short excercises, through which they can prove their understanding of the course content. In the seminar, students will have to apply the learned concepts in practice. They will form groups, learn how to work as teams, and answer a specific research question on aligning Generative AI models to social values. Through the final presentation and the delivery of the project they will prove their expertise in AI Alignment.

Media:
computer, presentations, videos

Reading List:
Gabriel, Iason. "Artificial intelligence, values, and alignment." Minds and machines 30, no. 3 (2020): 411-437.

Ryan, Michael J., William Held, and Diyi Yang. "Unintended Impacts of LLM Alignment on Global Representation." arXiv preprint arXiv:2402.15018 (2024).

Casper, Stephen, Xander Davies, Claudia Shi, Thomas Krendl Gilbert, Jérémy Scheurer, Javier Rando, Rachel Freedman et al. "Open problems and fundamental limitations of reinforcement learning from human feedback." arXiv preprint arXiv:2307.15217 (2023).

Shi, Weiyan, Ryan Li, Yutong Zhang, Caleb Ziems, Raya Horesh, Rogério Abreu de Paula, and Diyi Yang. "CultureBank: An Online Community-Driven Knowledge Base Towards Culturally Aware Language Technologies." arXiv preprint arXiv:2404.15238 (2024).

Responsible for Module:
Papakyriakopoulos, Orestis; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86097, SOT86074) Aligning Generative AI to Social Values (Vorlesung, 2 SWS)
Papakyriakopoulos O

(SOT86074) Aligning Generative AI to Social Values (part of 6 ECTS module) (Seminar, 2 SWS)
Papakyriakopoulos O
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86076: Open Data - Open Science | Open Data - Open Science

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module will be assessed in a scientific paper (3000 words) and a 90-minute written exam. The written exam allows students to demonstrate their knowledge of the principles of open science and open research and their understanding of political and economic dimensions in knowledge production. In the scientific paper students demonstrate that they are able to discuss the political and economic dimensions of knowledge production. The paper will be on a topic inspired by one of the module sessions as listed below. The essay needs to propose and defend a solution to one of the challenges identified and debated during the seminars. Essays need to be written in the 1st person ("I will argue that..") and make use of relevant scholarly literature, with at least 8 academic sources cited and discussed within the essay.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The module is designed to provide students with a comprehensive understanding of the principles and practices of openness in scientific research and data management. The course is structured to highlight the transformative potential of open science, in particular open access to publications, open research data, and open source for science in society, emphasizing not only aspects of research integrity or innovation (such as reproducibility), but also aspects of democratizing access and use of knowledge. It also aims to foster students' understanding of the Open Science movement, its impact on science and society, and, more generally, current transformation in research practices and governance. The module builds around the research conducted within the PHIL_OS project (www.opensciencestudies.eu), one of the leading research groups worldwide working on these issues, and therefore focuses on the cutting-edge of research on Open Science.

Through case studies, students will explore foundational concepts such as the political economy of scientific knowledge production and the significance of open science initiatives. The course will also cover key topics including open source projects, open infrastructures, and citizen science, illustrated with real-world case studies to demonstrate their impact on various fields. In terms of disciplinary domain, we will discuss emerging research within the fields of philosophy, history and social studies of science and technology, as well as meta-research (sometimes also referred to as “research on research”). Topics encompass, but are not be limited to: the reproducibility crisis; information quality; inequity and injustice across research environments; data-intensive technologies and AI; data management; cooperation and coordination within and across scientific institutions; citizen science and public science; science governance; scientific modelling and epistemology. See the detailed schedule for more details. Attendees are required to attend sessions regularly, study the readings for each week in advance of the meeting, and come prepared for discussion. Through case studies, students will explore foundational concepts such as the political economy of scientific knowledge production and the significance of open science initiatives.

In addition to theoretical knowledge, the course incorporates hands-on exercise components that engage students in practical applications of open access, open research data, and open source. Students will work in groups to discover, clean, analyze, and present data relevant to their fields of study. This exercise is designed to build practical skills and encourage collaboration. This dual approach ensures that students not only understand the importance of open science and open data but also gain the practical experience necessary to implement these practices in their future careers. By the end of the course, students will be well-equipped to contribute to the growing movement towards openness in research and public administration, fostering a more inclusive and accessible knowledge economy.

Intended Learning Outcomes:
By the end of this module, students will be able to:
Understand the principles and importance of open science and open (research) data.
Analyze the impact of open initiatives like the Human Genome Project across several societal domains, such as research, politics, education, economy, security and more.
Evaluate critically the political and economic dimensions of knowledge production.
Gain practical skills in data discovery, cleaning, analysis, and presentation.
Apply open science practices in their own research fields.
Contributors will also gain understanding of cutting-edge debates in the philosophy and social studies of science, especially life and environmental sciences; science governance and current global transformations; inequity and injustice in scientific knowledge production and use. Contributors will also gain skills in discussing complex problems for science and society, articulating and defending their own position on such issues, and researching background and solutions in a scholarly, rigorous manner.

Teaching and Learning Methods:
The module will consist of a lecture and a seminar. The lectures will take the form of presentations given by experts in each topic with a discussion around readings circulated in advance (including

in many cases draft manuscripts of work that has not yet published). The seminars will take the form of updates and discussions among students and participants to the PHIL_OS project, thereby bringing the students right into the heart of ongoing research on these issues, including the latest policy and scientific developments.

Media:
Reader, PowerPoint

Reading List:
Fecher, B., & Friesike, S. (2014). Open science: one term, five schools of thought (pp. 17-47). Springer International Publishing.
Gold, E. R. (2021). The fall of the innovation empire and its possible rise through open science. Research Policy, 50(5), 104226.
Heimstädt, M., & Friesike, S. (2021). The odd couple: Contrasting openness in innovation and science. Innovation, 23(3), 425-438.
Leonelli, S. (2023) Philosophy of Open Science. Cambridge University Press.
Levin, N. and Leonelli, S. (2016) How Does One “Open” Science? Questions of Value in Biological Research. Science, Technology and Human Values 42 (2): 280-305. DOI: 10.1177/0162243916672071
Maxson Jones, K., Ankeny, R. A., & Cook-Deegan, R. (2018). The Bermuda Triangle: The pragmatics, policies, and principles for data sharing in the history of the human genome project. Journal of the History of Biology, 51(4), 693-805.
Ross-Hellauer, T., Reichmann, S., Cole, N. L., Fessl, A., Klebel, T., & Pontika, N. (2022). Dynamics of cumulative advantage and threats to equity in open science: a scoping review. Royal Society open science, 9(1), 211032.
Salazar, A., Wentzel, B., Schimmler, S., Gläser, R., Hanf, S., & Schunk, S. A. (2023). How Research Data Management Plans Can Help in Harmonizing Open Science and Approaches in the Digital Economy. Chemistry–A European Journal, 29(9), e202202720.
Tyfield, D., Lave, R., Randalls, S., & Thorpe, C. (Eds.). (2017). The routledge handbook of the political economy of science (pp. 21-31). London, UK: Routledge.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Open Data - Open Science (Seminar, 2 SWS)
Jones E, Leonelli S

Introduction to Open Data - Open Science (Vorlesung, 2 SWS)
Jones E, Leonelli S
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86097: Aligning Generative AI to Social Values (3 ECTS) | Aligning Generative AI to Social Values (3 ECTS)

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The module examination consists of a written exam (Multiple Choice Test) (60 minutes). With the Multiple Choice Test, the students show their understanding of the principles and frameworks for aligning generative AI systems with societal values and ethical considerations. They further demonstrate their ability to critically evaluate the impact of generative AI technologies on different social dimensions and to understand the challenges and complexities of balancing innovation with ethical responsibility in deploying of generative AI.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of machine learning concepts and algorithms is recommended, though not strictly required. The same applies for coding skills. An interest in ethics, social science, and policy aspects related to technology would be advantageous for engaging with the course content.

Content:
This module explores the intersection of generative AI and social values, focusing on ethical considerations, bias mitigation, and the development of AI systems that reflect diverse societal values. Students will engage with theoretical frameworks, practical tools, and case studies to understand and address the ethical challenges in generative AI.
Course Content:
1. Introduction to Generative AI and Social Values
Overview of generative AI technologies
Importance of aligning AI with societal values

Ethical principles in AI (fairness, accountability, transparency, inclusivity)
2. Ethical Frameworks and Principles
Key ethical theories and their application to AI
Existing frameworks for ethical AI
Case studies on ethical AI failures and successes
3. Understanding and Mitigating Bias in Generative AI
Types and sources of bias in AI models
Methods for detecting and mitigating bias
Practical exercises in bias identification and mitigation
4. Transparency and Accountability in AI
Importance of transparency in AI systems
Techniques for improving transparency
Ensuring accountability in AI deployment
5. Auditing and Red Teaming Approaches
Introduction to auditing AI systems
Red teaming methodologies for stress-testing AI models
Hands-on projects in auditing and red teaming generative AI
6. Aligning Large Language Models with Societal Values
Challenges specific to large language models (e.g., GPT, BERT)
Techniques for aligning language models with ethical standards
Practical projects in fine-tuning and aligning language models
7. Balancing Innovation and Ethical Responsibility
Case studies on innovation vs. ethical dilemmas in AI
Strategies for responsible AI development
Policy implications and regulatory considerations

Intended Learning Outcomes:
Upon successful completion of this module, students will:
Develop a thorough understanding of the principles and frameworks for aligning generative AI systems with societal values and ethical considerations.
Be able to critically evaluate the impact of generative AI technologies on various social dimensions, including fairness, accountability, transparency, and inclusivity.
Acquire skills to identify and mitigate biases in generative AI models, ensuring more equitable and just outcomes.
Understand the challenges and complexities of balancing innovation with ethical responsibility in the deployment of generative AI.

Teaching and Learning Methods:
The module consists of a lecture.
In the lecture students will be introduced to key concepts in Generative AI & Social Values. During the lecture, there will be slides and presentations, which will describe different parts key concepts.

Students will answer questions and perform short excercises, through which they can prove their understanding of the course content.

Media:
computer, presentations, videos

Reading List:
Gabriel, Iason. "Artificial intelligence, values, and alignment." Minds and machines 30, no. 3 (2020): 411-437.

Ryan, Michael J., William Held, and Diyi Yang. "Unintended Impacts of LLM Alignment on Global Representation." arXiv preprint arXiv:2402.15018 (2024).

Casper, Stephen, Xander Davies, Claudia Shi, Thomas Krendl Gilbert, Jérémy Scheurer, Javier Rando, Rachel Freedman et al. "Open problems and fundamental limitations of reinforcement learning from human feedback." arXiv preprint arXiv:2307.15217 (2023).

Shi, Weiyan, Ryan Li, Yutong Zhang, Caleb Ziems, Raya Horesh, Rogério Abreu de Paula, and Diyi Yang. "CultureBank: An Online Community-Driven Knowledge Base Towards Culturally Aware Language Technologies." arXiv preprint arXiv:2404.15238 (2024).

Responsible for Module:
Papakyriakopoulos, Orestis; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86097, SOT86074) Aligning Generative AI to Social Values (Vorlesung, 2 SWS)
Papakyriakopoulos O
For further information in this module, please click campus.tum.de or here.

Module Description

WI000285: Innovative Entrepreneurs - Leadership of High-Tech Companies | Innovative Entrepreneurs - Leadership of High-Tech Companies

Version of module description: Gültig ab summerterm 2021

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

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

Description of Examination Method:
The examination performance is achieved through individual project work, which is divided into three phases. In the first phase, the students intensely engage themselves over a period of six to eight weeks with a self-chosen "Inner Development Challenge" from one of the following topic areas: Relationship to Self, Cognitive Skills, Caring for Others and the World, Social Skills, and Driving Change. Subsequently, in the reflection phase, a written reflection paper is produced in which the students critically reflect on their experiences and draw conclusions for their future.
In the Peer feedback phase, the students read and analyze five reflection papers of their fellow students. This fosters the students' ability to critically analyze their own works as well as the works of others and to give and receive effective feedback.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
- Knowledge: No special requirements, willingness to participate
- Abilities: Identifying opportunities; proactiveness; communication; commitment
- Skills: openness; analytical thinking; visual thinking; self-motivation; networking

Content:
The objective of the module is to inspire and motivate the participants coming from various disciplines for an entrepreneurial career, and to give them a basic understanding about founding and managing technology- and growth-oriented companies. To serve this purpose, the module

provides an introduction to the topic of (effectual) entrepreneurship, as well as guest lectures by outstanding founders, entrepreneurs, managers, and investors on selected topics, such as:

1. The entrepreneurial ecosystem
2. Founding of companies for students and scientists
3. How to develop an idea into a market-ready product
4. Financing of startups
5. Corporate growth
6. Creating and managing an entrepreneurial culture
7. Strategic business management
8. Innovation management
9. Corporate finance
10. Business succession

Moreover, for self-motivated participants, there is ample opportunity for personal development through interactive workshops, closed networking events.

Intended Learning Outcomes:
Upon successful completion of this module, participants will be able to...
- understand the entrepreneurial mindset
- recognize and develop personal strengths
- develop and implement personal ideas
- understand Design Thinking methodology

Moreover through guest speakers’ lectures and optional workshops participants will be empowered to:
- realize opportunities and challenges associated with the founding and managing of technology- and growth-oriented companies;
- create a personal roadmap for entrepreneurial success.

Thus, students familiarize with topics like opportunity recognition, innovation management, growth, leadership, and the facets of entrepreneurship. In doing that, they are enabled to see, realize, and experience the multiplicity in the everyday life of an entrepreneur, entrepreneurial personalities, as well as entrepreneurial skills and motivations.

Teaching and Learning Methods:
As guest lecturers, each week an outstanding founder, entrepreneur, manager, or investor, spanning a wide-ranging industrial spectrum, is hosted to report on their individual entrepreneurial careers.

At the end of each lecture, the participants can actively engage in discussions with the guest speaker during an open session.

Moreover, in context of a workshop, the participants venture their own personal qualities and skills to understand in a structured way their own entrepreneurial identity. In doing that, they focus on their individual strengths and resources to develop a plan to be entrepreneurial.

The module also provides participants with ample opportunity to network with people from the entrepreneurial environment of TUM.

Media:
- Lecture slides downloadable
- Online discussion forum (e.g., for questions and feedback on guest lectures)
- Handouts (distributed online)

Reading List:
Read, S., S arasvathy, S., Dew, N., Wiltbank, R., & Ohlsson, A. V. (2016). Effectual Entrepreneurship. Taylor & Francis

Responsible for Module:
Schönenberger, Helmut; Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Innovative Entrepreneurs - Leadership of High-Tech Companies (WI000285, englisch) (Vorlesung, 2 SWS)
Schönenberger H [L], Schönenberger H, Schuster C
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001309: Advanced Seminar Marketing, Strategy, Leadership & Management: Life Mastery: Essential Human, Social, and Financial Skills They Don’t Teach in School | Advanced Seminar Marketing, Strategy, Leadership & Management: Life Mastery: Essential Human, Social, and Financial Skills They Don’t Teach in School

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
The examination consists of
1) an individual presentation (25% of the final grade)
2) an individual written work (75% of the final grade).

In the examination, students demonstrate that they
- have understood an assigned topic in depth and have demonstrated the most important aspects in a way that is comprehensible to their fellow students
- have identified and prepared practical fields of application for this topic
- have presentation and communication skills that enable them to present their findings on the topic in a clear and structured manner and discuss the applicability of their findings to business practice

Repeat Examination:
Next semester

(Recommended) Prerequisites:
IMPORTANT: Available seats will be allocated based on academic eligibility, relevant experience and skills.

Content:
This course exists to cover and convey all the content that otherwise falls short - whether in school, college, education, and public exchange - so that students of all disciplines can gain and benefit from this knowledge. What really matters in life, work and career? Many of the unwritten laws

and connections are discovered by many people only late in life and are often only passed on informally among themselves.
The aim of this seminar is to close these "white spots" and "gaps" by conveying practical, useful content, the knowledge and understanding of which represents real added value for work, career and other areas of life.
In doing so, this course focuses on three overarching topics:
- personal competencies
(such as career planning and self-leadership; e.g., "How do I know what I really want?", "How can I set critical priorities for my career?", or "How can I strategically use microhabits to achieve my goals?").
- social skills
(such as communication and relationship management; e.g., "How do I generate positive feedback?" or "How do I deal with difficult counterparts?"),
- financial competencies
(such as planning finances, asset, and retirement; e.g., "What is passive income and how can I take advantage of it?").

Intended Learning Outcomes:
Students who have attended this seminar will possess
- a comprehensive understanding of key design opportunities in work, career, and life
- knowledge of major issues related to personal, social, and financial skills, as well as promising approaches and methods to address these issues
and have acquired practical skills in
- personal, social, and financial competencies,
- critical thinking, reflection, and application of concepts and scientific findings to concrete challenges, and
- engaging and descriptive preparation of content for practical application.
- basic knowledge of working scientifically.

Teaching and Learning Methods:
In this seminar, participants will receive input on the topics covered in various thematic blocks, as well as working materials for self-study and reappraisal. Subsequently, the contents are deepened in the seminar in the context of exercises, role plays, reflections, presentations and discussions. As part of the examination, the participants will work on a topic from one of the three areas in depth and in detail and prepare this didactically in such a way that all other course participants can also benefit from it. During the seminar, they will have the opportunity to present and discuss this topic and to receive feedback on the developed content following the presentation as well as in the context of a peer-review process. Based on this, the participants will further elaborate, concretize and vividly prepare their topic in the course of the semester.

Media:
Activity-based learning, interactive teaching, flipped classroom, group discussions, presentations, practical exercises, reflection, literature, script.

Reading List:
• Dalio, R. (2017). Principles: Life and work. Simon and Schuster.
• Housel, M. (2020). The Psychology of Money: Timeless lessons on wealth, greed, and happiness. Harriman House Limited.
• Carnegie, D. (2014). Wie man Freunde gewinnt: Die Kunst, beliebt und einflussreich zu werden. S. Fischer Verlag.

Responsible for Module:
Welpe, Isabell M.; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Seminar Marketing, Strategy, Leadership & Management (MGT001309, englisch): Life Mastery: Essential Human, Social, and Financial Skills They Don’t Teach in School (Seminar, 4 SWS)
Welpe I, Born N, Hochstraßer S
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001348: Innovation Sprint | Innovation Sprint

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 140	**Contact Hours:** 40

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

Description of Examination Method:
Combination of group and individual project assignment - final examination consists of two components, each carrying 50% of the final course grade: (1) a 5 minute group presentation plus 10 minutes Q&A and feedback at the end of the course and (2) an individual reflection paper of ca. 2,500 words.
Students will present to the class, the lecturer and the partner how the team identified an attractive opportunity in a suitable market, understood the customers' / users' needs in the process and, as a result, proposed a sustainable business model that balances people, planet and profit.

In a written reflection paper, every student will reflect upon and consolidate their individual learnings from (1) the reading package and (2) their entrepreneurial experience on three different levels - self, team and entrepreneurship.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Interest in entrepreneurship and sustainability, ability to work in a team

Content:
Supported by the reading package students will work on five intensive days in Campus only in interdisciplinary teams on a challenge from a partner and learn why and how to develop customer and user centric business ideas through applying an entrepreneurial mindset and innovative methods - always considering the triple bottom line.
Taking on an embedded view on the interrelatedness of economic, social and environmental systems, students will develop an ecosystem map to get an overview of relevant stakeholders and potential customers as well as important relationships and value streams. Input on Empathy

Research will prepare them to collect qualitative insights from potential customers and users through interviews, immersion and contextual observations.
After conducting their Empathy Research they will step by step learn how to synthesize their insights and define opportunities for sustainable innovation. With a concrete how-might-we-question they will start into ideation. Through different creativity methods they will develop and prioritize ideas and build a simple prototype. This prototype is being tested again through qualitative tests with potential customers and users. When they come back after testing they do a first iteration based on the feedback they got and derive assumptions on a potential business model. After input on pitching they will prepare slides or other material and pitch in front of the group, partner and external guests. After the pitch event they will be led through a reflection of the learnings they gained during the week. The reading package will support the transfer of these learnings.

Intended Learning Outcomes:
After participating in this module students will be able to understand and apply life-centered design principles in the early stages of an entrepreneurial process: from identifying an entrepreneurial opportunity and understanding its environmental and social impact to validating assumptions by applying qualitative research methods and interpreting data as well as using prototyping as a tool for communication and learning. They will be able to apply creativity methods, take over collective responsibility and know how to effectively communicate their business opportunities.
Taking decisions under uncertainty, ambiguity and risk in newly formed teams will foster their collaboration and communication skills and prepare them for future team work in appreciating and accommodating team members' individual personalities and boundaries.
At the same time the reading package enables students to gain a broader understanding of the methods learned in the course providing them with the ability to apply them beyond the context of innovation.

Teaching and Learning Methods:
This module relies on a combination of readings, input sessions, workshops, teamwork and individual feedback and support. While input sessions will stimulate students’ engagement with relevant tools and topics, workshops and team discussions will support the implementation of the knowledge in their projects and facilitate students’ learning of the soft and intricate aspects of adopting an entrepreneurial mindset and skills. Working on a design challenge that a partner (e.g. TUM Venture Labs) provides stimulates peer competition and allows students to directly apply what they learn in a real life setting. The reading package will strengthen students' understanding of the methods and allow them to make sense of their practical experience.

Media:
Presentations, canvas, handywork

Reading List:
Each semester students will be provided with a mandatory reading package.

Responsible for Module:
Alexy, Oliver; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Innovation Sprint (MGT001348, englisch) (Seminar, 4 SWS)
Alexy O [L], Hartmann B, Baur C
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001404: Scaling Entrepreneurial Ventures | Scaling Entrepreneurial Ventures

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
This module's learning objectives are examined via exercises ("Übungsleistung") comprising the four elements outlined below. There is no written exam.

(1) Individual oral class engagement & homework (40%): For each session, you will be given in advance a set of questions or tasks to prepare (homework). In class, you will be assessed regarding the quality of integrating the prepared homework into course discussions, case assessments, group work, and presentations. This will demonstrate that you can explain and integrate learned entrepreneurial venture scaling and growth concepts, frameworks, and theories in practice and describe, compare, and appraise the conduct and performance of existing scaling/scaled entrepreneurial ventures. In case not all sessions can be attended, under specific circumstances and upon granted instructor permission, you may submit written/video solutions of your homework before class as a basis for grading.

(2) Individual written reflection paper (10%): At the end of the course, you will submit a short reflection paper highlighting the key learnings of the course and explaining why, how, and where they might help you in the future. The individual reflection will show that you can process, synthesize, and prioritize the newly learned knowledge and critically think about and argue for more expansive fields of application beyond those discussed in class.

(3) Group written report (30%): As part of a group composed in the kick-off session, you will create a "scaling plan" by analyzing and formulating the scaling potential and related implications of a real-life early-stage startup and developing concrete recommendations for scaling-related strategies and actions. This assessment will show that you can directly apply the learned frameworks, theories, and concepts to uncover and assess the implications of venture scaling, determine and evaluate suitable scaling strategies, prioritize and initiate actions and decisions for their implementation, identify predictors of failure, and propose mitigative steps. It also illustrates

that you can collaborate in a team, adopt a leader's perspective, strategize, and solve problems in an analytical and structured way. The scaling plan will be submitted at the end of the course. An assessment sheet filled in by each group member and handed in at the end of the course will clarify your individual contribution.

(4) Group final presentation (20%): In the final session, you will present a part of your group's scaling plan. As each member of the group will present, your individual contribution is clearly identifiable and appraisable. The final group presentation will showcase that you are able to synthesize and present your findings in a comprehensive, precise, and structured way. It will also show that you communicate clearly and perform professionally.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Scaling an entrepreneurial venture can be a very complex and demanding challenge. Often this requires a fundamental redesign of many firm areas, high team effort, and very strong leadership. In addition, dynamic markets and grand challenges create additional pressures on young ventures attempting to grow.
This module provides a holistic view of the scaling process of an entrepreneurial venture from a leader’s perspective. It introduces you to theories, concepts, and frameworks for scaling entrepreneurial ventures and venture growth. Based on engaging with crucial literature and concepts in entrepreneurship, strategy, and general management, discussing related news articles, case studies, industry insights, and best practices, and applying them in short class activities, you will learn why, how, and when entrepreneurial ventures scale and grow, which challenges and barriers they might face and how to overcome these. In addition, you will use this knowledge to analyze the conduct and performance of existing scaling/entrepreneurial ventures. Finally, you will directly apply this knowledge to assess the scaling potential and related implications of a real-life early-stage tech startup and develop and present concrete recommendations for effective scaling strategies and actions. Thus, the module will prepare you to effectively lead, accompany, or monitor an entrepreneurial venture through its scaling and growth phase.

Topics include, but are not limited to:
- Firm growth and scaling concepts, frameworks, and strategies from theory and practice
- Adopting a growth mindset
- Scaling and sustainability
- Implications of venture scaling: key opportunities and critical challenges focusing on leadership and strategy, people and culture, operations and structure, and financials
- Venture-specific and contextual factors for scaling
- Managerial scaling strategies, decisions, and actions
- Scaling success measures, risks, and risk mitigation strategies

- Venture exit options and strategies
- Predictors of venture failure and steps for dealing with failure and managing a turnaround.

Intended Learning Outcomes:
Upon successful completion of this module, you will be able to:
Knowledge objectives:
(1) Explain and apply key concepts, frameworks, and theories related to scaling entrepreneurial ventures and venture growth in practice
(2) Describe, compare, and appraise the conduct and performance of existing scaling/scaled entrepreneurial ventures
(3) Uncover and assess the implications of venture scaling
(4) Determine and evaluate scaling strategies considering venture-specific and contextual factors
(5) Prioritize and initiate actions and decisions for implementing suitable scaling strategies
(6) Identify predictors of failure and propose mitigative steps

Competencies objectives:
(1) Improve analytical, structured problem-solving, synthesis, and prioritization competencies
(2) Enhance team collaboration and leadership competencies
(3) Strengthen communication, presentation, and argumentation skills
(4) Build up critical thinking and strategizing competencies

Teaching and Learning Methods:
The module consists of an introductory session in which the fundamentals of scaling entrepreneurial ventures and venture growth will be shared and discussed. In addition, groups will be assembled, and each group will select a real-life early-stage tech startup for which a scaling plan will be jointly developed throughout the course.
In subsequent sessions, module contents will be co-developed by the course participants and the instructor(s). To enable building up a solid knowledge fundament, we integrate action-learning elements such as presentations and discussions of course material, case studies, and news articles; flipped classrooms, role plays, and games; and interactions with industry guest speakers. Continuous group work on the scaling plan will ensure that the newly acquired knowledge will be directly applied.
Hence, a large share of learning will occur through your individual and your group’s preparation for the in-class sessions and working on your startup cases. Respective instructions and materials to prepare will be given throughout the course. Through peer review exercises, presentations, discussions of intermediate findings, and feedback provided by the instructor(s), you will be able to share and get an assessment of your progress continuously. The module will end with a group presentation followed by a moderated Q&A and joint reflection exercise.

Media:
Presentations, flipchart, whiteboard, digital tools, videos, Zoom (for feedback sessions)

Reading List:
Specific & mandatory readings will be specified at the beginning of the course.

Familiarizing with the following book is encouraged but not mandatory for passing the course:
- Eisenmann, T. (2021). Why startups fail: A new roadmap for entrepreneurial success. Crown.

Responsible for Module:
Tryba, Anne; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Scaling Entrepreneurial Ventures (MGT001404, englisch) (Limited places) (Seminar, 4 SWS)
Tryba A [L], Mayer C, Tacke F
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001405: Global entrepreneurship summer school | Global entrepreneurship summer school

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:**	**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 final examination of the project consists of two components. The first is the presentation prepared by the students at the end of the summer school. The second part is a final report that must be submitted approximately eight weeks after the summer school. Both count for 50% of the grade.

At the final event of the summer school, the teams present an approach to solving the problem challenge they have worked on in the field of climate change. The presentation has a length of 5-10 minutes and is evaluated by an external jury. The students thus demonstrate that they are able to transform the information they have received into the independent development of an impact-oriented business model and present it appropriately. In the preparation of the presentation, they are accompanied and supported by their coaches and the accompanying facilitators.

The second part of the grade consists in the report to be submitted after the summer school. It documents in a structured way how the information received was used to develop an impact-oriented business model. Furthermore, feedback received during the final presentation should be considered and incorporated. The report ensures that instead of simply documenting their findings students structure and reflect on them. The final report should not exceed 7500 characters and must be submitted eight weeks after the completion of the summer school.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
- Basic understanding of entrepreneurship and its principles, such as from attending an introductory lecture on the topic, founding experience, or closely following the media on the topic

- Interest in developing innovative solutions from a systemic perspective to generate social and environmental impact

Content:
As part of the Global Entrepreneurship Summer School (GESS), up to 50 international students from universities all over the world per cohort spend seven days intensively working on global challenges and the question of how these can be solved with the help of social and innovative business ideas. In preparation, the participants learn about the forms and goals of Social Entrepreneurship with online materials. Furthermore, they inform themselves and reflect on the effects of climate change in their local context. For this purpose, they interview two to three people and showcase and share their observations and information in the provided online workspace.

During the actual Summer School in Munich and, possibly, at other locations in parallel, they discuss and research current problems in the field of climate change and then develop entrepreneurial ideas for solutions. To support them, methods and knowledge are conveyed on topics such as system innovation, design thinking, business modeling, impact management and financing. The systemic perspective is of particular importance in the program. "Wicked problems" as represented by the social and ecological problems of our time cannot be solved in isolation. Solutions are therefore only possible by looking at them as phenomena inside of complex systems.

At the end of the Summer School, the students present the solutions they have developed in the form of impact-oriented business models to a jury and guests. In this context, they receive feedback and the opportunity to apply for follow-up coaching for the business ideas they have developed. The final report reflects on the process and structures its results.

Intended Learning Outcomes:
The GESS aims to enable students to develop practice-oriented approaches to solutions in the form of impact-oriented business models. The aim is to generate impact in the sense of the United Nations Sustainable Development Goals. The students learn:

- to understand and apply the concept of impact and its implications
- to implement the entrepreneurial innovation process in interdisciplinary teams to generate concrete solutions
- to apply tools and methods from the field of system innovation and human-centered design.

The GESS focuses on experiential and problem-based learning and aims both to advance the development of social and entrepreneurial innovation and to promote and develop students' skills in responsible entrepreneurship. By working on solutions in international teams, students also improve soft skills such as creativity, perseverance, communication skills, and intercultural competencies.

Teaching and Learning Methods:
Lectures, discussion, development of challenges, excursion, team coaching sessions, feedback discussion, presentation, Q&A session. The variety of methods ensures that the right method is chosen for each learning content to be conveyed. For example, new knowledge and tools are presented by experts in impulse lectures and then discussed in large or small groups before they are incorporated into the development of solutions. Feedback talks and team coaching sessions guarantee that the tools and methods presented are correctly understood and applied. Furthermore, good cooperation within the teams is ensured and an appreciative feedback culture is trained. The final presentation at the closing event gives the participants the opportunity to practise their communication skills. The final report helps to consolidate and reflect on the acquired knowledge.

Media:
Videos, presentations, online materials, quiz, exercise sheets, Power Point, flip charts, mural boards

Reading List:
Thinking in Systems, Donella Meadows. Earthscan, 2009
Martin, L. Design of Business: Why Design Thinking is the Next Competitive Advantage. Harvard Business Press, 2009
Kurz, B./ Kubek, D.: Social Impact Navigator, Phineo, 2017, verfügbar auf https://www.social-impact-navigator.org/

Responsible for Module:
Alexy, Oliver; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Global Entrepreneurship Summer School (MGT001405, englisch) (Seminar, 4 SWS)
Alexy O (Vogel C)
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001410: ChangeMakers: Entrepreneurial and Design Competencies for Societal Transformation | ChangeMakers: Entrepreneurial and Design Competencies for Societal Transformation

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
This module's learning objectives are examined via exercises (“Übungsleistung”) comprising the three elements outlined below. There is no written exam.

(1) Group final presentation (50%): In the final session, you will present your team's approach and solution for a societally relevant challenge identified at the beginning of the course. The presentation format can be chosen by your team and should include the presentation of a design artifact. Design artifacts can include a 3-dimensional object, a visual representation, a video, a storyline, a systems map, and many other forms of storytelling and visualization. Presentations will last approximately 5 minutes, followed by a 5-10 minute Q&A and feedback round. Each team member must actively participate so your individual contribution is identifiable and appraisable. The final group presentation will showcase that you have acquired and can demonstrate essential entrepreneurial and design competencies: focus – you can identify whether a problem is worth solving; courage – you understand your role in creating change; imagination – you are capable of developing and articulating a vision; and action – you know how to take next steps.

(2) Individually written reflection paper (20%): At the end of the course, you will submit a short paper (2 pages excl. sources) reflecting on
(a) your overall experience with and synthesis of the course's format (considering both the experiential learning immersion and the reading package)
(b) your critical reflection on the design solution you and your team created
(c) whether and how the course allows and will allow you to generate hope in the face of critical societal challenges

(3) Daily course exercises (30%)

In each session during the project week, you will be asked to submit a small reflection exercise related to the day's content and learning objectives via Moodle. We will dedicate 10-15 minutes of each session to this exercise using a set of questions. You will be guided through the exercise by the course instructors. This will demonstrate that you have engaged with, understood, and critically reflected on the day's topic.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fluency in English; interest in entrepreneurship, design, and a sustainable future; willingness to work in a team;

Due to the nature of the assessments and the ongoing team-based work in this course, consistent participation is mandatory. If you need to miss a session for health reasons or other valid circumstances, please inform us in advance via email. We may provide an opportunity to make up the missed material or, in cases of documented illness, assign a "Q" grade (indicating a missed exam with an accepted medical certificate).

Please note: Conflicts such as overlapping courses or work commitments are considered planning issues and should be resolved before enrolling in the course.

Content:
In this module, students will acquire entrepreneurial and design competencies through experiential and scenario-based learning: Set in a future scenario, students will be confronted with signals (based on scientific projections) that make clear what circumstances we may live in in the future. The Impulse Symposium ahead of the project week will provide inspiration and insight to stimulate students' imagination of the future we might live in. During the immersive project week, participants will work in small teams to create a real-life practical solution for a larger societal problem: The first day of the project week creates space to explore what challenges students find relevant and care about, and to explore through design and entrepreneurial methods whether these challenges appear to be worth solving. Throughout the week, students will learn and apply creative problem-solving methods, entrepreneurial thinking and decision-making to work through that challenge they chose. Students will be encouraged to leverage Generative AI tools to illustrate the ideas they create. Students will be guided to apply visualization and prototyping methods as well as reflection techniques that will support them in producing a shareable vision of a livable and lovable future and identify why and how they can contribute to realizing it.
The module is intentionally structured to include an impulse before, as well as iteration and reflection after an immersive project week. In addition, students will receive a reading package. Combining these elements will allow students to start well-prepared, reactive their prior knowledge, inform themselves about relevant methods, and process and appraise new information.

Intended Learning Outcomes:
After successful completion of this module, students will be able to:

● Understand and apply basic entrepreneurial and design competencies, including: Focus for sophisticated problem identification; Courage to take an active role in creating change; Imagination to develop and articulate ideas; Action to take an idea forward towards implementation
● Leverage these competencies to retain hope in the face of critical societal challenges

While developing and articulating solutions in interdisciplinary project teams, students will learn how to plan, manage and conduct a project, mobilize scarce resources, act in the face of uncertainty, collaborate in a team, and present, discuss, and reflect upon their own solutions convincingly. In addition, working with future scenarios will strengthen students' creative confidence and analytical and strategic skills.

Teaching and Learning Methods:
This module relies on six core elements:

● Impulse – a university-wide public mini-symposium that includes high-quality inspirational speakers who will set the tone and give context.
● Project Week – an immersive one-week project-based experience including theory-driven and methodological impulses, team activities, interactive discussions, flipped classroom elements, and guided project work inside and outside the classroom.
● Iteration – a review of the work that has been created during the project week in small teams accompanied by feedback and support from peers and subsequent further development.
● Presentation – a celebratory moment where participating teams share their work with each other and discuss their process and results.
● Reflection – a moment to reflect on the experience and, importantly, plan for possible next steps of integrating the newly acquired skills into one’s work.
● Reading package - a collection of supporting course material, links, and articles to strengthen the understanding and sensemaking of the applied methods.

Media:
Presentations, videos, flipchart, whiteboard, digital tools, Zoom for feedback sessions, prototyping materials

Reading List:
Each semester students will be provided with a reading list relevant to the course.
Inspirational readings include (students will be asked to engage with a selection of inspirational readings):
*Arend, R. J. (2020). The roles of thought and affect on entrepreneurship – A new hope. Journal of Business Venturing Insights, 14. DOI: 10.1016/j.jbvi.2020.e00188.
* Brown, T., Carey, S.,& Wyatt, J.(2021). The next chapter in design for social innovation. Stanford Social Innovation Review.
* Giudice, M., & Ireland, C. (2023). Changemakers: How leaders can design change in an insanely complex world. Two Waves Books.

* Hari, J. (2023). Stolen focus: Why you can't pay attention--and how to think deeply again. Crown.
* Holiday, R. (2021). Courage is calling: Fortune favors the brave. Penguin.
* Hoppe, M., & Namdar, K. (2023). Towards entrepreneurship for a cause: educating transformative entrepreneurial selves for a better world. Entrepreneurship Education and Pedagogy, 6(4), 590-607.
*. Lans, T., Blok, V., & Wesselink, R. (2014). Learning apart and together: towards an integrated competence framework for sustainable entrepreneurship in higher education. Journal of Cleaner Production, 62, 37-47.
* Markovitz, D. (2020). How to avoid rushing to solutions when problem-solving. Harvard Business Review Digital Articles, 2–6.
* Mauch, C. (2019). Slow hope: Rethinking ecologies of crisis and fear. RCC Perspectives: Transformations in Environment and Society, 1. doi.org/10.5282/rcc/8556.
* Noel, L. A. (2023). Design social change: Take action, work toward equity, and challenge the status quo. Ten Speed Press.
* Thackara, J. (2005): In the Bubble: Designing in a complex world; The MIT Press.
* Wedell-Wedellsborg, T. (2017). Are you solving the right problems? Harvard Business Review, 95(1), 76–83.
* Weiss, L. (2017). Stop mindlessly going through your work day. Harvard Business Review Digital Articles, 2–4.

Responsible for Module:
Tryba, Anne; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
ChangeMakers: Entrepreneurial and Design Competencies for Societal Transformation (MGT001410, englisch) (Seminar, 4 SWS)
Tryba A, Diefenthaler A, Löhe T, Mayer C
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001435: Impact Entrepreneurship for Transformational Change | Impact Entrepreneurship for Transformational Change

Version of module description: Gültig ab winterterm 2025/26

Module Level: Master	**Language:** German/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 examination consists of two components. In the accompanying online course, the content of the respective units is tested and deepened through reflection tasks and research tasks (approximately 18,000 signs including spaces). This part represents 50% of the grade. Furthermore, the presentation prepared by the students at the end of the semester and its corresponding documentation (pitch deck or similar) is part of the examination (50%).

As part of a final event, the teams present a solution idea for the problem they have chosen and developed in the area of society, ecology or technology. The presentation lasts 5-10 minutes. The students demonstrate that they are able to translate the information they have received into an independently developed impact-orientated business model and present this in an appropriate manner. They are supported in their preparation by regular feedback from lecturers and coaches.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
- Basic understanding of entrepreneurship and its principles, such as from attending an introductory lecture on the topic, founding experience, or closely following the media on the topic
- Basic knowledge in sustainability
- Interest in developing innovative solutions from a systemic perspective to generate social and environmental impact

Content:
As part of the course, students from various disciplines spend a semester working intensively on social, ecological or technological challenges and the question of how these can be solved with the help of social and innovative business ideas.

The programme teaches methods and knowledge on topics such as system innovation, design thinking, future thinking, regenerative and impact-oriented business models, impact management and financing. The systemic perspective is of particular importance in the programme. In particular, the major social and ecological problems of our time cannot be solved in isolation as "wicked problems". Solutions are therefore only possible by viewing them as phenomena that are integrated into systems.

Students work in teams on social, ecological or technological challenges and apply the methodological knowledge they have acquired to develop an entrepreneurial solution for the selected problem. This process is structured and supported by lecturers and external coaches.

At the end of the semester, the students present the solutions they have developed in the form of impact-orientated business models. In this context, they receive feedback and the opportunity to apply for follow-up coaching for the business ideas they have developed.

The course is held in German in the summer semester and in English in the winter semester.

Intended Learning Outcomes:
The aim of the module is to enable students to develop practice-oriented solutions in the form of impact-oriented business models. The focus is on generating impact in the sense of the United Nations Sustainable Development Goals. Students will be able to

- explain the concept of impact and its implications and illustrate them using specific case studies.
- develop entrepreneurial solutions for real challenges in interdisciplinary teams.
- apply tools and methods from the fields of systems thinking, future thinking, human-centred design, impact orientation and business modelling to their challenges.
- present the solutions developed for their challenges using professional presentation techniques appropriate to the target group.
- categorise and discuss alternative economic models such as the Economy for the Common Good, Doughnut Economics and post-growth approaches.

The module focuses on experience-based and problem-oriented learning and aims to promote the development of social and entrepreneurial innovations as well as the promotion and development of students' skills with regard to responsible entrepreneurship. By developing solutions in interdisciplinary teams, students also improve their soft skills such as creativity, perseverance, communication skills, and interdisciplinary competences.

Teaching and Learning Methods:
Lectures and interactive, seminar-style teaching in the form of discussions, group work, development of challenges, team coaching sessions, feedback discussions, presentations, and Q&A sessions. The variety of methods ensures that the right method is chosen for each learning content to be taught. For example, new knowledge and tools are presented by experts in the field in keynote speeches and then discussed in large or small groups before being incorporated

into the development of solutions. Feedback discussions and team coaching sessions facilitate the application of the tools and methods presented. The final presentation at the closing event gives participants the opportunity to practise their communication skills and improve them through appreciative, constructive feedback. The synchronous online and face-to-face teaching is supplemented by asynchronous elements of self-learning time via the accompanying online course and associated reflection tasks, as well as by self-organised project group meetings, which are documented in the final report.

Media:
Videos, presentations, online materials, quiz, exercise sheets, Power Point, flip charts, mural boards

Reading List:
Meadows, Donella: Thinking in Systems, Earthscan, 2009
Stroh, David Peter: Systems Thinking For Social Change: A Practical Guide to Solving Complex Problems, Chelsea Green Publishing, 2015
Kurz, B./ Kubek, D.: Social Impact Navigator, Phineo, 2017, verfügbar auf https://www.social-impact-navigator.org/

Responsible for Module:
Alexy, Oliver; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Impact Entrepreneurship for Transformational Change (MGT001435, deutsch) (Seminar, 4 SWS)
Alexy O [L], Alexy O (Kaoui V, Vogel C)
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001459: TUM Climate Ventures | TUM Climate Ventures

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
This module's learning objectives are examined via exercises ("Übungsleistung") comprising the three elements outlined below. There is no written exam.

(1) Individual written reflection paper (10%): At the end of each session, you will submit a short reflection paper of 1/2 page (font size 12; double line spacing) highlighting the key learnings of the course and explaining why, how, and where they might influence your project. The individual reflection will show that you can process, synthesize, and prioritize the newly learned knowledge and critically think about and argue for more expansive fields of application beyond those discussed in class.

(2) Group presentations (60%): During the class, there will be three presentations: (1) A pitch in the first weeks of the course (2 minutes), (2) a midterm pitch (10 minutes), and (3) a final pitch (15 minutes). Each pitch has to reflect the content of the course. In the session, you will present a part of your group's climate venture. As each member of the group will present, your individual contribution is clearly identifiable and appraisable. The final group presentation will showcase that you are able to synthesize and present your findings in a comprehensive, precise, and structured way. It will also show that you communicate clearly and perform professionally. The final pitch will be graded.

(3) Group written reporting (30%): As part of a group composed in the first two weeks of the course, you will work on a climate venture project by assessing, analyzing, and designing climate-tech venture related strategies and actions. This assessment will show that you can directly apply the learned frameworks, theories, and concepts to uncover and assess the implications of climate ventures, determine and evaluate suitable climate ventures strategies, prioritize and initiate actions and decisions for their implementation, identify predictors of failure, and propose mitigative steps. It also illustrates that you can collaborate in a team, adopt a leader's perspective, strategize,

and solve problems in an analytical and structured way. The reporting includes the submission of a weekly (1) agenda for office hours meetings, a weekly update of an (2) interview tracking spreadsheet (approximately 50 interviews with experts and potential customers that you will conduct between week 3-13), and (3) the pitch decks of your presentations. An assessment sheet filled in by each group member and handed in at the end of the course will clarify your individual contribution.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
The course is looking for two different skill sets. You should either have advanced entrepreneurial knowledge and experience through courses, practical experience, or advanced programs like Manage&More or CDTM, or you have advanced technological understanding of relevant climate tech applications.

Content:
Building climate ventures that have impact can be a very complex and demanding challenge. Often this requires an expanded skillset of how to identify, assess, analyze, design, build, and launch climate-tech ventures, as well as high team effort, and very strong leadership. In addition, dynamic markets, technological uncertainties and grand challenges create additional pressures on novel ventures understanding their impact. This module provides a holistic view of the climate venture process in a real-world project. It introduces you to theories, concepts, and frameworks for climate ventures. Students will gain hands-on experience in the startup process, learning how to identify, assess, analyze, design, build, and launch climate-tech ventures.

Emphasis will be placed on effective collaboration within interdisciplinary teams to tackle real-world climate challenges. The course will help students build a strong climate-tech network and community, providing opportunities for collaboration and support. Students will work on creating new companies aimed at addressing high-impact climate problems, from ideation to market entry.

Exploration of breakthrough technologies and their potential applications in solving global climate issues will be a key component of the course. Students will understand the fundamentals of economic and technical evaluations specific to the climate-tech industry. The course will teach customer-centric approaches to developing climate solutions, emphasizing the importance of understanding and addressing customer needs.

Navigating the regulatory and market landscapes influencing climate-tech ventures will also be covered, helping students understand the broader context of their projects.

Intended Learning Outcomes:
Upon successful completion of this module, you will be able to:
Course Learning Goals:

1. Analyze relevant technical, business, political, and social drivers and barriers behind a vexing climate-tech challenge and design a solution as a team to address it.
2. Synthesize insights from research, analysis, and external engagements to compose a compelling value proposition around a new venture.
3. Evaluate and iterate through the potential success of a venture plan that meets the criteria of high impact, white space, unique value proposition, and self-sustainability.

Knowledge objectives:
(1) Explain and apply key concepts, frameworks, and theories related to climate ventures in practice
(2) Uncover and assess the implications of relevant technical, business, political, and environmental drivers and barriers behind climate tech ventures
(3) Determine and evaluate climate venture strategies considering venture-specific and contextual factors through research and external feedback
(4) Prioritize and initiate actions and decisions for implementing climate tech ventures with impact
(5) Identify predictors of failure and propose mitigative steps
Competencies objectives:
(1) Improve analytical, structured problem-solving, synthesis, and prioritization competencies
(2) Enhance team collaboration and leadership competencies
(3) Strengthen communication, presentation, and argumentation skills
(4) Build up critical thinking and strategizing competencies
(5) Perform under a maximised degree of realism in building a venture

Teaching and Learning Methods:
The module consists of an introductory session in which the fundamentals of climate ventures will be shared and discussed. In addition, groups will be matched and assembled, and each group will work on a real-world climate-tech venture for which a business case will be jointly developed throughout the course.

In subsequent sessions, module contents will be co-developed by the course participants, the instructor(s), and guest lecturers. To enable building up a solid knowledge fundament, we integrate action-learning elements such as presentations and discussions of course material, interview results, and relevant publications; individual mentoring; and interactions with industry and venture capital guest speakers.

Continuous mentoring on the climate-tech ventures will ensure that the newly acquired knowledge will be directly applied. Groups are asked to gather information on their climate venture cases through approximately 50 interviews.
Hence, a large share of learning will occur through your individual and your group's preparation for the in-class sessions and working on your climate venture projects. Respective instructions and materials to prepare will be given throughout the course.

Through presentations, discussions of intermediate findings, guest lectures, and feedback provided by the instructor(s), mentors, industry experts and venture capitalists, you will be able to share and get an assessment of your progress continuously. The module will end with a group presentation followed by a moderated Q&A and joint reflection exercise.

Media:
Presentations, flipchart, whiteboard, digital tools, videos, Zoom (for feedback sessions)

Reading List:
Class materials, lecture slides, suggested readings, other materials recommended for each team and guest speaker slides will be posted on Moodle.

Responsible for Module:
Tryba, Anne; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
TUM Climate Ventures (MGT001459, englisch) (Seminar, 4 SWS)
Tryba A [L], Eiermann-Hüser L, Lara Vargas L, Reiter S, Viertler M
For further information in this module, please click campus.tum.de or here.

Module Description

MGT001486: Smart Start: Financial, Tax, and Legal Fundamentals for Entrepreneurs and Everyone | Smart Start: Financial, Tax, and Legal Fundamentals for Entrepreneurs and Everyone

Version of module description: Gültig ab winterterm 2025/26

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** irregularly
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:
As an examination requirement, participants will choose a topic, study it in depth and prepare it in a didactic manner so that all other course participants can also benefit from it. During the seminar, they will have the opportunity to present and discuss this topic and receive feedback on the content they have developed following the presentation and as part of a peer review process. Building on this, participants will further develop, concretise and clearly present their topic over the course of the semester.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
none

Content:
This hands-on seminar equips (potential) entrepreneurs with essential financial, tax, and legal knowledge needed for long-term success. Participants will gain a deep understanding of core topics, empowering them to make informed decisions about legal structures, tax optimization, and financial planning. By the end, attendees will have developed a personalized Smart Start Master Plan

Intended Learning Outcomes:
Acquisition of sound knowledge in the areas of financial planning, tax law and the legal framework for entrepreneurial activity.

Ability to make well-founded decisions on the choice of legal form, tax optimization and long-term financial strategy.

Development of an individual Smart Start Master Plan for the concrete implementation of your own start-up idea.

Consolidation of knowledge through practice-oriented methods such as exercises, role plays, presentations and discussions.

Teaching and Learning Methods:
During the seminar, participants will receive input on the topics covered in seminar, as well as working materials for self-study and review. The content will then be consolidated in the seminar through exercises, role plays, reflections, presentations and discussions.

Media:
PowerPoint

Reading List:
Keck, A. (2022). GmbH gründen: Alles, was du wissen musst – Eine Schritt-für-Schritt-Anleitung zur Gründung einer GmbH oder UG (Steuern sparen, GmbH & Holding richtig nutzen). Unternehmergold Verlag.
Backhaus, R. (2022). Vererben und Erben. Stiftung Warentest Finanztest.
Kommer, G., & Gierhake, O. (2021). Souverän Vermögen schützen: Wie sich Vermögende gegen Risiken absichern – ein praktischer Asset-Protection-Ratgeber (1. Aufl.). Campus Verlag
Keck. A. (2021). Weniger Steuern & mehr Vermögen: Wie du als Unternehmer*in mehr aus deinem Geld machst – Rechtsform, Holding, Gehalt, Investitionen und Altersvorsorge (Steuern sparen, GmbH & Holding richtig nutzen). Unternehmergold Verlag.
Siegel, J. (2022). Stocks for the Long Run: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies. McGraw Hill.
Graham, B. (2003). The Intelligent Investor. Harper Business.
Kahnemann, D. (2016). Thinking, Fast and Slow. Penguin Verlag.
Shefrin, H. (2007). Beyond Greed and Fear: Understanding Behavioral Finance and the Psychology of Investing. Oxford University Press, U.S.A.
Kiyosaki, R. (2022). Rich Dad Poor Dad: What the Rich Teach Their Kids About Money That the Poor and Middle Class Do Not! Plata Publishing
Kommer, G. (2018). Souverän investieren für Einsteiger: Wie Sie mit ETFs ein Vermögen bilden. Campus Verlag GmbH.
Kommer, G. (2024). Souverän investieren mit Indexfonds und ETFs. Campus Verlag GmbH.
Kehl, T., Linke, M. (2022). Das einzige Buch, das Du über Finanzen lesen solltest: Der entspannte Weg zum Vermögen. Ullstein Taschenbuchvlg.
Walz, H. (2023). Ihre Finanzen fest im Griff: Vermögen aufbauen, statt Geld verschenken. Haufe.

Responsible for Module:
Welpe, Isabell M.; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Smart Start: Financial, Tax, and Legal Fundamentals for Entrepreneurs and Everyone (MGT001486, englisch) (Limited places) (Seminar, 4 SWS)
Hochstraßer S, Welpe I, Wimmer C
For further information in this module, please click campus.tum.de or here.

Module Description

SOT82134: Business Negotiation and Mediation | Business Negotiation and Mediation

Version of module description: Gültig ab summerterm 2025

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 module examination is a presentation (30 minutes, including 20 minutes presentation and 10 minutes discussion). The topic of the presentation covers one of the topics covered in the module or related topics. The module examination can also be taken by participating in and presenting a comprehensive case study as part of the seminar. In the various units, the principles of negotiation theory and business mediation are developed and presented together with the students. The plan is for students to build on this by comprehensively presenting a specific problem area from the introduction. In particular, structural perspective issues should be presented with a view to the strategic, psychological, and economic problem areas of negotiation theory as well as the relevant processes of complex business mediation. By preparing the presentation or case study, students demonstrate that they have understood the various dimensions of negotiation theory and business mediation and have gained in-depth knowledge of the issues presented. In the discussion part, they will show that they are able to recognize the connections between the respective introductory parts.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None.
No prior legal or technical knowledge is required. Everything that is necessary for attending and passing the module is taught as part of the module. Preparation before the start of the module is also not necessary.

Content:
At the beginning of the module, there will be an introduction to the topic of negotiation theory, focusing in particular on the central importance of negotiations in the economic and political spheres and discussing common negotiation goals and levels. The main types of conflict in an economic context will be presented and the psychological aspects of negotiation theory will be highlighted. This is followed by an introduction to negotiation theories, distinguishing between distributive and integrative negotiation. Various negotiation styles and communication techniques are then presented and discussed. Finally, important strategic aspects of negotiation are introduced. The various topics of the seminar are accompanied by a range of case studies and interactive negotiation simulations.
In a second step, students are introduced to the concept of business mediation as a form of conflict management, with a particular focus on the organizational process of a mediation procedure. Students will learn to develop creative solutions to underlying economic problems using innovative visualization and communication techniques. In particular, connections will be made to the principles of negotiation theory taught earlier.
The module ends with a comprehensive case study in which students are assigned the role of business mediator or party to the dispute and are asked to demonstrate the knowledge and skills they have learned in the seminar. The negotiation simulation will be supervised and then comprehensively analyzed and discussed.

Intended Learning Outcomes:
Upon completion of the module, students will be able to describe the fundamentals of negotiation theory and will be familiar with the relevant concepts of strategic negotiation, the psychological and economic background, and the basic communication techniques of successful business-related negotiation. In addition, students will gain in-depth knowledge of the process, methods, and implementation of business mediation, learning in particular about the various paths to mediation, the fundamentals of procedural law, processes, visualization techniques, and solution techniques. The aim is, in particular, to enable students to understand the breadth of the topic of negotiation management and business mediation and how the topic extends across various economic and political areas.

Teaching and Learning Methods:
The module is conducted as a seminar in the form of theory sections/lectures combined with discussion sections and case studies. It is an interactive block seminar divided into four sessions, each of which differs methodologically from the others. In each session, the basic knowledge required for the seminar is first imparted through lectures with discussion elements. In addition, students have the opportunity to work on specific case studies under supervision and guidance, discussing them with each other and asking the lecturer questions. The last session consists of a final, comprehensive case study, followed by a comprehensive final discussion in which the results are compared and abstracted.

Media:
PowerPoint

Reading List:
The following literature can be read in preparation but is by no means a prerequisite. In particular, nothing needs to be purchased:
- R. Fisher/W. Ury/B. Patton, Getting to Yes, 2012
- R. Fisher/W. Ury/B. Patton, The Harvard Concept, 2018
- S. Jung/P. Krebs, Die Vertragsverhandlung, 2016
- T. Schelling, The Strategy of Conflict, 1960
- D. Ariely, Predictably Irrational, 2008
- G. Williams, Legal Negotiation and Settlement, 1983
- F. De Calliers, L'art de negotier sous Lous XIV, 1761 (engl.: The Art of Diplomacy. On the manner of negotiating with princes.)

Responsible for Module:
Paal, Boris; Prof. Prof. Dr. Dr. jur.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT82134) Business Negotiation and Mediation (Seminar, 2 SWS)
Djebbari S, Paal B (Krikis K)
For further information in this module, please click campus.tum.de or here.

Module Description

SOT82410: Legal framework for start-ups | Rechtliche Grundlagen für Start-ups

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
The module examination is a written examination.
The written examination covers topics relating to the legal framework for creating a start-up. The exam lasts 60 minutes and consists of several questions in which students demonstrate that they have understood the essential legal regulations of industrial property rights, product labeling, data protection law and competition law. In addition, the exam is intended to show that students have understood the concept of founding a start-up and can identify the criteria for selecting a suitable legal form and financing for the start-up. Through the written examination, students demonstrate that they can present the individual analysis and decision-making steps in a comprehensible and coherent manner in a suitable written form.

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
The following topics are covered in the module:
Founding a start-up: legal form and tax law, financing and contracts, specifics, etc.;
Protection of Intellectual Property: Intellectual Property, Patents, Copyright, Trade Secrets, Trademarks;
Data protection law;
Competition law

Intended Learning Outcomes:
After completing the seminar, students will be able to choose the appropriate legal form for the establishment of a start-up, as well as to identify the appropriate financing method for the foundation. In addition, students are able to understand the essential legal regulations of intellectual property law, product labelling, data protection law and competition law.

Teaching and Learning Methods:
The module will be conducted as a seminar in the form of business games / case studies. The students will first complete several introductory units that explain the course of the business game. Subsequently, the students will create concepts for the foundation of a start-up in groups and carry out legal analyses. Finally, qualified feedback is given to show the students possible improvements.

Media:
Exercise documents, PowerPoint, Reader

Reading List:
1. "Wirtschaftsrecht: Handels- und Gesellschaftsrecht", 2. Auflage; Kristian Ewers, Sebastian Jagusch, Daniel Lorberg; NWB Verlag; ISBN: 978-3-470-65542-0
2. "Steuerrecht – leicht gemacht: Eine Einführung nicht nur für Studierende an Universitäten, Hochschulen und Berufsakademien"; 6. Auflage; Stephan Kudert; Ewald-von-Kleist-Verlag; ISBN: 978-3-874-40330-6
3. "Gewerblicher Rechtsschutz und Urheberrecht"; 13. Auflage; Joachim Gruber; Niederle, J; ISBN: 978-3-867-24131-1

Responsible for Module:
Paal, Boris; Prof. Prof. Dr. Dr. jur.

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

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

Module Description

WI001141: Principled Entrepreneurial Decisions | Principled Entrepreneurial Decisions [PED]

How to make game-changing decisions

Version of module description: Gültig ab winterterm 2017/18

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 140	**Contact Hours:** 40

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

Description of Examination Method:
Mandatory participation on all workshop days
(1) active class participation (25%)
(2) short assignement questions on cases (25%)
(3) presentation of values and principles for their company/project/future startup (25%)
(4) reflection paper, 2-3 pages, max 1.200 words (25%)
The seminar is on application:
https://academy.unternehmertum.de/programs/principled-entrepreneurial-decisions

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Application & willingness for active participation
being or becoming part of a Startup or project team
Students who are interested in Venture Capital and decision-making of founders are also welcome

Content:
This course will challenge the next generation of leaders and entrepreneurs to think critically about how their personal values and principles inform the difficult decisions they will have to make as they grow their business. The course will first equip students with frameworks to crystalize their own values and principles. Students will learn to apply their own core values. A selection of readings and case studies will provide students with tangible examples of the challenges other entrepreneurs have faced. Each class will be highly immersive, featuring conversations with entrepreneurial guest speakers and break-out sessions. Through conversations with case

protagonists and each other, students will leave the class more prepared to navigate the ethical dilemmas that they may encounter during their professional lives.

Intended Learning Outcomes:
1_students are able to brave difficult situations in the startup context
2_Enable students to begin to craft their own framework – personal and company
3_Discuss case examples (i.e. Flixbus, Konux, ProGlove, Luminovo, fernride, Reactive Robotics, Grupon, buecher.de, SevDesk, inveox, 10X, ...) and conduct exercises to help them on their journey

Teaching and Learning Methods:
lectures
group works
role plays
real Start-up cases with the founders in class
discussions

Media:
presentations
founders in class
video

Reading List:
Dalio, R. (2017). Principles: Life and work. New York, NY
Horowitz, B., & Kenerly, K. (2014). The hard thing about hard things: building a business when there are no easy answers. New York, NY: Harper Business.
More literature will be provided in class

Responsible for Module:
Patzelt, Holger; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Principled Entrepreneurial Decisions (WI001141, englisch) (Seminar, 4 SWS)
Bücken O
For further information in this module, please click campus.tum.de or here.

Module Description

MCTS0041: Advanced Topic: Ethics & Responsibility | Advanced Topic: Ethics & Responsibility

Version of module description: Gültig ab winterterm 2018/19

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

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

Description of Examination Method:
Students are required to write a research paper (2300 - 2500 words) in which they demonstrate their ability to:
- understand and analyze ethical concepts of reasoning, their opportunities and limitations, from a theoretical and practical point of view
- identify ethical conflicts in the context of technology and society
- apply a specific ethical position to an empirical example
- design their own research approach
The paper is accompanied by a graded presentation (20 - 30 minutes) in which students demonstrate their ability to present their findings in a clear and concise manner. The weighting of the grades is 70% for the paper and 30% for the presentation.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Students should, ideally, have basic knowledge in this field of STS. An Advanced Topic module either constitutes a content-specific specialization of the corresponding Core Topic module or it allows students to apply the concepts and theories learned in the corresponding Core Topic module to their own research questions. Students who have not taken the corresponding Core Topic module are provided with a preparatory reading list.

Content:
This module introduces students to the following topics:
- different fields of applied ethics in the science of technologies, their special questions, problems, and strategies of ethical problem-solving

- different case studies and how they reflect ethical conflicts in fields of techno-sciences and society
- the ethical validation of case studies in Science and Technology Studies (STS)
- strategies for ethical problem-solving in special fields of applied sciences and technology
- ways of designing research approaches in the field of applied ethics

Intended Learning Outcomes:
Upon successful completion of this module, students are able to:
- analyze different ethical concepts of reasoning, their opportunities and limitations, from a theoretical and practical point of view,
- identify specific ethical conflicts in different fields of techno-sciences and society, e.g. technological innovation vs. ethical acceptance in society (e.g. genetic engineering)
- evaluate these conflicts and apply them to concrete practical examples, e.g. social media, big data, and the private sphere
- develop a specific strategy of problem-solving by working on an empirical case study
- design their own research approach that could be applied in a master’s thesis
- present their findings in a clear and concise manner

Teaching and Learning Methods:
Studying advanced literature familiarizes students with the different ethical concepts of reasoning. Discussing case studies, key texts and other sources trains students to structure their knowledge, evaluate relevant issues and ethical conflicts caused by technological development, and to develop strategies of problem-solving and research approaches. Presenting and discussing their work trains students in structuring their arguments in a concise manner and defending their own findings and positions in academic debate.

Media:
Texts, slide presentations, flipchart/whiteboard, worksheets, Moodle

Reading List:
Fleming, John I. (et al.), Ethics of Risk. Southern Cross Bioethics Institute, Ratio 6 (1) June 1993. pp 239-252; http://www.bioethics.org.au/Resources/Online%20Articles/Other%20Articles/The%20ethics%20of%20risk.pdf).

Grunwald, Armin: Technology Assessment or Ethics of Technology?, Reflections on Technology Development between Social Sciences and Philosophy, Ethical Perspectives 6 (1999)2, pp. 171-182 (http://www.ethical-perspectives.be/viewpic.php?LAN=E&TABLE=EP&ID=237).

Hedgecoe, Adam M.: Critical bioethics: beyond the social science critique of applied ethics. Bioethics 18.2 (2004): 120-143.

John J. Reilly Center (Eds.): The Reilly Center Reports. Ethics and policy in pace with science and technology, Notre Dame 2013, http://reilly.nd.edu/rcr.

van den Hoven, J. (et al.) (Eds.): Responsible Research and Innovation Actions in Science Education, Gender and Ethics. Cases and Experiences, New York Springer 2014.Please specify 5-8 books or articles.

Plus additional literature specified at the beginning of the course

Responsible for Module:
Leonelli, Sabina; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Ethics & Responsibility: Society, Technology and Environment (Seminar, 2 SWS)
Jones E

Decision-Making Systems (Seminar, 4 SWS)
Milano S
For further information in this module, please click campus.tum.de or here.

Module Description

SOT53200: Responsibility in the Engineering Profession | Verantwortung im Ingenieurberuf

Applied Ethics for Engineers

Version of module description: Gültig ab summerterm 2022

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

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

Description of Examination Method:
The examination consists of of a presentation (15 - 20 minutes) and an essay (1000 - 1200 words) in which the students demonstrate their analytical-argumentative abilities:
- to identify different conflicting goals of their profession, which are elaborated in the course, with regard to functional, social-normative and ethical implications and classify them critically argumentatively;
- to classify and apply different models of responsibility ethics taught in the seminar with regard to divers applications (case studies);
- to present an analysis and application of different models of responsibility ethics taught in the course by means of examples from the field of activity;
- to present and discuss their results in a concise analytical-argumentative form.
The work must be accompanied by a graded presentation (15 - 20 minutes). The weighting of the marks is 70% for the essay and 30% for the presentation.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
No knowledge.

Content:
The module introduces students to the following topics:
General issues of normative and applied ethics;
Responsibility in the professional field of civil and environmental engineering;
Recognising, classifying and evaluating professional, social-normative and ethical conflicts of objectives;

models and methods of responsible problem-solving competence;
Implementation of technical solutions (models): stakeholders, social acceptance, sustainability goals (in terms of normative guard rails, responsible communication and implementation).

Intended Learning Outcomes:
On successful completion of this module students will be:
- familiar with basic social normative and ethical challenges in the field of engineers' activities;
- understand the most important topics and issues in the field of ethics of responsibility;
- are able to analyse, classify and assess activity-related conflicts of objectives;
- are able to analyse und to discuss critically models of responsible problem-solving competence with regard to the implementation of technical solution strategies.

Teaching and Learning Methods:
The module introduces students to the following topics:
General issues of normative and applied ethics;
Responsibility in the professional field of civil and environmental engineering;
Recognising, classifying and evaluating professional, social-normative and ethical conflicts of objectives;
models and methods of responsible problem-solving competence;
Implementation of technical solutions (models): stakeholders, social acceptance, sustainability goals (in terms of normative guard rails, responsible communication and implementation).

Media:
Literature, reader, presentation and discussion

Reading List:
Resnik, David B.: The Ethics of Science. An Introduction, New York 2005.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Responsibility in the Engineering Profession. Applied Ethics for Engineers (Seminar, 2 SWS)
Wernecke J
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86114: Ethics for Engineers: Foundations, Theories, and Applications | Ethics for Engineers: Foundations, Theories, and Applications

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
In Progress...
The module will be graded with „pass – fail“.

Repeat Examination:

(Recommended) Prerequisites:

Content:
The module opens with metaethics, introducing moral realism and anti-realism, cognitivism, relativism and related positions that clarify what moral claims mean and how they can be justified. It then surveys the three classical strands of normative ethics. First, virtue ethics is discussed from Aristotle to contemporary revisions, highlighting how character traits inform responsible engineering practice. Next, deontological theories are examined, beginning with Kant’s categorical imperative and extending to plural duty frameworks such as Ross’s prima-facie duties. A further block analyses consequentialist approaches, focusing on act and rule utilitarianism and on newer developments like negative or rule-consequentialism.
Additional sessions introduce alternative perspectives—contractualism, the ethics of care, pragmatist ethics and selected non-Western traditions such as Buddhist and Ubuntu ethics—broadening the conceptual toolkit and fostering cultural sensitivity. The programme concludes with targeted case studies in which students apply the full range of theories to areas such as sustainable energy, autonomous systems and biomedical technology, producing reasoned recommendations for engineering practice.

Intended Learning Outcomes:
On completing the module, students master the core concepts and questions of normative ethics. They articulate the leading traditions – virtue ethics, deontological theories and consequentialism – with accuracy and can contrast their respective strengths and limits. When analysing technical cases, they locate moral conflicts, choose appropriate lines of argument and draft action-oriented recommendations. Throughout, they display awareness of intercultural viewpoints and of the professional responsibility that accompanies engineering practice.

Teaching and Learning Methods:
The module consists of a lecture with integrated exercises.
The module blends asynchronous self-study with interactive learning. Concise video lectures provide the theoretical groundwork. Online reflection tasks and asynchronous, moderated discussions consolidate comprehension. Formative peer feedback sharpens the argumentative quality of the short written pieces, whereas summative quiz questions test analytical rigour.

Media:
Videobasierte Plattform

Reading List:

Responsible for Module:
Pfeffer, Jürgen; Prof. Dr. rer. soc. oec.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86114) Ethics for Engineers: Foundations, Theories, and Applications (Vorlesung mit integrierten Übungen, 2 SWS)
Matter D, Pfeffer J
For further information in this module, please click campus.tum.de or here.

Module Description

MHP00004: Football Analytics Hackathon | Football Analytics Hackathon

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
Project work (pass/fail): including presentation (30 min) and written report: students will have to solve one of the presented challenges as a part of an interdisciplinary workgroup. This includes a running software-prototype, and a 30 min group presentation on the results. Software prototype has to proof that the develop concepts (e.g. machine learning pipelines) work and solve the problem.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Analysis, Sports Informatics, Performance Analysis

Content:
The technological innovations of recent years - in particular, advances in the field of position tracking – lead to enormous amounts of data in soccer. In this module students will have to solve challenges given by an expert group including sport data scientists, professional soccer clubs and sports data companies. Students will be organized interdisciplinary workgroups including students from computer science as well as from sport science.
Challenges are related to soccer performance. The refer to an technical or tactical concept in soccer such as pressing, passing quality, line break, build up play, circle play, movements to receive, tactical formation, physical effort passing lines and much more. Based on these concepts, the students will have to:
- specify the concept from the perspective of sport science (e.g., what is a line and a line break?)
- specify the concept from the perspective of computer science (e.g., how can we model line breaks in a mathematical way?)

- develop a technical solution for detecting this concept in raw data (e.g., identifying the moment when a line break occurs)
- validate the detection quality based on video analysis (e.g., were the right moments founds?)
- calculate performance indicators based on these concept (e.g., number of line breaks, broken units, unsuccessful attempts)
- use appropriate methods from visual analytics to make the results be interpretable in an easy and intuitive way (e.g., by visualizing indicators in relation to context variables)
- interpret the results from the perspective of performance analysis (e.g., how can the results be used by a coach?)

Intended Learning Outcomes:
The general aim of the module is to introduce students to the research field of soccer analytics. After successfully completing the project, students will be able:
- to understand typical professional sport competition data (spatiotemporal tracking data, event data) and their characteristic.
- to apply methods and paradigms of computer science such as network analysis, machine learning and visual analytics for modelling phenomena in soccer.
- to develop sports data products for mass media, competition information provider and top level sports.

Teaching and Learning Methods:
In the module, students will have to solve challenges of match analysis in professional soccer. Students will work on spatiotemporal data of players and the ball provided by German professional soccer league (DFL). They will learn how to implement intelligent algorithms for deriving complex performance indicators from raw data, develop meaningful visualizations and and create added value for performance analysis. Challenges include various topics such as rating individual player actions, detection of match phases and playing styles or estimating physical workload of players. Students will be organized interdisciplinary workgroups, working independently on the challenges. The module will be realized as a block from 12.01.2026 to 17.01.2026. There will be preparation sessions in the first 4 week of the term, in which the students have to solve exercises related to the data used during the hackathon.

Media:
Slides, Videos

Reading List:
Alamar, B. C. (2013). Sports Analytics. A guide for coaches, managers, and other decision makers. NewYork:Columbia UniversityPress.
Lames, M. (2023). Performance analysis in game sports: Concepts and methods. Berlin/ Heidelberg, Germany: Springer. https://doi.org/10.1007/978-3-031-07250-5
Link, D. (2018). Sports Analytics - wie aus (kommerziellen) Sportdaten neue Möglichkeiten für die Sportwissenschaft entstehen. German Journal of Exercise and Sport Research, 48(1), 13-26. doi: 10.1007/s12662-017-0487-7

Responsible for Module:
Link, Daniel; Prof. Dr. phil. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Football Analytics Hackathon (Übung, 4 SWS)
Link D
For further information in this module, please click campus.tum.de or here.

Module Description

MHP00006: Project Week: Sleep and Circadian Health | Project Week: Sleep and Circadian Health

Project Week

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Scientific Work:
- Final synthesis (research paper) of the research topics presented in the seminars (85%) in a 6,000-word essay
- Literature search and 20-minute presentation (15%)

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic knowledge health sciences, in particular in psychology and biomedical science

Content:
Sleep and our biological clock have a fundamental influence on our health and well-being. This seminar will be focused on concepts and research results in the area of “sleep and circadian health”. A specific focus will be on fundamental concepts and methods in chronobiology and sleep research, as well as current research methods. The seminar will take an integrative approach, incorporating also nutrition, exercise and metabolism into the understanding of the circadian clock. The seminar will be held as a hybrid seminar.

Intended Learning Outcomes:
At the end of the module students are able to:
- understand basic concepts in chronobiology and sleep research
- understand diverse state-of-the-art methods in the area of sleep and circadian health
- apply diverse state-of-the-art knowledge in the area of sleep and circadian health
- evaluate scientific presentations and presentation styles

- create syntheses of research areas

Teaching and Learning Methods:
Lectures, student-led presentations

Media:
Zoom (if hybrid participation)
Webcam and microphone (if hybrid participation)
PowerPoint presentation via Zoom (if hybrid participation)

Reading List:
Blume, C., Garbazza, C., & Spitschan, M. (2019). Effects of light on human circadian rhythms, sleep and mood. Somnologie (Berl), 23(3), 147-156. doi:10.1007/s11818-019-00215-x

Responsible for Module:
Spitschan, Manuel; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Sleep and Circadian Health (Seminar, 2 SWS)
Spitschan M
For further information in this module, please click campus.tum.de or here.

Module Description

MHP00009: Explore the Art of Dance - perceive, explore and experience creative performance processes. | Tanzkunst entdecken – wahrnehmen, explorieren und kreative Gestaltungsprozesse erfahren.

Plug-In Module

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor/Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
Practical Demonstration 1 and 3 Minutes
Report (1400 Words), 1:1

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
none

Content:
In a world with internet, smartphones and a performance-oriented society in which cognitive work is the focus, our body and the conscious use of it have taken a back seat.
This module is about exploring the possibilities of encounters between the body, posture, creativity, joy, expression, presence and connection. On the other hand, it is about experiencing the diversity in dance (in the forms it manifests itself in dance).

Students learn to get in touch with themselves and their inner and outer world through somatic mindfulness. Observing inner and outer processes is a powerful strategy for strengthening mental health.

Our movements have an impact on our nervous system, our brain function and our physical and mental health. The course links theory and practice (body and movement education). New opportunities arise to perceive, discover and feel yourself and your body, to perceive yourself in relation to yourself and others, to try things out and to bring body and mind into harmony through movement and dance. The process of developing creativity and personal design processes take priority over standardized, technology-oriented movement learning and product-oriented work.

Practical focus:
• Body and movement education
• Somatic mindfulness, embodiment, body perception, posture and presence
• Exploring space (inner, outer, imaginary)
• Exploration, expression and presence
• Creativity, improvisation, design
• Diversity of manifestations in dance
• Dance and cultural education
• Dance and cross-topic work
• Feedback culture
• Process and product-oriented design of movements (individually, in a partner, in a group)
• Experimenting with objects and materials
• Acceptance Dance (dance and inclusion/neurodiversity), posture training
Theoretical focus
• Connections between neuroscience, neurobiology, brain research, dance science, somatic mindfulness and body and movement education (embodiment)
• Mental health
• Theoretical foundations of the gymnastics & dance department

Intended Learning Outcomes:
After completing the module, students will be able to remember and understand the basic concepts of somatic mindfulness, creativity, improvisation, process- and product-oriented work, as well as terms from the field of dance. They will be able to implement a variety of dance-practical and theoretical principles regarding dance-specific forms of movement (also regarding different manifestations of dance: hip hop, contemporary dance, creative dance, folk dance/cultural education). They will also have experienced techniques and methods of artistic, creative processes and reflection processes.

Specifically, students will be able to...

- Perceive their body more consciously (self-perception) and direct their attention in a targeted manner with the help of somatic mindfulness.
- Look at space in all its diversity, personal space (inside), external space and imaginary space.
- Consciously come into contact with themselves and others.
- Classify dance with its diverse manifestations.
- Experience the special nature of individual creative learning processes and sensual-aesthetic processes and use them consciously
- Differentiate between skills that can be trained through dance and movement: social, emotional, cognitive, sensorimotor, creative and artistic.
- Recognize and differentiate between dance methods such as structured improvisation, compositional processes, deductive and inductive.

- Name and apply choreographic principles. They are able to look at music in terms of tempo, beat, formal structure and musical peculiarities and can apply the music theory knowledge they have gained in dance designs. The Students are able to create movement designs themselves and to differentiate and reflect on the compositional principles of time, space and dynamics.
- Express themselves through movement, music and dance and understand the phases of creative processes.
- Present themselves.
- Observe and reflect on their own attitudes and actions, also based on their own and others' perceptions.
- Transfer, transfer personal knowledge to other areas (study, work, private life) and develop it further independently.

Teaching and Learning Methods:
Individual, partner and group work, cooperative learning methods, practical exercises, exploratory learning, improvisation

Media:
Presentation, Moodle, TUMonline,
-use of music, video examples, video analysis, Power Point, script, flip chart

Reading List:
KALTWASSER, V. (2016). Mindfulness in school. Self-regulation and relationship skills as the basis of education. Weinheim: Beltz.

KINGE, A. (2019/2017). On the knowledge of the body and its educational potential in sport and dance. Kubi-Online. https://www.kubi-online.de/artikel/wissen-des-koerpers-seinen-bildungspotenzialen-sport-tanz (13.9.2024)

PIETSCH, S. (2020). Kompetenzentwicklung durch und über den Körper am Beispiel Tanz im Kontext pädagogischer Studiengänge. Dissertation.

RYAN R. M., Deci E.L. (2000). Self- determination theory and the facilitation of intrinsic motivation, social development and well-being. Am Psychol. 55, 68-78. 10.1037/0003-066X.55.1.68

SCHWENDER, T. Spengler S, Oedl C and Mess F (2018). Effects of Dance Interventions on Aspects of the Participants' Self: A Systematic Review. Front. Psychol. 9:1130. doi: 10.3389/fpsyg.2018.01130.

STOLZ, S. A. (2015). Embodied Learning. Educational Philosophy and Theory 47, 474–487. doi: 10.1080/00131857.2013.879694.

STORCH, M., CANTIENI, B., HÜTHER G., TSCHACHER W., (2022): Embodiment. Understanding and using the interaction between body and mind. Göttingen: hogrefe

Responsible for Module:
Lisa Lugo

Courses (Type of course, Weekly hours per semester), Instructor:
Tanzkunst entdecken – wahrnehmen, explorieren und kreative Gestaltungsprozesse erfahren (Übung, 2 SWS)
Lugo L
For further information in this module, please click campus.tum.de or here.

Module Description

MHP00010: Computational Modeling of Motivation, Emotion & Coping | Computational Modeling of Motivation, Emotion & Coping

Integrating Control Systems, Artificial Intelligence, and Neuroscience

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
Pass/fail: Project Work (Report and Presentation)
The aim of the project work is to solve a theoretical or implementation-related problem, which is developed over several phases (initiation, problem definition, role distribution, idea generation, criteria development, decision-making, execution, documentation, presentation). The corresponding project task should be completed within 3 months using appropriate resources (literature research, programming environments, PowerPoint, Word). The project work concludes with a comprehensive documentation (between 2000 and 5000 words) and presentation (20 min + 25 min discussion) of the task. The project work can also be done in a group. The project will be evaluated on a pass/fail basis ("successful" vs. "unsuccessful"; no grades).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
- An introductory course in psychology/motivation/emotion, cognitive science, neuroscience, or computational methods is recommended.
- Basic knowledge of programming and statistical analysis will be beneficial.

Content:
- Foundations of Motivation, Emotion and Coping: Key concepts in motivation; Zurich Model of Social Motivation; Neuroscientific underpinnings of motivation and coping
- Computational Modeling: Basics of computational thinking and programming
- Modeling techniques: agent-based models, machine learning, simulations
- Modeling Motivation and Coping: Techniques for representing motivational, stress, and coping processes in computational models; case studies and practical examples

- Integrated Modeling Approaches: Combining the modeling of motivation and coping; applications in predicting behavioral responses to situational changes and challenges
- Project Development and Presentation: Guidance on developing individual research projects; presentation of projects and peer feedback sessions

Intended Learning Outcomes:
Students are able to:
- understand theories of motivation, emotion and coping, and understand their application in psychological research.
- apply computational tools and techniques, including agent-based modeling, machine learning, and simulation, to model psychological phenomena.
- create and apply computational models to investigate questions related to motivation, emotion and coping.
- conduct a computer simulation or a part of an empirical research project or program a code that integrates theoretical and computational approaches, culminating in a comprehensive report and presentation.

Teaching and Learning Methods:
Presentations, Discussions, Group/Project Work, Inquiry-Based Teaching, Case Studies, Computer Simulations, Blended Learning, Flipped Classroom,
Self-Study, Study Groups, Peer Learning, Feedback, Problem-Based Learning (PBL), Brainstorming

Media:
Academic articles (PDF), PowerPoint presentations,Educational videos, Recorded lectures, Hybrid events via Zoom, Computer simulations (MATLAB/Simulink), WhatsApp groups

Reading List:
Basic Literature:
Bischof, N. (2016). Struktur und Bedeutung. Eine Einführung in die Systemtheorie für Psychologen, Biologen und Sozialwissenschaftler zum Selbststudium und für den Gruppenunterricht [Structure and Meaning: An Introduction to Systems Theory for Psychologists, Biologists, and Social Scientists for Self-Study and Group Instruction]. 3., überarbeitete und neu illustrierte Auflage. Bern: Hans Huber.
Kuhl, J., Quirin, M. (2024). Persönlichkeitspsychologie: Motivation, Kognition und Selbststeuerung [Personality Psychology: Motivation, Cognition, and Self-Regulation]. Göttingen: Hogrefe.

Additional Literature:
Research articles and book chapters to be announced.

Responsible for Module:
Quirin, Markus; Dr. rer. nat.

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

Computational Modeling of Motivation, Emotion & Coping (Seminar, 2 SWS)
Quirin M

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

Module Description

MH110036: Scientific Methods in Workplace Health Promotion | Wissenschaftliche Methoden in der Betrieblichen Gesundheitsförderung

Version of module description: Gültig ab summerterm 2025

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 67.5	**Contact Hours:** 22.5

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

Description of Examination Method:
Scientific Work:
The examination takes the form of a scientific paper with a presentation in the seminar (50 % written research paper, 50 % presentation in small group: 15 minutes in total). The students prepare a short scientific presentation on selected topics, prepare the corresponding empirical data for the seminar, present these in plenary, and discuss them with all course participants. The students work on a joint presentation in small groups. Each person presents for 5-10 minutes (including discussion). In addition, each person prepares a mini scoping review on a selected topic with research and preparation of the literature in the form of a seminar paper.

Repeat Examination:

(Recommended) Prerequisites:
Basic knowledge of health promotion and prevention with reference to different environments and target groups – ideally with a focus on employees in the workplace setting – is a prerequisite. It is recommended that the students have their own laptops to work on the content in RStudio

Content:
As part of the seminar, students learn how to process empirical data from scientific surveys in the occupational setting using the RStudio software. This data will be analyzed in small groups and interpreted, discussed, and presented in the context of specific topics (e.g., mental health, health-relevant behaviors such as exercise, nutrition, and sleep, mobile employees, presenteeism, shift workers, etc.) against the background of the current state of research. Furthermore, students will systematically develop the current state of research on one of these topics in the occupational setting by preparing a scoping review. In addition, interactive focal points for health promotion in

the workplace are developed in the seminar together with the lecturers in order to identify possible transfers for workplace health promotion programs.

Intended Learning Outcomes:
After successfully completing the module, students will be able to
- Understand in-depth studies and applications of topics (models, strategies, and implementation) of health promotion and prevention in the workplace
- Process, evaluate, and visualize scientific data on health promotion and prevention in the workplace using common statistical methods in RStudio
- Develop selected health topics in the workplace setting and present them in conjunction with selected data
- Apply scientific methods when researching and preparing literature (formulating questions, creating a search strategy, screening, extraction, and presentation)

Teaching and Learning Methods:
The seminar combines theoretical and methodological impulses from the lecturers with application-oriented group and individual work phases to achieve the learning objectives. Various thematic focuses and associated empirical data sets and research strategies are discussed together and then worked on in depth in small groups as a transfer to the students' own focus topics. The students analyze the data, link it to the current state of research, and present or discuss their results in the seminar. The independent preparation of a scoping review promotes systematic examination of the current state of research and, among other things, the methodological skills of the students on the respective focus topics. Interactive methods, self-directed learning, presentations, and written submissions strengthen both subject-specific and methodological skills as well as self-awareness and personal responsibility in the learning process.

Media:
- Literature (scientific articles and textbooks)
- RStudio statistical software
- Tools for the preparation of reviews
- presentations

Reading List:
Bamberg, E., Ducki, A. & Metz, A.-M. (2011). Gesundheitsförderung und Gesundheitsmanagement in der Arbeitswelt: Ein Handbuch (Innovatives Management). Göttingen: Hogrefe.
Uhle, T. & Treier, M. (2019). Betriebliches Gesundheitsmanagement: Gesundheitsförderung in der Arbeitswelt - Mitarbeiter einbinden, Prozesse gestalten, Erfolge messen (4., vollst. aktual. u. erw. Aufl.). Berlin: Springer.

Responsible for Module:
Friedrich, Julian; Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Wissenschaftliche Methoden in der betrieblichen Gesundheitsförderung (Seminar, 2 SWS)

Blaschke S, Friedrich J, Herz M

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

Module Description

MH111022: Workplace Health Promotion | Grundlagen und Anwendungen der Betrieblichen Gesundheitsförderung

Version of module description: Gültig ab summerterm 2025

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 30	**Contact Hours:** 30

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

Description of Examination Method:
The examination takes the form of a written examination (60 min). In this exam, students must demonstrate that they are able to theoretically justify, apply and critically reflect on the fundamentals and practical applications (target groups, topics, etc.) of workplace health promotion and workplace health management in a limited amount of time and without any aids. The answers require both independent formulations and the marking of given multiple answers.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Module “Healthcare systems”

Content:
As part of the lecture, students will learn the fundamental concepts, models, legal aspects, processes, and analytical methods in Workplace Health Promotion (WHP) and Workplace Health Management (WHM). In addition, key topics and target group-specific characteristics in WHP/WHM will be explored in greater depth, always in the context of current societal and health-related developments relevant to the workplace environment.

To introduce, implement, and evaluate a systematic and sustainable WHP/WHM, the necessary procedures will be simulated with students using the PDCA cycle. Best-practice examples from various companies will be used throughout to illustrate the concepts.

Typical analysis methods introduced to students include employee surveys, workplace inspections, interviews, and health circles. Classical behavioral prevention measures (nutrition, physical activity, addiction, etc.), leadership training, health circles, and workplace programs will be discussed in terms of their theoretical design and applied through practical examples.

Common evaluation criteria and potential indicators such as participation rates, satisfaction, surveys, and sickness absence measurements will be critically examined. In addition to the theoretical content, WHM experts from companies and public institutions will occasionally be invited ("meet the expert") to provide insights into the challenges of WHM from the perspective of those responsible, allowing for analysis and joint discussion.

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

- Understand the fundamentals of health promotion, prevention (including analytical methods, topics, target groups, etc.), and workplace health promotion programs.
- Analyze and further develop existing workplace health promotion programs.
- Design exemplary workplace health promotion programs tailored to specific topics and target groups.
- Plan topic- and/or target group-specific studies in the context of workplace health promotion.

Teaching and Learning Methods:
In the lecture, key elements and subfields as well as fundamental theories and areas of application of Workplace Health Promotion (WHP) and Workplace Health Management (WHM) are conveyed through an interactive lecture format. Guest contributions may occasionally complement the lecturer’s presentation. Presentations are used to support the delivery of knowledge. Students are expected to supplement the presented content through self-study using the literature specified in advance.

Media:
Presentations

Reading List:
Bamberg, E., Ducki, A. & Metz, A.-M. (2011). Gesundheitsförderung und Gesundheitsmanagement in der Arbeitswelt: Ein Handbuch (Innovatives Management). Göttingen: Hogrefe.
Hurrelmann, K. & Klotz, T. (2014). Lehrbuch Prävention und Gesundheitsförderung (4., sollst. überrag. Aufl.). Göttingen: Hogrefe.
Uhle, T. & Treier, M. (2019). Betriebliches Gesundheitsmanagement: Gesundheitsförderung in der Arbeitswelt - Mitarbeiter einbinden, Prozesse gestalten, Erfolge messen (4., vollst. aktual. u. erw. Aufl.). Berlin: Springer.

Responsible for Module:
Mess, Filip; Prof. Dr. rer. soc.

Courses (Type of course, Weekly hours per semester), Instructor:
Grundlagen des Betrieblichen Gesundheitsmanagements (Seminar, 2 SWS)

Blaschke S, Friedrich J, Herz M, Mess F, Schmickler J
For further information in this module, please click campus.tum.de or here.

Module Description

MH160035: Medicine in the Tropics and Global Health | Medicine in the Tropics and Global Health

Medicine in the Tropics and Global Health

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 26	**Self-study Hours:** 90	**Contact Hours:** 64

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

Description of Examination Method:
20 min presentation of a module topic-related paper

The grading is based on a 20 min paper presentation followed by questions (total 30 min). This occurs at the end of the semester and the students present a paper of their choice related to one of the module topics. With the presentation, students have to show that they have understood the relevance of the topic and the translational aspects into global health perspectives and the Sustainable Developmental Goals (SDG). How the student introduces the topic in the paper, concisely presents the data/information, and accurately discusses the findings are evaluated.

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
- Introduction: Medicine in the tropics and Global Health
- Women's Health in LMIC: what are the challenges?
- Malaria: from physiology to novel vaccines
- Hepatic diseases in the tropics and how Egypt combats it's Hepatitis C epidemic
- Surgery in the tropics
- Introduction into NTDs and leishmaniases
- A look into helminthic NTDs: Filarial diseases and schistosomiasis
- Special bacterial diseases in the tropics: from anthrax to leprosy and Buruli ulcer
- Microbiota and its Manipulation for Health

- Two sides of the same “Trypanosome” coin? Sleeping sickness and Chagas disease
- HIV/AIDS in Africa: clinical perspectives and experiences
- Practical laboratory short course

Intended Learning Outcomes:
At the end of the module, students will be able to (1) understand the evolution of global health and how it can be achieved through the integration of interdisciplinary approaches in LMIC context, (2) recognize the particularities of relevant and neglected diseases in the tropics, and the socioeconomic impacts as well as the challenges posed by climate-sensitive diseases (e.g. dengue), (3) understand the role of cultural, geographical, and environmental factors in healthcare delivery for contextual health interventions, (4) examine the interplay between nutrition, infections, environmental factors, and global health outcomes, with a focus on malnutrition, and the role of microbiota in health, (5) develop practical skills to recognize disease transmitting vectors and diagnostic tools for resource-limited tropical settings.

Teaching and Learning Methods:
The module consists of eleven lecture series, each of which includes one session of two hours held by guest speakers to reflect on how classical "tropical medicine" or "medicine in the tropics" which originated in colonial times and was largely focused on diseases primarily endemic in these regions, is now embedded in the concept of "Global Health”. Students will be provided with the lecture slides a week before to prepare for each lecture, in addition to referenced literature they will be asked to read. The sessions are interactive and students will be encouraged to prepare topic-related questions to be discussed. The course will conclude with a practical teaching unit in which students will be instructed to carry out independent blood and stool diagnostics in a "mini-laboratory" customary in the tropics. Further, live disease-transmitting vectors such as Anopheles, freshwater snails and Tsetse flies will also be demonstrated.

Media:
Lecture slides will be available via Moodle

Reading List:
- Beeching N, Gill G: Tropical Medicine, 7th Edition
- Manson's Tropical Infectious Diseases, 23rd Edition
- Gyapong J, Boatin B: Neglected Tropical Diseases, Sub-Saharan Africa, 2024
- Barrie J 2016: Schistosoma - Biology, Pathology and Control
- Takken W, Knols B: Emerging pests and vector-borne diseases in Europe
- Lancet Perspectives: Volume 377, Issue 9773, p1230, April 09, 2011

Responsible for Module:
Dr. Fabien Ulrich Prodjinotho / Prof. Dr. med. Clarissa Prazeres da Costa

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

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

Module Description

POL65101: Global Health (MSc.) | Global Health (MSc.)

Part 1: Introduction to Global Health, Part 2: Gender Disparities in Health and Development

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination consists of a research paper ("Policy Brief", approx. 6-7 pages), which tests students' ability to identify key challenges of global health in a selected country and develop evidence-based policy recommendations to promote population health in the given context. A
As part of a mid-term examination, students may voluntarily hold a 15-20 minute presentation discussing and critically evaluating a selected empirical paper. In this presentation, students demonstrate their competence in applying basic concepts of the Global Health discipline and interpreting and critically appraising relevant empirical studies. Successful completion of the mid-term will lead to a +0.3 bonus on the final grade.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Quantitative methods

Content:
The module provides a general introduction to the global health discipline, whereby specific focus is placed on developments and processes in countries of the Global South. The first part (seminar 1) defines the global health discipline in relation to other disciplines such as public health and epidemiology, introduces basic concepts and terms, and sheds light on associations between health and development. Further, it discusses trends in the global burden of disease and critically appraises different approaches to the measurement of disease. Lastly, the seminar discusses various intervention strategies on a policy- and individual level and evaluates their theoretical

foundations and empirical evidence. The second part (seminar 2) looks at health and development through a gender lense. It first discusses different approaches to the measurement of (gender) inequality and covers various additional topics, including Amartya Sen's theory on "Missing Women" as welll as related empirical studies, differences between matrilineal and patrilineal societies, fertility and reporoductive health, and gender-based violence.

Intended Learning Outcomes:
Upon successful completion of the module, students are able to define basic concepts and terms of the global health discipline. Moreover, students are able to reflect on trends in the spread and global prevalence of important communicable and non-communicable diseases as well as comment and criticise strategies for their prevention or treatment. In addition, students are able to explain macro-relationships between poverty and health, and to assess the impact of various health interventions and health promotion policies. Lastly, students can summarise, interpret, and assess the findings of influential empirical studies.

Teaching and Learning Methods:
The module consists of two seminars. The first seminar ("Introduction to Global Health", 2 SWS) is focused on the theoretical and conceptual foundations of the discipline and introduces key topics and empirical papers on global health. The second seminar ("Gender Disparities in Health and Development", 2 SWS) provides a more in-depth discussion of global health and development topics with a focus on gender. The module is taught in a combination of teacher-centered lectures, interactive discussions, student presentations, and occasional group work.

Media:
multimedia-supported

Reading List:
Skolnik, R. (2019). Global health 101 (3rd or 4th Edition). Jones & Bartlett Publishers.

Responsible for Module:
Steinert, Janina; Prof. Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
(POL65101) Global Health (MSc) (Introduction to Global Health and Gender Disparities) (Seminar, 4 SWS)
Steinert J (Gruschwitz B)
For further information in this module, please click campus.tum.de or here.

Module Description

LS40026: Digest - A Student Social Media Project | Der Verdauungskanal – Ein Studentisches Social Media Projekt

Version of module description: Gültig ab summerterm 2025

Module Level: Bachelor	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 5	**Total Hours:** 90	**Self-study Hours:** 75	**Contact Hours:** 15

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

Description of Examination Method:
Die Prüfungsleistung wird im Rahmen eines Lernportfolios erbracht.
Die Studierenden sammeln dafür Ideen, Textfragmente und Entwürfe zu den zwei von Ihnen federführend geplanten Beiträgen. Das einzureichende Portfolio zielt darauf ab, die eigenen Überlegungen, Kompetenzen und den Fortschritt ihrer Leistungen anhand ihrer themenbezogenen Arbeiten in einer Mappe zu dokumentieren. Im Lernportfolio soll nachgewiesen werden, dass Sie im Projekt eigene Verantwortung für inhaltliche und gestalterische Themen übernommen haben und Beiträge fristgerecht erstellt haben. Das Portfolio dokumentiert zum Ende der Projektphase den Lernfortschritt und Leistungsstand anhand Ihrer Beiträge für den Social-Media-Kanal. Erklären Sie hier zum Beispiel, warum Sie diese Überschrift gewählt haben und welcher Alternativtext verworfen wurde.
Bei der Bewertung des Lernportfolios spielt die Fähigkeit zur sachbezogenen Selbstreflexion bei der Kommunikation von wissenschaftlichen Inhalten an ein Laienpublikum eine große Rolle. Im Mittelpunkt steht dabei eine Überarbeitung der ersten Auswahl, ein Verwerfen einer Konzeption, ein Umsteuern bei der Gliederung oder das Reformulieren der ursprünglichen Idee. Anstoß für die Überarbeitung kann dabei die Diskussion der Entwürfe im Team oder mit dem betreuenden Dozierenden sein. Auch ein technisches Scheitern der geplanten Umsetzung kann Anlass für eine veränderte Konzeption sein.
Ziel des Portfolios ist es, nicht nur das finale Resultat darzustellen, sondern den Reifeprozess, den die Grundidee bis zum Endprodukt zurückgelegt hat.
Dabei ist auch die Gruppendynamik von Bedeutung: Wie gut hat die Gruppe zusammengearbeitet? Wie haben gut haben sich die Mitglieder gegenseitig geholfen und Schwierigkeiten gemeinsam überwunden. Wer hat welche Kompetenzen zur Verfügung gestellt? Wie gut wurden Kompetenzen aus anderen Gruppen einbezogen?
Das Portfolio wird zwei Wochen vor Ende der Vorlesungszeit eingereicht und soll maximal 6 Seiten im Format DINA4 umfassen.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Interesse an der Kommunikation wissenschaftlicher Inhalte an ein Laienpublikum
Freude am Gestalten in verschiedenen Medien (Foto, Video, Grafik, Text)
Begeisterung für und erste Erfahrungen in Social Media
Hohe Eigenmotivation und fristgerechte Erstellung von Posts
Zuverlässigkeit und konstante Betreuung des aufgebauten Social Media-Kanals im Team
Lust zum Einbringen persönlicher Ideen und Fähigkeiten
Interesse Ziele und Ausrichtung des Kanals mitzugestalten

Dabei wird angestrebt, alle Projektteams gemischt zu besetzen. Dies bedeutet, dass kein Studierender alle Voraussetzungen mitbringen muss und sich vielfältige Möglichkeiten ergeben, von den Kompetenzen der anderen Teammitglieder zu lernen.

Content:
Planung einer Social Media Initiative: Welche Zielgruppe soll angesprochen werden, was wollen wir erreichen, wir soll das erreicht werden? Dies beinhaltet die Beurteilung bestehender ähnlicher Angebote, Definition von best und worst practices.
Erstellung von Beiträgen für die Social Media Initiative: Planung von Beiträgen in verschiedenen auch gemischten Formaten (Bild, Text, Video), Erlernen und Umgang mit den jeweils notwendigen kreativen Werkzeugen, Visualisierung komplexer Sachverhalte, Erarbeitung einer gemeinsamen Text- und Bildsprache.
Laufender Betrieb: Management von Reaktionen, teilen anderer Inhalte, folgen anderer Kanäle
Evaluationsphase: Welche Posts haben die meisten Reaktionen erzeugt, wer hat Inhalte geteilt, wer hat Kommentare abgegeben.

Die im Social-Media-Kanal aufbereiteten Inhalte richten sich nach den Interessen der beim Projekt mitarbeitenden Studierenden und werden in der Initiationsphase festgelegt. Die einzelnen Beiträge werden dann in kleineren Teams in enger Abstimmung mit dem jeweils betreuenden Dozierenden erstellt. Dabei übernimmt jede Teilnehmerin/jeder Teilnehmer federführend die Gestaltung von mindestens zwei Beiträgen in unterschiedlichen Beitragsarten (Post, Reel, Video), Die wesentlichen Impulse zu Inhalt und Gestaltung stammen dabei vom jeweiligen Studierenden. Die Schritte bis zum finalen Beitrag beziehen Diskussionen im Team und Anstöße vom betreuenden Dozierenden ein. Insbesondere soll jede Teilnehmerin / jeder Teilnehmer von den bei anderen Teammitgliedern oder in anderen Projektgruppen vorhandenen Kompetenzen Gebrauch machen, um den eigenen Beitrag zu verbessern und fehlende Kompetenzen zu erwerben. Zur Sicherung einer hohen wissenschaftlichen Qualität müssen die Beiträge vor der Veröffentlichung vom jeweiligen Dozierenden freigegeben werden.

Mögliche Themenfelder sind:
• Supplemente – brauchen wir welche?
• Ballaststoffe – Hype oder Hoffnung

• Kurze Berichte zur aktuellen Forschung am Campus
• Kurze Spotlights aus (Praxis)-Lehrveranstaltungen
• Ernährung in kritischen Lebensphasen
• Kritische Auseinandersetzung mit Werbeaussagen und Inhaltsstoffen
• Ernährungsmythen im Sport

Intended Learning Outcomes:
Im Projekt wird durch die Studierenden ein Social-Media Kanal aufgebaut, der zum Ziel hat, verlässliche ernährungsbezogene Informationen für eine breitere Öffentlichkeit aufzubereiten.

Nach der Teilnahme an dem interdisziplinären Projekt sind die Studierenden in der Lage, eine Social Media Initiative zu planen. Sie können Ziele entwickeln, Zielgruppen identifizieren und bereits bestehende ähnliche Angebote analysieren und bewerten. Sie definieren eine gemeinsame Text- und Bildsprache, kreieren Beiträge in verschiedenen Formaten (Bild, Text, Video) mit dafür geeigneten Anwendungen und visualisieren damit komplexe Sachverhalte. Sie stimmen sich hinsichtlich des Managements auf Reaktionen ab und evaluieren den Erfolg des Social-Media-Kanals.

In der Summe reflektieren die Teilnehmenden den Bedarf für eigenes Fachwissen um wissenschaftlich sprechfähig zu werden und Inhalte einfach aber strukturiert aufzubereiten. Sie erhalten Einblick in andere Tätigkeitsfelder (visuelles Gestalten und kreatives Schreiben), die für die Vermittlung der Inhalte erforderlich sind. Sie lernen, in heterogenen Teams produktiv zu arbeiten, erleben die Verschränkung der eigenen Disziplin mit anderen Disziplinen (z. B. wissenschaftliche Fragen mit gestalterischen Aspekten), und gewinnen dabei Wertschätzung für andere Disziplinen.

Teaching and Learning Methods:
In einer Initialphase werden in Plenarveranstaltungen und Gruppendiskussionen die Zielgruppen, Ziele und die zur Kommunikation an diese Zielgruppen geeignete Methoden festgelegt.
Nach dieser Plenar-Phase formieren sich Projektteams aus 5-7 Studierenden. Die Teams werden gemischt besetzt, so dass sich in jedem Team sowohl fachlich Interessierte als auch in gestalterischen Aufgaben versierte Studierende befinden. In dieser Mischung profitieren die fachkundigen Studierenden von den Gestaltungsvorschlägen und kreativen Ideen. Die künstlerisch versierten Studierenden sind dabei gleichzeitig ein Testpublikum, bei dem die Kommunikation von Wissenschaft an Laien ausprobiert werden kann.
Jedes Projektteam ist einem Dozierenden zugeordnet, der steuernd und beratend mitwirkt und die erstellten Beiträge vor deren Veröffentlichung begutachtet und freigibt.

Media:

Reading List:
Godemann J, Bartelmeß T (Hrsg.): Ernährungskommunikation: Interdisziplinäre Perspektiven – Theorien – Methoden. Springer, 2021

Endres, E.: Ernährungsbildung durch Social Media. In: Nachhaltigkeit und Social Media. Springer, 2022, pp 223-239.

Responsible for Module:
Stolz, Jürgen, PD Dr. rer. nat. habil. stolz@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Der Verdauungskanal – eine studentische Social Media Initiative (Projekt, 1 SWS)
Stolz J [L], Stolz J, Brandl B, Geyer K, Raab R, Rath E, Bartelt A, Klingenspor M, Köhler K, Ocvirk S, Miesera S, Skurk T
For further information in this module, please click campus.tum.de or here.

Module Description

ED0341: STS 2: Philosophy of Science and Technology | STS 2: Philosophy of Science and Technology [STS 2]

Version of module description: Gültig ab winterterm 2018/19

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

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

Description of Examination Method:
The examination consists of a research paper (1500 to 2000 words) and an in-class presentation (15 to 20 minutes). In the research paper, students demonstrate their ability to portray and discuss contemporary philosophical debates on key ideas in the philosophy of science and technology, and to identify, defend and criticize philosophical points of view. In the presentation, students demonstrate that they are able to communicate their analysis of the chosen topic clearly and concisely.
Grading: the research paper counts for 70%, the presentation for 30% of the final grade.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The module provides an introduction to central topics in the philosophy of science and technology. With a focus on the 20th century and contemporary approaches, it identifies major philosophical strands and schools, such as logical positivism, hypothetico-deductivism, social constructivism, the practice turn, and technoscience. Each session is dedicated to one of these specific topics. For each topic, the major positions are outlined, and the respective pros and cons are discussed. By the same token, some of the most influential authors in the field are introduced. Issues addressed are:
- paradigms of scientific method - induction versus deduction
- structure of scientific theories - semantic versus syntactic views
- the relevance of scientific practice - the role of models and experiments
- theory change and scientific revolutions - rationalism versus relativism

- the science-technology relationship - autonomy of technology versus applied science
- the nature of technical artefacts
- critical theories of technology

Intended Learning Outcomes:
Upon completion of this module the students
- understand a wide range of philosophical issues concerning science and technology
- are able to portray contemporary philosophical debates, for example on the nature of science and technology, on the relationship between science and technology, or on scientific methods and rationality
- have conceptual and analytical skills to identify, defend and criticize philosophical points of view
- are able to engage in philosophical argumentation on science and technology in a clear and structured manner

Teaching and Learning Methods:
A variety of methods are used to convey different perspectives on the content of the module. Lecture elements provide essential background information that enables the students to understand the relevant literature and engage in discussions. In preparation for each session, the students are given a reading assignment with questions they need to work on. The reading assignments comprise classical texts from the philosophy of science and technology, selected with the aim of familiarising students with influential authors and their styles of philosophical argumentation and writing. In-class presentations ensure that the students are able to summarize and adequately structure the contents of these readings. Of particular importance are in-class discussions that allow students to propose hypotheses, exchange arguments, and develop well-founded positions on exemplary questions from the philosophy of science and technology.

Media:
Texts, slide presentations, flipchart/whiteboard, worksheets, Moodle

Reading List:
Carnap, R. An Introduction to the Philosophy of Science. Dover, New York, 1995
Chalmers, A. F. What's this thing called science?, 3rd ed. Hackett, Indianapolis/Cambridge, 1999.
Dusek, V. Philosophy of Technology: An Introduction. Blackwell, Malden, 2006.
Ihde, D. The historical-ontological priority of technology over science. In Philosophy and Technology, P. T. Durbin and F. Rapp, Eds. Reidel, Dordrecht, 1983, pp. 235-252.
Kuhn, T. S. The Essential Tension. University of Chicago Press, Chicago, 1977, Ch. 9.

Responsible for Module:
Wernecke, Jörg-Wilhelm; PD Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
STS 2: Philosophy of Science and Technology (Seminar, 3 SWS)
Jones E, Leonelli S
For further information in this module, please click campus.tum.de or here.

Module Description

ED0384: Active Learning | Active Learning [ActiveLearning]

Version of module description: Gültig ab winterterm 2021/22

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

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

Description of Examination Method:
The students will have to master the theoretical background and the computational bases of information search and active learning theories and models, tackled from a developmental perspective. This seminar is an active experience, and requires students' full engagement. Participation includes active involvement in class discussions and activities: asking questions about the topics and subject matter and expressing themselves through comments and opinions. Active contributions to in-class discussions count toward your pass/fail grade. To pass the seminar and earn credits for the course, students will be additionally required to write a 3-4 pages paper about the research project they have been working on during the Active Learning workshop. In case students decide to get a number grade for their participation in the seminar, their paper will be graded. This is how the grade will be determined:
- Research article commentaries, discussion and presentation (4 * 5% per lecture day): 20%
- Active Learning workshop participation (4 * 15% per lecture day): 60%
- Research paper: 20%

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Students must have a basic understanding of introductory statistics (descriptive statistics, correlation) from their Bachelor's studies and from Module 1 "Introduction to Methods in Teaching and Learning Science"

Content:
How do young children learn so much about the world, so quickly? A rich body of research has demonstrated that that active engagement with the world is a crucial component of learning: As soon as they can sit or walk,

infants spontaneously grab and manipulate objects and approach or avoid people. As language develops, young children ask about the meaning of words, request the labels of objects, and inquire about the many new and puzzling phenomena they encounter. Active learning has been a topic of interest for philosophers, psychologists, cognitive and computer scientists.

What is active learning? Are children efficient active learners? Is there a developmental trajectory for active learning? Is active learning better than more passive forms of instruction? This seminar examines these questions across domains such as visual attention, hysical reasoning, causal learning, and problem solving; readings will also address issues in explanation, exploration, and other related topics. The seminar involves a mix of lectures, group readings and discussions, as well as an active learning workshop designed to offer students a hands-on experience on how questions related to active learning are investigated experimentally, from identifying the research questions and hypotheses to interpreting and presenting the results obtained.

Intended Learning Outcomes:
At the end of the module, students will be familiar with the theoretical background and the computational bases of information search and active learning theories and models, tackled from a develpomental perspective, and will have developed an understanding of how the results from active learning research can impact education.

Teaching and Learning Methods:
This course is an active experience, and requires students' full engagement. Participation includes active involvement in class discussions and activities: asking questions about the topics and subject matter and expressing themselves through comments and opinions.

Lectures. The seminar comprises four lectures, corresponding to the four seminar days. For all lectures we will suggest a few readings. Students are supposed to read suggested papers prior to the class for which they are listed. Lectures will not go over the specific content of the readings, but rather build upon the content of the readings. In other words, lectures will never merely repeat information in the readings. Therefore, students are responsible for understanding what they read, asking questions about what they do not understand, and being prepared to go beyond the readings in class. All suggested readings will be available on Moodle.

Research Article Commentaries, Discussions and Presentation.
Throughout the seminar, students will be asked to read eight research articles (two per day) and to prepare at least two written questions and/or critical comments per paper, demonstrating that they have horoughly read, understood, and thought about each article. Discussion will take place in class, and will be followed by a group activity, in which students will be asked to either prepare a short presentation or to write a blog post about one of the research articles discussed. All research articles will be available on Moodle.

Active Learning workshop. This group workshop is designed to offer students a hands-on experience on how questions related to active learning are investigated experimentally. It is divided

in four blocks (one per seminar day), each roughly corresponding to an experimental research phase:
1. Identify an interesting research topic; narrow it down to a research question; do some background research to get familiar with what has been done on the topic, and to make sure the question is original; evelop one or few competing hypotheses;
2. Design a simple study aimed at answer the research question and test the hypotheses; prepare the materials and the instructions;
3. Test (test modalities will depend on the design the group has developed);
4. Analyze, interpret and present the results. At the end of each seminar day, each group will present its progress to the rest of the class.

Media:
Projector, Keynote presentations; board; flipcharts.

Reading List:
Readings are defined in the course.

Responsible for Module:
Ruggeri, Azzurra; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Active Learning (Seminar, 2 SWS)
Ruggeri A, Török G
For further information in this module, please click campus.tum.de or here.

Module Description

SOT10069: Introduction to Psychology and Human Behavior | Introduction to Psychology and Human Behavior

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Die Prüfungsleistung wird als 90-minütige Klausur erbracht. Diese prüft die Reproduktion, Reorganisation und den Transfer des in der Lehrveranstaltung erlernten Wissens. Neben der Überprüfung des Kenntnisstands hinsichtlich psychologischer Grundbegriffe, Modelle und Studien zielen die Fragen auch auf die Anwendung der Inhalte im beruflichen und alltäglichen Kontext. Das Frageformat besteht aus Single-Choice-Fragen, ggf. kann auch auf eine automatisierte Auswertung offener Fragen zurückgegriffen werden.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
keine

Content:
Die Lehrveranstaltung ist eine Einführung in die Psychologie. Im Zentrum steht das menschliche Handeln und die Kernfragen: Warum handeln Menschen wie sie handeln? Welche Rolle spielt ihre Umgebung? Wie lässt sich das menschliche Handeln untersuchen?
Die Studierenden erhalten Einblicke in verschiedene Teilbereiche der Psychologie (z. B. Lernpsychologie, Arbeits- und Organisationspsychologie, Sozialpsychologie). Anhand aktueller Studien und Forschungsergebnisse gibt die Lehrveranstaltung einen Überblick über ausgewählte psychologische Modelle und Theorie sowie unterschiedliche Methoden der Psychologie.

Intended Learning Outcomes:
Die Studierenden können Grundbegriffe und Methoden der Psychologie sowie psychologische Modelle wiedergeben und Bezüge zu ihrem berufspraktischen Alltag ziehen.

Teaching and Learning Methods:
Die Lehrveranstaltung kann in unterschiedlichen Formaten (synchron, asynchron, hybrid) stattfinden. Unterstützt wird diese durch einen Moodle-Kurs. Die Studierenden erhalten eine Reihe von Materialien, die ihnen die Lerninhalte vermitteln. Es erfolgt Input (z.B. 20-minütige Videoclips), in denen ihnen vorlesungsartig zentrale Erkenntnisse präsentiert werden. Daneben haben sie zweitens die Möglichkeit, in interaktiven Formaten die Lerninhalte zu intensivieren und Bezüge zum berufspraktischen Alltag herzustellen.

Media:
Präsentationen, textbasierte Arbeitsmaterialien, interaktive computergestützte Elemente

Reading List:
Coolican, H. (2019). Research methods and statistics in psychology (seventh edition). Routledge.
Smith, E. R., Mackie, D. M., & Claypool, H. M. (2019). Social psychology (fourth edition). Routledge Taylor & Francis Group.

Responsible for Module:
Holzberger, Doris; Prof. Dr. phil. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Psychology and Human Behavior (Vorlesung, 2 SWS)
Munk S, Holzberger D
For further information in this module, please click campus.tum.de or here.

Module Description

SOT10080: Introduction to Judgement and Decision Making | Introduction to Judgement and Decision Making [JDM]

Introduction to Judgement and Decision Making

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
Students will be evaluated based on a final written examination delivered on moodle, which will assess students' understanding of the theoretical aspects of the course and their ability to think critically and use primary source materials to build novel arguments. Students will be allowed to use their notes during the examination. It will be a coursework (pass/fail assessment).

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
English language fluency

Content:
1) How do we make decisions? Introduction to judgement and decision theory;
2) How can we measure and study decision making?;
3) Normative theories of judgement and choice (subjective probability, subjective utility, preferences, bayes rule, decision making under risk and uncertainty);
4) Descriptive theories of judgement and choice: Biases and heuristics;
5) A tale of two systems (fast and slow thinking) ;
6) Decisions from experience vs. description;
7) Intertemporal choices, influences of attention and memory on decision making, multi-alternative choice;
8) Computational rationality and bounded optimality;
9) Perception of risk and individual differences;
10) Choice architecture: nudging and boosting;
11) The social psychology of decision making;

12) Group decision making;

Intended Learning Outcomes:
The module will provide an overview of the field of judgement and decision making, outline the dominant theoretical approaches, and present the main empirical findings. By the end of the module, students will understand the processes through which humans weigh options and make choices under risk and uncertainty, and how these processes may lead people to diverge from the normative solutions suggested by formal decision theories, for better or for worse. Participation in the module will encourange students to reflect on the ways in which they can apply this theoretical knowledge about decision science to various fields (e.g., use of nudges/boosts in education policy, medicine, finance) and the potential difficulties and pitfalls of taking decision science outside the lab. Ultimately, the students will be encouraged to reflect on how they can use the information provided to become better decision makers in their personal and future professional lives.

Teaching and Learning Methods:
The course will contain 6 seminars taking the format of interactive workshops, interleaved with asynchronous video lectures and individual assignments. The first part of the seminars will take the form of a lecture and will convey key concepts in the field of judgement and decision making, provide a brief historical overview and the present main methodologies employed. The second part of each seminar will be a highly interactive workshop and will guide students through research topics and questions in judgement and decision science, offering demonstrations (e.g. via participation in in-class experiments and surveys), and will highlight experimental findings from psychology and behavioral economics. Some of the asynchronous video lectures and workshops will include invited speakers who are experts in the topic covered. Students will be engaged in group discussions on the applied implications of the research findings.

Media:
Power point lecture presentations; educational videos (asynchronous lectures); interactive computer demonstrations

Reading List:
For each seminar, one or two journal articles (canonical papers or articles which detail applications of the theoretical content covered in the lecture) will be provided as background reading. A list of reference books and textbooks will be provided for those who want to delve deeper into the topic, but will not be mandatory.

Responsible for Module:
Ruggeri, Azzurra; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Judgement and Decision Making (Seminar, 4 SWS)
Ruggeri A [L], Ruggeri A, Stanciu O
For further information in this module, please click campus.tum.de or here.

Module Description

SOT10125: The Psychology of Teamwork: Theory and Practice in Organizations | The Psychology of Teamwork: Theory and Practice in Organizations

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
Im Seminar wird eine Studienleistung erbracht (bestanden/nicht bestanden). Um das Seminar zu bestehen, müssen die Studierenden aktiv teilnehmen, d. h. das zugewiesene Material lesen und es in Form von reflektierenden Diskussionen und eigenständigen Präsentationen im Seminar wiedergeben. Neben der Überprüfung des Kenntnisstands hinsichtlich psychologischer Grundbegriffe, Modelle und Studien zielen die Aktivitäten auch auf die Anwendung der Inhalte im beruflichen und alltäglichen Kontext.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
keine

Content:
The course offers a deeper focus on psychological theories and perspectives that are integral to organizational contexts and play a key role into how work-based teams or groups form, develop and perform. Further, the seminar explores executive work-based motivational and behavioral theories that are integral to organizational processes.

Intended Learning Outcomes:
Die tiefere Auseinandersetzung mit organisationspsychologischen Konzepten ermöglicht den Studierenden, ein differenzierteres Verständnis dafür zu entwickeln, wie Teams entstehen, funktionieren und arbeiten - und was zu ihrem Erfolg beiträgt.

Teaching and Learning Methods:
Unterstützt wird die Lehrveranstaltung durch einen Moodle-Kurs. Die Studierenden erhalten eine Reihe von Materialien, die ihnen die Lerninhalte vermitteln. Es erfolgt Input der Dozierenden zu zentralen Inhalten des Seminars. Darüber hinaus ist in jeder Sitzung eine kleine Gruppe von Teilnehmern dafür verantwortlich, den zugewiesenen Inhalt zu lesen, zu verstehen und kritisch in einem Präsentationsformat wiederzugeben, das zur Gruppe passt.

Media:
Präsentationen, textbasierte Arbeitsmaterialien, Diskussionen, interaktive computergestützte Elemente

Reading List:
Arnold, j., Randall, R., Patterson, F., Silvester, J., Robertson, I., Cooper, C., Burnes, B., Swailes, S., Harris, D., Axtell, C., & Den Hartog, D. (2010). Work Psychology: Understanding Human Behavior in the Workplace.
Coolican, H. (2019). Research methods and statistics in psychology (seventh ed.). Routledge, Taylor & Francis Group.
Greenberg, J. (2011). Behavior in Organizations. Pearson. https://books.google.de/books?id=OL-8cQAACAAJ
Jex, S. M., & Britt, T. W. (2014). Organizational psychology: A scientist-practitioner approach. John Wiley & Sons.
Peeters, M., De Jonge, J., & Taris, T. (2014). An introduction to contemporary work psychology. Wiley Online Library.
Smith, E. R., Mackie, D. M., & Claypool, H. M. (2019). Social psychology (fourth ed.). Psychology Press.

Responsible for Module:
Holzberger, Doris; Prof. Dr. phil. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
The Psychology of Teamwork: Theory and Practice in Organizations (Seminar, 2 SWS)
Holzberger D, Mitsostergios G
For further information in this module, please click campus.tum.de or here.

Module Description

SOT10139: Critical Thinking: Journal Club | Kritisches Denken: Lesegruppe [CT:JC]

Critical Thinking: Journal Club

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** irregularly
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 90	**Contact Hours:** 30

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

Description of Examination Method:
The course will be graded on a pass/fail basis. The evaluation of this course will be based on the preparation of a portfolio.
Part 1 - Sustained and active in-class participation with includes submitting concise written reflections prior to each session.
Part 2 - Group Project: in groups of 3/4, students will select and present to the class a topic or reading of their choice. This presentation will be followed by the submission of a written summary of the ensuing discussion, which will serve as the final assignment for the course.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
English language fluency

Content:
Students will read and discuss academic papers and practice critical analysis of contrasting sources. In later sessions, the focus shifts to applied critical thinking (e.g., fake news) group-led sessions on self-chosen topics. Topic suggestions: what is critique, intellectual humility, the development of a critical mind, biases, fake news, Interventions against fake news.

Intended Learning Outcomes:
Students will cultivate the ability to critically analyze both academic and non-academic texts, formulate thoughtful and well-reasoned questions, and reflect on their own reasoning as well as that of others. Throughout the course, they will practice identifying biases, evaluating evidence, and comparing contrasting perspectives. By the end of the course, students will be equipped to

apply critical thinking techniques to a wide range of materials and to communicate their evaluations effectively in both discussion and writing.

Teaching and Learning Methods:
Each session includes student-led paper presentations followed by interactive group discussions. Students are encouraged to engage critically with the material, formulate insightful questions, and compare diverse perspectives. The final sessions are dedicated to student-selected topics, fostering autonomy and collaborative learning within groups.

Media:
Power point presentations; Video materials; online materials, books. Moodle for sharing of resources and interaction in the forum

Reading List:
Horkheimer, M. (1972). Traditional and critical theory. Critical theory: Selected essays, 188(243), 1-11.

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. science, 341(6149), 976-980.

Zmigrod, L., Zmigrod, S., Rentfrow, P. J., & Robbins, T. W. (2019). The psychological roots of intellectual humility: The role of intelligence and cognitive flexibility. Personality and Individual Differences, 141, 200-208.

Responsible for Module:
Serko, Daniil; M.Sc.

Courses (Type of course, Weekly hours per semester), Instructor:
Critical Thinking Reading Group (Vorlesung, 2 SWS)
Serko D [L], Schlingloff-Nemecz L, Serko D
For further information in this module, please click campus.tum.de or here.

Module Description

MH160036: Children, Well-Being, and Digital Technologies | Children, Well-Being, and Digital Technologies

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 90	**Contact Hours:** 90

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

Description of Examination Method:
Project work
• (20%) Begin the seminar with an initial presentation designed to spark conversation, then lead (or co-lead) a 90-minute discussion that challenges you to structure a dynamic learning session and engage participants around a specific issue or topic.
• (65%) Written document. Write a document that outlines a research idea, including its objectives, significance, methodology, questions, and expected outcomes.
• (15%) Video presentation (20% of Project Work): Produce a 1-minute video that enhances the clarity and persuasiveness of your document, effectively summarizing and highlighting the key elements.

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
Children represent the hope of our future, yet what does it mean to be a child or a young person in today's rapidly evolving digital world? This module explores the multifaceted intersection of children, well-being, and digital technologies, examining how emerging innovations reshape every aspect of young people's lives.

In the lecture, students will engage with a broad range of topics that frame our understanding of youth, well-being, and digital technologies. They will explore how definitions of “children” and “youth” are evolving and what coming of age means amid rapid cultural, social, political, and technological shifts. The lecture will also introduce diverse research methods highlighting different approaches to data collection, analysis, and presentation. Interactive elements such as polls, group discussions, and role-playing activities will ensure that students connect past and present insights with current realities.

Building on the lecture content, the seminar zooms in on artificial intelligence (AI) and its impact on children's lives. Here, students will explore emerging trends such as AI influencers, digital twins, and evolving digital identities. The seminar delves into ethical, methodological, and social questions surrounding AI. With guest instructors from research, policy, and industry enriching the conversation, students will lead discussions and explore the ethical, methodological, and social implications of AI.

In the two workshops, students and instructors will collaborate to bring all these insights together by designing an initial study pitch on youth, well-being, and digital technologies. The first will include hands-on work that encourages creative problem-solving and practical application of learned concepts. Following the first workshop, students will participate in a second two-day (virtual) workshop where they will receive feedback to refine and strengthen their research proposal.

Topics may include:
• Definitions: Explore how the concepts of children and youth and coming of age are evolving.
• Methods: Delve into different research methods — from classic surveys to creative tools like DALL-E — that are redefining how we collect, analyze, and present data.
• Connectivity: Address the digital divide and its implications for access to technology, opportunities, and overall well-being, particularly in under-resourced communities.
• Relationships: Examine how friendships and social bonds are shifting.
• Health: Understand global concepts of well-being and the impact of digital technologies on mental health.
• Learning: Understand the skills needed for the future through AI-enhanced personalized learning and explore how research can be effectively translated into policy and practice.
• Privacy: Explore different concepts of digital privacy and data protection for children.
• Work: Investigate the transformation of traditional career paths in the face of AI-driven job automation.
• Creativity: Rethink what creativity means in a digital age where technology shapes the way we express ourselves.

Intended Learning Outcomes:
At the end of the module — which includes a lecture, a seminar, and a project work — students are able to:
• Analyze the evolving definitions of "children" and "youth" amid rapid societal and technological change while mastering and articulating key concepts and theories related to children, digital technologies, and global well-being frameworks.
• Evaluate how digital innovations have historically shaped — and continue to influence — children's experiences, behaviors, and futures across diverse cultural, social, political, and technological contexts.

• Assess, in addition to digital technologies more broadly, the multifaceted impacts of AI on children, recognizing both its transformative opportunities and potential challenges.
• Identify and compare a range of research methodologies, both qualitative and quantitative, used to study children and digital technologies, and demonstrate your research skills by developing a document (i.e., study pitch) that outlines a research idea, including its objectives, significance, methodology, questions, and expected outcomes.
• Examine how children’s engagement connects with digital technologies to concepts such as digital literacy, health literacy, child safety, and ethical AI, while reflecting on the broader ethical and societal implications for education, well-being, and creativity.
• Analyze emerging trends such as AI influencers, digital twins, and evolving digital identities, and their implications for children’s development and future opportunities.
• Design and deliver a presentation aimed to spark conversation and either lead or co-lead a 90-minute discussion. Formulate questions and comments to structure a learning session, engaging participants around a specific issue or topic relevant the course.

Teaching and Learning Methods:
This module consists of a weekly lecture (2 SWS), a weekly seminar (2 SWS), and two two-day workshops (2 SWS) to drive forward project work. Each component deepens students’ understanding of children, well-being, and digital technologies, while fostering critical thinking, creativity, communication, and collaboration among students.

Lecture
This lecture introduces key concepts and theories at the intersection of children and digital technologies, emphasizing emergent innovations and global well-being frameworks. Designed to foster active engagement, it provides opportunities for discussion and reflection, ensuring that students can critically connect theoretical insights with practical implications.

Seminar
Building on what students learned in the lecture about children, well-being, and digital technologies broadly, this seminar takes a closer look at artificial intelligence (AI) and its impact on children’s lives. AI is already significantly shaping childhood by influencing how children learn, interact, or build their identities. Focusing on AI allows us to understand these rapid changes and develop strategies to ensure that digital innovations support children's well-being and future opportunities.

Workshops
Over the course of twice two full days (tentatively: July 14-15; second (virtual) workshop dates TBD), students and instructors will engage in collaborative project work. Together they will develop an initial idea for a study pitch. Following the two-day workshop, students will receive feedback to refine and strengthen their pitch.

Media:

Reading List:
• Cortesi, S., Hasse, A., Lombana-Bermudez, A., Kim, S., & Gasser, U. (2020). Youth and Digital Citizenship+ (Plus): Understanding Skills for a Digital World. Youth and Media, Berkman Klein Center for Internet & Society. http://nrs.harvard.edu/urn-3:HUL.InstRepos:42638976
• Gasser, U. (2019). AI Innovators Should be Listening to Kids. WIRED. https://www.wired.com/story/ai-innovators-should-be-listening-to-kids/
• Furlong, A. (2013). Youth studies: An introduction, Routledge. Read chapter 1, Youth and the Life of Course, pp. 1-23.
• Hasse, A., Cortesi, S., & Gasser, U. (2022). Transforming state of the art offline approaches for the digital world: A methods guide for youth and well-being focus groups. Youth and Media, Berkman Klein Center for Internet & Society. https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37373988
• Hasse, A., Cortesi, S., Lombana-Bermudez, A., & Gasser, U. (2019). Youth and artificial intelligence: Where we stand. Berkman Klein Center for Internet &; Society at Harvard University. http://nrs.harvard.edu/urn-3:HUL.InstRepos:40268058
• Madden, M., Calvin, A., Hasse, A., & Lenhart, A. (2024). The dawn of the AI era: Teens, parents, and the adoption of generative AI at home and school. San Francisco, CA: Common Sense. www.commonsensemedia.org/sites/default/files/research/report/2024-the-dawn-of-the-ai-era_final-release-for-web.pdf
• Waller, G., Süss, D., Suter, L., Willemse, I., Külling, C., Bernath, J., Skirgaila, P., Löpfe, S. (2021). JAMESfocus – Looking Back on a Decade of Youth Media Research. Zürich: Zurich University of Applied Sciences. https://www.zhaw.ch/storage/psychologie/upload/forschung/medienpsychologie/james/jamesfocus/2022/JAMESfocus_Jugendmedienforschung_EN.pdf

Responsible for Module:
Cortesi, Sandra; Prof. Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Workshop: Children, Well-Being, and Digital Technologies (Übung, 2 SWS)
Cortesi S, Hidalgo Avila C

Seminar to Children, Well-Being, and Digital Technologies (Seminar, 2 SWS)
Cortesi S, Hidalgo Avila C

Introduction to Children, Well-Being, and Digital Technologies (Vorlesung, 2 SWS)
Cortesi S, Hidalgo Avila C
For further information in this module, please click campus.tum.de or here.

Module Description

MH160037: Lost in Translation? Transforming Research into Policy and Practice | Lost in Translation? Transforming Research into Policy and Practice

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 150	**Contact Hours:** 30

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

Description of Examination Method:
Project work. The project work is assessed through two main components: A “creative submission” and a presentation.

Creative Submission (90% of overall grade)
• Creation (80%): Develop a creative representation of research using text, visuals, audio, or multimedia formats. Your submission must be based on a dataset and demonstrate your ability to present complex information in an engaging, accessible manner. Students are free to choose the medium that best represents their idea. Examples may include: A research paper or policy brief, poster or collage, data visualization, animation, video, podcast, comic, workshop, game, exhibition or installation, or interactive website.
• Written explanation (20%): Provide a brief written explanation of your design choices, outlining how your creative submission effectively communicates the research.

Presentation (10% of overall grade)
• Showcase your creative submission during a peer-feedback session. This presentation is an opportunity to engage with your peers by exchanging insights and receiving constructive critiques.

Weighting factor: Creative submission (90%): Actual creation (80%) and written explanation (20%). Presentation (10%).

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
Research holds the potential to shape formal (such as strategies, laws, and regulations) and informal (such as unwritten norms and internal procedures) policy (i.e., principles, guidelines, or rules designed to influence and guide decision-making within governments, organizations, or institutions) and influence real-world change, yet transforming research into actionable policy and practice is complex.

In this bi-weekly seminar, students will explore the intricate relationship between research, policy, and practice, identifying both opportunities and challenges in making research impactful. Through case studies, group discussions, and hands-on exercises, students will examine how diverse stakeholders — from policymakers and industry leaders to advocates and the public — engage with research, and how various formats and creative outputs can enhance its reach and influence. Students will critically debate different dimensions of evidence-based policymaking, analyzing both its successes and shortcomings. Building on these explorations, students will work directly with researchers, policymakers, and practitioners to develop the skills needed for making research resonate within and beyond academia. Reflecting on their own roles in bridging the research-to-policy-to-practice gap, students will be equipped to thoughtfully contribute to policy discussions and navigate the challenges of applying evidence in real-world contexts.

Topics may include:
• Mapping the research-policy-practice journey: Understand the full policy cycle — from agenda-setting to implementation — and how each stage influences the translation of research into policy and practice.
• Bridging Research and Practice: Explore how research informs both formal and informal policy.
• Overcoming barriers: Identify the challenges in converting research into policy and practice — including financial and capacity limitations, institutional issues, temporal misalignment, communication and cultural barriers, and stakeholder conflicts and political pressures — and examine strategies to overcome these obstacles.
• Creative communication: Learn how to design creative formats and outputs that effectively showcase research.
• Tailoring for diverse audiences: Adapt formats and outputs for various stakeholders — from academic peers, to policymakers, industry leaders, and the public.
• Stakeholder engagement: Understand the roles and perspectives of key actors in the policy ecosystem, and learn how to foster meaningful collaboration between researchers and decision-makers.

Intended Learning Outcomes:
Participation in this module — which includes a seminar and self-directed project work — will allow students to explore the journey from research to policy to practice. By the end of this seminar, students will be able to:
• Understand the relationship between research, policy development, and implementation, and identify key opportunities and challenges in translating research into actionable outcomes.

• Differentiate among the needs of diverse stakeholders (e.g., policymakers, industry leaders, advocates, and the public) and evaluate how various communication formats enhance the impact and reach of research findings.
• Reflect on personal roles in bridging the research-to-practice gap and develop the skills to effectively translate research into accessible, engaging formats.
• Gain diverse perspectives on knowledge translation through the active engagement with researchers, policymakers, and practitioners.
• Understand the methodological, ethical, and political dimensions of integrating research into policy and practice by analyzing both successful and problematic cases of evidence-based policymaking.
• Propose innovative strategies that improve the translation of research into policy and practice by applying the insights learned in the seminar.

Teaching and Learning Methods:
Seminar (2 SWS)
This seminar is designed to be highly interactive and unfolds over eight sessions throughout the semester. Through a mix of case studies, group discussions, tutorials, creative activities, and hands-on exercises, students will apply theoretical insights to the real-world challenges of translating research into policy and practice. Guest speakers — researchers, policymakers, and practitioners — will offer diverse perspectives and encourage dialogue, enriching the learning experience. Continuous guided reflections will encourage students to critically assess their learning process, refine their ideas, and build the practical skills needed to translate research into meaningful policy and practice

Media:

Reading List:
• Ashar, A., Faris, R., & Gasser, U. (2016). Networked policy making avenues: Assessing the role of academics in digital policy (Networked Policy Series, Berkman Klein Center Research Publication No. 2016-14). SSRN. http://ssrn.com/abstract=2842796
• Thaler, R. & Sunstein, S. (2008). Nudge: Improving Decisions about Health, Wealth, and Happiness, New Haven: Yale University Press, Introduction, pp. 1-14.
• Langdon Winner (1986). “Do Artifacts Have Politics?” In: The Whale and the Reactor: A Search for Limits in an Age of High Technology. Chicago, IL: University of Chicago Press. Chap. 2, pp. 19–39.
• Tactical Tech. (n.d.) The Glass Room. https://theglassroom.org/
• Zagoruichyk A. (2023, October 18). Picturing the Invisible: Interview with Makoto Takashashi. Anthrosphere, The Oxford Climate Review. https://www.anthroposphere.co.uk/post/picturing-the-invisible-interview-with-makoto-takahashi

Responsible for Module:
Cortesi, Sandra; Prof. Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Lost in Translation? Transforming Research into Policy and Practice (Seminar, 2 SWS)
Cortesi S, Hidalgo Avila C
For further information in this module, please click campus.tum.de or here.

Module Description

POL10500: Comparative Politics - Fundamentals | Comparative Politics - Fundamentals

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:
The module examination is a written test.
Students' achievement of the intended learning outcomes will be assessed through a 90-minute multiple-choice examination of 50 questions. With the written test, students demonstrate their ability to identify key terms and theories in comparative politics and describe structural elements of political systems. They also show that they can analyze key determinants of regime stability and regime change, clarify how and why political institutions vary, assess their effects in different contexts, evaluate political processes, and design research projects in comparative politics.
The exam is designed to evaluate theoretical knowledge and practical application. Approximately 70% of the questions will assess students' understanding of key concepts, theories, research design, and empirical findings covered in lectures and readings. The remaining 30% will test the application of knowledge gained through practical exercises conducted in seminars, ensuring that students can engage with comparative political analysis beyond memorization. The multiple-choice format allows for a broad assessment of learning outcomes while maintaining objectivity and efficiency. To ensure a fair and comprehensive evaluation, the exam will be structured to balance recall, comprehension, and applied reasoning, reflecting the module's emphasis on theoretical foundations and analytical skills.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
This module explores fundamental questions in comparative politics, such as: What distinguishes democratic from non-democratic regimes? Why do some countries democratize while others do not? Does economic growth lead to democracy? Do democracies perform better than non-democratic regimes in providing public goods?

The module is structured into three parts:
- Foundations of Comparative Politics – Covers core theoretical principles, research design, and methodological approaches in political science.
- State Formation and Political Systems – Examines state-building processes, different political system types, and their structures and institutions, with a particular focus on democracies and dictatorships.
- Political Actors and Institutions – Analyzes key institutional and actor-specific dynamics, including political parties, interest groups, and social movements.

Intended Learning Outcomes:
By the end of this module, students will be able to:
- Recognize and define key terms, concepts, and theories in comparative politics.
- Design research projects in comparative politics and apply basic scientific methods of comparative analysis.
- Identify and describe structural elements of political systems and classify different types of government based on key criteria.
- Analyze the key determinants of regime stability and regime change, explaining how and why political institutions vary and assessing their effects in different contexts.
- Compare and evaluate competing theories to explain political events, justifying why one theory may offer a better explanation than another.
- Assess political processes using different evaluation criteria across various contexts.
- Develop and support well-reasoned answers to questions about political institutions by drawing on relevant literature and empirical evidence.

Teaching and Learning Methods:
The module employs a combination of lectures, exercises to facilitate both theoretical understanding and practical application.

- Lectures introduce key concepts, theories, research designs, and methods of comparative politics, using real-world examples to illustrate their application.
- Exercises provide opportunities to deepen and extend this knowledge through individual and collaborative hands-on activities, applied case studies, and problem-solving tasks.
- Discussions and reflections encourage students to critically engage with the material, analyze different perspectives, and articulate their understanding through structured debate and commentary.

- Practical applications allow students to apply theoretical knowledge to concrete political scenarios, reinforcing learning through interactive problem-solving and case-based exercises.

Media:
Power Point

Reading List:
'• Newton, K. & van Deth, J. W. (2021). Foundations of Comparative Politics (Fourth Edition). Cambridge: Cambridge University Press.
• Adams, K.A. & Lawrence, E.K. (2018). Research Methods, Statistics, and Applications (2nd Edition). London: Sage
• Kellstedt, P.M. & Whitten, G.D. (2018). The Fundamentals of Political Science Research (3rd Edition). Cambridge: Cambridge University Press.
• Boix, C. & Stokers, S. (2009). The Oxford Handbook of Comparative Politics. Oxford: Oxford University Press.
• Lijphart, A. (2012). Patterns of Democracy: Government Forms and Performance in Thirty-Six Countries (Second Edition). New Haven: Yale University Press.
• King, G., Keohane, R. & Verba, S.(1994) Designing Social Inquiry: Scientific Inference in Qualitative Research. Princeton: Princeton University Press.
• Brady, H.E. & Collier, D. (2004) Rethinking Social Inquiry: Diverse Tools, Shared Standards. Oxford: Rowman and Littlefield.
• Clark, W. R., Golder,M. & Golder, S. M. (2017). Principles of Comparative Politics (Third Edition). (Washington DC: SAGE Publications)
• Caramani, D. (2020) Comparative Politics (Fifth Edition). Oxford: Oxford University Press
• Przeworski, A. (2019). Crises of Democracy. Cambridge: Cambridge University Press
• Toshkov, D. (2016). Research Design in Political Science. London: Palgrave.

Responsible for Module:
Theocharis, Ioannis; Prof. Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
(POL10500) Fundamentals of Comparative Politics (Exercise) (Übung, 2 SWS)
Pradel-Sinaci F, Theocharis I

(POL10500) Fundamentals of Comparative Politics (Lecture) (Vorlesung, 2 SWS)
Theocharis I
For further information in this module, please click campus.tum.de or here.

Module Description

POL60102: Science Communication and Public Engagement | Science Communication and Public Engagement

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
The module examination is a presentation which is supplemented by a short written elaboration. The presentation consists of an individual or group presentation on a new format idea in the field of science communication. With the presentation (approx. 20 minutes) and discussions in the classroom the students demonstrate that they understand the practical aspects of format prototyping for science communication and public engagement as well as that they have grasped the major concepts and can explain them and react to questions. With the written summary (1-2 pages) of the presentation, students show that they are able to present the concept they have developed for the presentation in a structured and comprehensible way.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
1) Introduction to science communication and public engagement: The growing role of science communication for universities and research organizations, the main actors and topics of science communication; Goals, target groups and formats; participatory science communication and public engagement
2) Learn the practical aspects by developing your own format of science communication: Specify content, define target group/personas and design a digital format or event. We will work with practitioners and follow the new TUM format prototyping handbook that was developed during the last semester.

Intended Learning Outcomes:
After the successful completion of the class „Science communication and Public Engagement", the students understand the basic concepts of science communication. They have an overview of media, platforms and formats and understand how to address specific target groups. They know the basic concepts of digital format prototyping and have themselves developed a new format.

Teaching and Learning Methods:
The module consists of a seminar with integrated exercises. Together with digital format experts the students will develop a format prototyping manual. With the help of the manual, they will develop and propose own ideas which can cover a broad range of media formats (videos, podcasts, social media channels etc.) and public engagement formats (slams, festivals, citizen science, etc.). By presenting these format ideas, the students will train to talk and reflect about specific methods of science communication. In class discussions they will broaden their knowledge on communicating science in an increasingly fragmented media world.

Media:
Assigned readings, presentations, discussions

Reading List:
Göpfert Winfried, Wissenschafts-Journalismus: ein Handbuch für Ausbildung und Praxis, 6., überarbeitete und aktualisierte Auflage, 2019, https://doi-org.eaccess.tum.edu/10.1007/978-3-658-17884-0
Meredith, Dennis, Explaining Research: How to Reach Key Audiences to Advance Your Network, 2nd edn (2021; online edn, Oxford Academic, 19 Aug. 2021), https://doi-org.eaccess.tum.edu/10.1093/oso/9780197571316.001.0001, accessed 10 Mar. 2024.
Bertemes, Jean Paul, Haan Serge and Hans, Dirk. 50 Essentials on Science Communication, Berlin: De Gruyter Mouton, 2024 https://doi-org.eaccess.tum.edu/10.1515/9783110763577

Responsible for Module:
Rubner, Jeanne; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
(POL60102) Science Communication and Public Engagement (Seminar, 2 SWS)
Rubner J
For further information in this module, please click campus.tum.de or here.

Module Description

SOT46402: Society and Technology | Society and Technology

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module examination is a 60min written exam, which takes place in the last session of the semester. The format of a written exam gives students the opportunity to demonstrate their ability to recall knowledge about the societal dimensions of data infrastructure and basic social science approaches in 5 closed questions. The 3 open questions in the examination give the students the opportunity to transfer and apply their knowledge and illustrate they are able to assess the societal dimensions of data infrastructure, evaluate their benefits, safety requirements and social impacts. Additionally, they can showcase their ability to transfer their knowledge on basic social science approaches for analyzing data structures to selected examples, demonstrate their ability to assess their societal impact and to reflect on methodological choice and empirical findings in a critical but constructive way and finally to independently draw conclusions.
The format further enables to test the recall of social science epistemology and fundamentals of qualitative methods. To conclude, the students can demonstrate their ability to apply the above concepts on novel examples.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The module will be taught in two lectures. The first lecture seeks to open the so-called black box of the ‘society’ of data infrastructures. It focuses on the societal, political and cultural dimensions of data production and governance. To this end, the module introduces social science approaches and basic concepts such as responsibility, risk, safety, infrastructure, innovation, and societal trust. It addresses topics such as how data are societally embedded, inscribed by underlying cultural values and governed by rules and result in un-intended consequences. We will discuss

distinct societal implications of technical trajectories, long-term as well as short-term benefits, and risks of the data-fiction of societies (including implications for vulnerability and resilience as well as inequalities and justice. We unpack institutional & cultural drivers of techno-change as well as varieties of societal pathways how to govern data and ways how to gain trust in institutions (science, administration), which are responsible for the assessment and management of data. Based on these findings, we explore the range of options for how technologies can be best governed: by whom, to what ends, by what means, and with what welfare consequences for affected groups.
The module also introduces into approaches of interdisciplinary technology assessment (Technology Assessment, Responsible Research and Innovation, Anticipatory Governance, living labs). We apply concepts of the lectures to possible fields of application such Extreme Events, Climate services, AI, Critical Infrastructure, Consumer Protection, Security, Climate Engineering, Carbon Removal Technologies and illustrate societal causes and impacts with examples of TUM research.
The second part of the module students learn how the qualitative social sciences know and analyze social dynamics, society, and social order. Students will be introduced to social science epistemology: How do explaining and interpreting differ? What does understanding someone really mean? What drives societal development? They will understand how 'the social' differs from 'society' and 'social order' by way of addressing selected social theories and their underlying ontologies. Last but not least, the course turns towards crucial qualitative methods so that students get a first grasp of how society and 'the social' can be known in different ways and what the consequences of these differences are.

Intended Learning Outcomes:
After successfully completing module, students can assess the societal dimensions of data infrastructure, evaluate their benefits, safety requirements and social impacts. They have the competence to apply basic social science approaches to analyze data structure in a targeted manner to the analysis of selected cases (e.g. critical infrastructures, health), to assess societal impacts and causes respective risks, and to develop responsible solutions. They have competencies to reflect methodological choices and empirical findings in a critical, but constructive way.
They will further know the basics of social science epistemology and have gained an understanding of social theories and their underlying ontologies.

Teaching and Learning Methods:
The module takes place in the form of two lectures (including video presentations), student presentations and single and group exercises. In the lecture, PowerPoint presentations are used to explain the basics of societal assessment and management.
During lectures, the content of teaching is disseminated by way of talks or presentations. Tablet PCs are used to derive and illustrate complex issues. In the course of the lectures, explicit questions are raised which call for transfer capabilities on the part of students while giving them the opportunity to speak up and discuss potential solution concepts. This approach is aimed at providing deeper insights into societal risk and their safety challenges, thus simultaneously fostering a transfer of the acquired know-how to other problem areas. It further serves to build a

better understanding of social science epistemology and how to utilize it and lay the groundwork for qualitative methods and their application.
The module is oriented to towards concrete societal impacts of data infrastructure which are used as examples to apply and improve their social science skills. Group work and other interactive formats are used to enable a critical discussion of the learning content and outcomes, to apply it to selected fields and to draw evidence-based conclusions.

Media:
PowerPoint, Video, Poster, break-out groups, Scenario-Building, Flipchart

Reading List:
Bowker, G. C., Baker, K., Millerand, F., & Ribes, D. (2010). Toward information infrastructure studies: Ways of knowing in a networked environment. International handbook of internet research, 97-117.
Marres, N. (2017). Digital sociology: The reinvention of social research. John Wiley & Sons.

Responsible for Module:

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

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

Module Description

SOT56307: Philosophy of Artificial Intelligence: Key Readings | Philosophie der Künstlichen Intelligenz: Schlüsseltexte

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
In an oral examination (30 minutes), students will demonstrate their ability to interpret philosophical texts on AI topics and discuss their approaches in relation to current debates.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Can machines learn and think? How do AI systems differ from human thought, speech, and action? How is AI changing knowledge and science? What are the ethical risks? And how should the basic assumptions of AI research and development be considered? Assigned courses address AI-related topics from a variety of philosophical perspectives, including logic, philosophy of language, philosophy of mind, knowledge, and science, philosophical anthropology and ethics.

Intended Learning Outcomes:
Students are able to,
- understand texts on philosophical issues in the context of artificial intelligence
- identify and exemplify philosophical concepts relevant to AI phenomena
- apply philosophical concepts to discuss current AI phenomena (selected examples).

Teaching and Learning Methods:
Seminar: readings and discussions of texts including teaching on historical and philosophical contexts and discussions to argue their relevance for current debates.

Media:
Online Reader

Reading List:
Margaret A. Boden (Ed.): The Philosophy of Artificial Intelligence, Oxford 1990

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Philosophy of Artificial Intelligence. Classical Readings in the Phenomenology of AI (Seminar, 3 SWS)
Centrone S
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86072: Project Week: Application Project: Public Sector | Project Week: Application Project: Public Sector

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Students will be assessed based on their project work, making up 50% of their grade, and an accompanying 30min presentation, making up 50% of their grade. The project work will be assessed with a 10 page report. In the first phase of the project students can demonstrate their ability to research and analyze current public sector projects as well as their skill to evaluate and identify gaps in political engagement. In the second stage of the project students demonstrate their ability to develop and implement novel methods for political engagement incorporating different disciplines. The presentation will examine the students ability to present their work to expert groups.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
In this project-oriented module, students will work in interdisciplinary teams alongside staff from public administration and government entities. By researching and analyzing current public sector projects, students will identify gaps and devise novel methods for political engagement. They will present and discuss their ideas with peers, public officials, learning how to successfully realize their proposals and create impactful projects for social purposes in interdisciplinary teams. The primary goal of the module is to actively create new methods to support and enhance public sector innovation for various groups. Students will develop their ideas independently and then discuss their potential projects with representatives of public instiutions. After completion the resulting projects will be ready and fit to be used by the public sector for enhancing digital participation and democratic engagement.

The module acts as a bridge between public sector entities and TUM, supporting the development of new digital participation opportunities and the interdisciplinary integration of technical implementation, governance perspectives, and societal needs concerning digital participation. The students will be working together on projects through a holistic, interdisciplinary approach to enhance digital participation and democratic engagement, thus strengthening democracy. At the end of the seminar, students will be capable of designing and implementing projects while incorporating different disciplines.

Intended Learning Outcomes:
After successful completion students are able to: research and analyze current public sector projects, evaluate and identify gaps in, and devise novel methods for, political engagement. Additionally they can design and implement projects while incorporating different disciplines.

Teaching and Learning Methods:
The module will take place in seminars, in which the stundes will be able to work together in interdiscipinary teams to jointly develop and implement novel projects while receiving feedback and guidance from their peers, lecturers and public sector entities.

Media:
PowerPoint

Reading List:
Noveck, B. S. (2021). Solving public problems: a practical guide to fix our government and change our world. Yale University Press.

Responsible for Module:
Pfeffer, Jürgen; Prof. Dr. rer. soc. oec.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86072) Application Project: Public Sector (Project Week) (Seminar, 4 SWS)
Pfeffer J, Schröder J
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86079: History and/of Technology | History and/of Technology

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
This module will be examined with a 60min written exam. This format allows the students to demonstrate their ability to explain the role history and its implications play for the present and future, with a focus on the history of genocide and the holocaust. It will further give students the opportunity to demonstrate their knowledge on how the history of genocide and the holocaust has been used as a tool to advocate for a different present and future, and which role technology plays. Students ability to translate their knowledge to the current multiethnic and immigration society as well as to populist tendencies is tested as well.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The history of mankind is a history of struggle for human rights. The 20th century is closely connected with the worst experiences of war, genocide and violence in human history, at the same time it brought about democracy, times of peace, equality and prosperity. Towards the end of the 20th century history – esp. the history of genocide & the holocaust – became a creative and powerful tool to advocate for a different present and future. Which role do the history of war and genocide play today, in a time deeply shaken by polycrises and an uncertain future? Can a history of human achievements (such as overcoming war and violence), technological innovation and democratic politics contribute to a culture of confidence and hope?

Intended Learning Outcomes:
After successfully completing the module, students will be able to:
- Understand and recall how history, specifically history of genocide and the holocaust, was used as a tool to influence current and future events
- Critically assess and analyze the role technology has, and continues to play
- Analyze the role of memory in a multiethnic and immigration society and in times of populism
- And utilize their gained knowledge to defend democracy

Teaching and Learning Methods:
The module will be taught in lectures in a hybrid format. The lecture format combined with in class discussions will provide the ideal learning environment to teach students the fundamentals of how history can impact current and future prospects.

Media:
PowerPoint

Reading List:
Zadoff, M. (2023). Gewalt und Gedächtnis: Globale Erinnerung im 21. Jahrhundert. Carl Hanser.

Responsible for Module:
Zadoff, Mirjam; Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86079) History and/of Technology (Seminar, 4 SWS)
Zadoff M
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86080: Risk & Crisis Communication (6 ECTS) | Risk & Crisis Communication (6 ECTS)

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module will be assessed through a case study report of 10-15 pages, which will make up 80% of the grade and a 20 minute presentation which makes up the remaining 20%.
The case study report allows the students to demonstrate their ability to determine what constitutes a crisis, that they understand the key concepts and theories in risk and crisis communication and that they know of the typical stages of a crisis. They are further able to highlight their knowledge of the intersection of communication strategies, political decision-making and public attitudes. Within the report students will also critically assess the communication practices utilized in their given topic. In their presentation students will demonstrate their ability to communicate scientific findings to an academic audience.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
An interest in leaning about different theories and scenarios of risk and crisis communication as well as social science research.

Content:
The module consists of a lecture and a seminar. The lecture introduces the theoretical foundations and practical applications of risk and crisis communication from a social science perspective. It delves into how communication strategies are developed and executed in times of crisis, the role of media, the impact of political decisions, and the psychological aspects of risk perception. This also includes the different stages of the crisis management process, including precrisis (prevention, preparation, planning), crisis response (crisis communications and stakeholder engagement), and

postcrisis (lessons learned, corrective actions and reputation recovery). During the lecture, there will be slides and presentations, students will answer questions and perform short exercises that help them to better understand the course content. In the seminar, students will apply the learned concepts to a case study. They will form groups, learn how to work as teams, and examine a real-life risk and crisis event. Through a presentation and a project report, they will prove their expertise in risk and crisis communication.

Intended Learning Outcomes:
After successful participation in the module, students will have a comprehensive understanding of risk and crisis communication: what constitutes a crisis, understand key concepts and theories in risk and crisis communication, and typical stages of a crisis. They will have an understanding of the intersection of communication strategies, political decision-making, and public attitudes. They will be equipped to critically assess communication practices of past and recent crises. They will be able to work in teams, to conceptualize, plan and execute a risk and crisis communication case study.

Teaching and Learning Methods:
Lectures, presentations, group work and discussions, assigned readings, film/video screenings. The module consists of a lecture and a seminar. The lecture introduces the theoretical foundations and practical applications of risk and crisis communication from a social science perspective. It delves into how communication strategies are developed and executed in times of crisis, the role of media, the impact of political decisions, and the psychological aspects of risk perception. This also includes the different stages of the crisis management process, including precrisis (prevention, preparation, planning), crisis response (crisis communications and stakeholder engagement), and postcrisis (lessons learned, corrective actions and reputation recovery). During the lecture, there will be slides and presentations, students will answer questions and perform short exercises that help them to better understand the course content. In the seminar, students will apply the learned concepts to a case study. They will form groups, learn how to work as teams, and examine a real-life risk and crisis event. Through a presentation and a project report, they will prove their expertise in risk and crisis communication.

Media:
Computer, presentations, videos

Reading List:

Responsible for Module:
Walter, Stefanie; Prof. Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86080, SOT86102) Risk & Crisis Communication: Theories and beyond (Vorlesung, 2 SWS)
Walter S

(SOT86080) Risk & Crisis Communication (part of 6 ECTS module) (Seminar, 2 SWS)
Walter S
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86124: Generative Design Studio: Responsible Quantum Innovation | Generative Design Studio: Responsible Quantum Innovation

Version of module description: Gültig ab summerterm 2025

Module Level: Master	**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:
Students will complete a portfolio of three preparatory exercise sheets (20%), and a semester-long design project for creating a generative design artifact (40%) along with a presentation (20%) and reflective essay (20%).
During the module, one exercise sheet will be submitted about quantum basics, responsible innovation, and generative design respectively. This makes three exercise sheets in total. These exercises demonstrate the students understanding about the core vocabulary and concepts learned in this course, which are to be applied in the following parts of the seminar.
Throughout the semester, students document their design process, participate in consultation sessions for feedback, and refine their concepts. Students independently develop a generative design concept that integrates quantum principles with responsible innovation themes. The course culminates in the submission of a final design artifact accompanied by a presentation and a short reflective essay of around 1,000 words.
The design artifact will take the form of a documented design concept, a prototype, or an implemented design. The design artifact demonstrates the students understanding and transfer of generative thinking and design methods in practice, and communicating complex ideas through data- and design-driven storytelling.
The reflective essay articulates the societal relevance, design rationale, and responsible innovation considerations of their work, demonstrating the ability to critically reflect on the application of generative design principles on the subject of responsible quantum innovation.
The final presentation of the process and results (i.e., the design artifact) will showcase the students understanding of the three explored domains of quantum technology, responsible innovation, and generative design. Students will demonstrate their ability to communicate complex ideas through storytelling, while also critically reflecting on their own process and the subject-matter explored.

Repeat Examination:

(Recommended) Prerequisites:
No prerequisites.
Basic programming skills can be helpful, for example from experience with or classes on JavaScript, Python, HTML/CSS, or even p5.js/Processing.

Content:
The module introduces students to the foundations of quantum technologies and their societal implications through the lens of generative design. It combines basic quantum theory (superposition, entanglement, uncertainty) with principles of generative design, creative coding, and responsible innovation. Students explore how emerging quantum technologies may shape future design challenges, societal developments, and ethical questions.
The module emphasizes speculative design and responsible innovation, encouraging students to critically reflect on the potential applications, risks, and governance challenges of quantum technologies. Students engage with creative coding exercises, data-driven storytelling, and design methods such as ideation frameworks, scenario-building, and prototyping. Throughout the course, students develop individual or collaborative projects that integrate quantum concepts with responsible design approaches, culminating in the creation of speculative design artifacts.
Key topics include:
- Foundations of quantum theory and its differences from classical computing
- Generative design principles: automation, randomness, and rule-based design
- Responsible innovation and societal implications of quantum technologies
- Data as design material and storytelling component
- Speculative futures and scenario development
- Human-machine collaboration and co-creation processes

Intended Learning Outcomes:
After successful participation in the module, students are be able to
- Apply core vocabulary of generative thinking and design methods.
- Communicate complex ideas through data- and design-driven storytelling.
- Explain basic quantum concepts.
- Critically reflect on the societal impact of quantum technologies.

Teaching and Learning Methods:
The module is offered in a studio-based, practice-oriented format that combines seminar and workshop sessions with independent project development. The initial three-day block seminar introduces core theoretical foundations and creative methods through lectures, discussions, coding exercises, and group-based ideation workshops.

Students engage in experiential learning by applying generative design principles and quantum concepts in their own design projects. The course emphasizes iterative experimentation, peer feedback, and reflective practice. Throughout the semester, bi-weekly consultation hours provide structured opportunities for individual guidance, troubleshooting, and formative feedback. Learning takes place through a mix of instructor-led inputs, collaborative exercises, self-directed inquiry, and the development of individual or group design prototypes. The studio format supports active participation, creativity, and critical engagement with the societal implications of quantum technologies.

Media:
PowerPoint, White boards, Literature, Zoom

Reading List:
Key Reading:
Hübner, P. (2025). The Generative Mind. A New Approach to Creative Thinking, niggli, ISBN 978-3-7212-1059-0
Selective Readings from:
Capra, F., Luisi, P. (2014). The Systems View of Life. A Unifying Vision, Cambridge University Press, ISBN 978-1-316-61643-7
Dunne, A., Raby, F. (2013). Speculative Everything. Design, Fiction, and Social Dreaming, MIT Press books, ISBN 978-0-262-019842
Maeda, J. (2019). How to Speak Machine. Laws of Design for a Digital Age, Penguin RandomHouse, ISBN 978-0-241-42214-4
Büscher, B (Hrsg.) (2004). Kaleidoskopien Band 5: Ästhetik als Programm. Max Bense/Daten und Streuungen, Vice Versa, ISBN 3-00-014180-4

Responsible for Module:
Gasser, Urs; Prof. Dr. jur.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86124) Generative Design Studio: Responsible Quantum Innovation (Seminar, 3 SWS)
Gasser U, Marco F, Molnar A, Schönborn S
For further information in this module, please click campus.tum.de or here.

Module Description

LS60021: Places of Change – Education for Sustainable Development Outside the Classroom | Places of Change – Education for Sustainable Development Outside the Classroom

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The module examination takes the form of a project work in which students work in groups to design a specific ESD program, carry it out in practice and then prepare and evaluate it in writing. The project work is divided into the following components: peer feedback during the process of finding ideas (10% of the grade), practical implementation (20% of the grade), written report (approx. 6 - 8 pages, 50% of the grade), written evaluation and reflection (approx. 2 pages, 20% of the grade).

In the course of the module, students work in groups to design an ESD program for a target group of their choice under the guidance of the lecturer and with the help of peer feedback (10% of the grade) and implement it outdoors in an authentic situation. The practical implementation should demonstrate that a technically and didactically sound educational offer for the target group can be developed independently and implemented outdoors. The implementation takes place as a practical group examination, lasting approx. 60 - 90 minutes depending on the size of the group (approx. 15 - 20 minutes per student, 20% of the grade). Subsequently, students are expected to prepare a written report (approx. 6 - 8 pages, 50% of the grade) on their ESD education program. The individual achievements of each student are to be marked in the report. In addition to the methodological and didactic implementation, the report should address the theoretical background and scientific findings and classify the student's own ESD offer in the context of sustainable development. In addition, the report should be followed by a written critical reflection and evaluation (approx. 1 - 2 pages, 20% of the grade) of the implemented ESD offer.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Participants should be willing to participate in outdoor lessons in various weather conditions during the winter semester. Basic knowledge and/or studies related to sustainability are an advantage, but not a prerequisite.

Content:
ESD means education for sustainable development. Development is sustainable when people worldwide, now and in the future, can live with dignity and develop their needs and talents while taking planetary boundaries into account. Such a social transformation requires strong institutions, participatory decisions and conflict resolution, knowledge, technologies and new behavioral patterns. ESD should enable people to reflect on the impact of their own actions on the world and to make responsible, sustainable decisions. (© BMBF)

The following contents and methods are part of the module:

- Education for Sustainable Development (ESD)
- Education Outside the Classroom
- Environmental Education, Global Learning, Transformative Learning
- Socio-Ecological Transformation
- Whole Institution Approach
- Resilience as a future skill
- Philosophical conversation as an ESD-method
- Human-nature-relationship
- Inclusion of Nature in Self Scale (INS-Scale) as a method to measure connectedness to nature
- LandArt and other types of active nature experiences

Intended Learning Outcomes:
After successfully completing the module, participants will be able to:
1. identify places of change that are suitable for Education for Sustainable Development (ESD) and outdoor education programs
2. understand the concept of the Whole Institution Approach
3. use the INS scale to measure closeness to nature and evaluate its role in sustainable action
4. implement ESD and outdoor education methods themselves with a target group
5. assess the role of ESD and outdoor education in the context of sustainable development
6. develop ESD and outdoor education programs for different target groups

Teaching and Learning Methods:
The interdisciplinary module is in its format as a project interactive and combines various learning methods. The content of the lessons is mainly actively developed, illustrated and deepened by the students in the form of presentations, group work, peer- feedback and discussions. Individual presentations by the teacher serve primarily to impart basic knowledge in the field of education for sustainable development. In the group work and discussions, the content, some of which has been prepared by students themselves, is deepened, critically examined and presented. The knowledge gained is put directly into practice within the module by students working in teams under guidance

of the teachers and by means of peer-feedback to develop an ESD offer for a target group of their choice and putting this into practice outside on site.

Media:
PowerPoint, flipcharts, films, virtual exchange in Zoom

Reading List:
BAIER, A.; MÜLLER, C.; WERNER, K. (2024): Unterwegs in die Stadt der Zukunft. Urbane Gärten als Orte der Transformation. transcript Verlag, Bielefeld
CORNELL, J. (2006): Mit Cornell die Natur erleben. Verlag an der Ruhr. Mühlheim
GEBHARD, U. (2020): Kind und Natur. Die Bedeutung der Natur für die psychische Entwicklung. 5. Aufl., Springer VS, Wiesbaden.
GEBHARD, U.; LUDE, A.; MÖLLER, A.; MOORMANN, A. (2021): Naturerfahrung und Bildung. Springer VS, Wiesbaden.
KOEDELPETER, T.; KREUZINGER, S.; SCHLEHUFER, A. (2022): Wandel braucht Bildung. Impulse, Konzepte und Praxis zur Bildung für nachhaltige Entwicklung. oekom Verlag, München.

Responsible for Module:
Egerer, Monika; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Places of Change – Education for Sustainable Development Outside the Classroom (Projekt, 3 SWS)
Endriß T
For further information in this module, please click campus.tum.de or here.

Module Description

POL23200: Environmental Politics in International Comparison | Umweltpolitik im internationalen Vergleich

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The examination consists of a scientific paper. The examination consists of a scientific paper (term paper/seminar paper) of 20-25 pages (60%), which is accompanied by an oral performance (40%). Within the framework of the term paper, a broader topic is dealt with that was treated in a course and is analyzed in the form of an in-depth elaboration, guided by a precise question. The oral performance can also take the form of group work, provided that the individual contributions are recognizable.

In the scientific paper, students show that they are able to discover important research questions, to work methodically, and to link theoretical approaches with empirical examples.

In the presentation, the students also show that they are able to present the connections between theory, methods, and empiricism.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The module introduces environmental politics from an international comparative perspective. The central institutions, actors, processes, content and outcomes of environmental politics will be considered and analysed comparatively and theoretically. A focus will be on policy conflicts and problems, governance instruments (implementation challenges) and actor constellations. The multiple levels of environmental policy making in the European and international context will also be considered. Finally, the module will consider which factors influence the environmental policies

of a country as well as the factors contributing to the successes and failures of pioneer and laggard states.

Intended Learning Outcomes:
After participating in the module, students will be able to identify key concepts and theories of environmental policy; to distinguish among different theoretical approaches to environmental politics research; to apply methods of comparative analysis to various environmental politics areas; to compare internationally the institutions, actor constellations, processes and outcomes of national environmental politics, and to evaluate environmental policy outcomes from a comparative perspective.

Teaching and Learning Methods:
The module is offered in the form of two seminars, each dealing with different, but complementary thematic areas of the module. The best approach to obtaining a deeper understanding of a module's topics through independent work and general discussion will determine the form of the seminar. Seminars offer the opportunity for both an instructor's direct input and a wide variety of active learning methods. During the seminars, deep discussions and students' inputs will help in understanding the material presented by the instructor. Concrete examples will be used to practice, analyse, and evaluate the material which has been presented. The presentations developed and given by the students and ensuing discussions of those presentations will also contribute to this understanding.

Media:
Course reserve readings, Online Reader, Whiteboard, PowerPoint

Reading List:
Katharina Holzinger, Thomas Sommerer, Was verursacht die Aufwärtsspirale in der Umweltpolitik? Der Einfluss internationaler Harmonisierung auf nationale Umweltstandards. Österreichische Zeitschrift für Politikwissenschaft 41(1), 53-72 2012. Martin Jänicke, Helmut Weidner (Hg.), Successful Environmental Policy. A Critical Evaluation of 24 Cases. Berlin 1995. Wolfgang Muno, Umweltpolitik, in: Hans-Joachim Lauth (Hg.): Vergleichende Regierungslehre. Eine Einführung. Wiesbaden, 349-372 2010. Miranda A. Schreurs, Environmental Politics in Japan, Germany, and the United States. Cambridge 2002. Paul Steinberg and Stacy VanDeveer eds., Comparative Environmental Politics: Theory, Practice, and Prospects (Cambridge: MIT Press 2012).

Responsible for Module:
Prof. Dr. Miranda Schreurs

Courses (Type of course, Weekly hours per semester), Instructor:
(POL23200) Umweltpolitik im internationalen Vergleich (Seminar 1) (Seminar, 2 SWS)
Ohlhorst D

(POL23200) Umweltpolitik im internationalen Vergleich (Seminar 2) (Seminar, 2 SWS)
Ohlhorst D

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

Module Description

POL60402: Technology and Development | Technology and Development

Version of module description: Gültig ab summerterm 2020

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

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

Description of Examination Method:
Students will submit 3 homework assignments/exercises throughout the semester. Assignments will include a short policy briefing (4-6 A4 pages, excl. reference list and title page), thoughtful contributions to at least three discussion topics in an online forum, and a group presentation (slides, video or poster). These homework assignments enable the students to demonstrate their mastery of the learning outcomes: the presentation addresses learning outcomes 1 and 2, the policy briefing learning outcomes 3 and 4, and the discussion comments learning outcome 5. The final grade reflects the sum of the homework grades.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none required (though Intro to IR would be helpful for students)

Content:
Technology is often promoted as a new "miracle solution" to longstanding developmental problems, among them, hunger, poverty, and gender discrimination. Yet a closer look shows this "miracle" is far from becoming a reality in many developing and emerging states. This seminar follows two goals: 1) to look behind the curtain to discover the challenges inherent in using technology for developmental purposes; and 2) to brainstorm about the opportunities - some as of yet unrealized - that technology creates and make concrete plans for realizing them.

Intended Learning Outcomes:
Upon completing this course, students will be able to:
1) identify and use theories of technology in explaining development activities;
2) evaluate the usefulness of these theories in real world development activities;

3) empirically identify trends in the use of technology in development;
4) contextualize (technological) development within broader global trends, including power shifts and responses to COVID-19; and
5) critically evaluate empirical evidence related to technological development programs.

Teaching and Learning Methods:
The seminar uses (online) discussions, guided projects, lectures and exercises to accomplish the above-listed goals. This combination of methods engages different types of student learners (e.g., visual vs. auditory) to gain basic knowledge, to articulate their own explanations of the challenges and opportunites of technological development, and to brainstorm about solutions to developmental problems facing today's policymakers.

Media:
PowerPoints, videos, newspapers/magazines, (online) whiteboard and/or discussion board, exercise sheets

Reading List:
Literature lists will be provided at the start of the semester. Readings include, but are not limited to:
1) Bernards, Nick. 2019. "'Fintech' and Financial Inclusion." In The Palgrave Handbook of Contemporary IPE, edited by Timothy M. Shaw, Laura C. Mahrenbach, Renu Modi and Yi-chong Xu. London: Palgrave Macmillan.
2) Arora, Payal. 2016. "The Bottom of the Data Pyramid: Big Data and the Global South." International Journal of Communication 10:1681-1699.
3) Hilbert, Martin. 2016. "Big Data for Development: A Review of Promises and Challenges." Development Policy Review 34 (1):135-174.
4) Kettl, Donald F. 2016. "Making Data Speak: Lessons for Using Numbers for Solving Public Policy Puzzles." Governance 29 (4):573-579.

Responsible for Module:
Pfeffer, Jürgen; Prof. Dr. rer. soc. oec.

Courses (Type of course, Weekly hours per semester), Instructor:
(POL60402) Technology and Development (Seminar, 4 SWS)
Mahrenbach L
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86085: Sustainable Transitions | Sustainable Transitions

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
The module will be assessed in two inter-linked parts, reflecting the lecture + seminar setup. There will be a 60 min end of term written exam consisting of multiple choice questions, open questions and small tasks involving graphs (50%). In the exam students will be need to demonstrate that they grasp the key concepts presented in class and the empirical evidence discussed along state-of-the-art research papers. More specifically, students will need to showcase an understanding of socio-technical systems, the drivers and barriers to transition, the role of technology characteristics and innovation, the importance of finance and effects on developing countries. Alongside the course, students will work in groups (individual grading) on two assignments (50%). These assignments will involve working with data on real-world sustainabilty transition challenges in the OECD as well as non-OECD (i.e., developing) countries.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
This module focuses on climate change as one of the key dimensions of sustainability. Climate change is largely driven by the way we generate and use energy (incl. for mobility). A secondary driver of climate change is agriculture and land use change, which will also be discussed in class. Both the 2015 United Nations Paris Agreement on climate change and the UN Sustainable Development Goals call for a fast and extensive transition of our economies and societies. As the Intergovernment Panel on Climate Change (IPCC) puts it: "rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems [...]. These systems transitions are unprecedented in terms of scale, but not necessarily in terms

of speed [...]". This module introduces students to the challenges involved in this transition and the opportunities (e.g., in innovation, finance, and development) with a particular emphasis on the rate and direction of technical change. It compares the current situation with historical socio-technical transitions and derives the consequences for policymaking using concepts from the innovation and transitions literatures. It then focuses on the role of public policy in governing these transitions, considering the role of finance, institutions and policy feedback - again with a particular focus on emerging and developing countries. The module is designed for an interdisciplinary audience and we expect students to be open to learn from each other and be curious to understand different backgrounds, including the need to explain foundational concepts that may be new to some students but known to others.

Intended Learning Outcomes:
After successful completion of the module students will be able to:
* understand the importance of the rate and direction of innovation and technological change to address urgent challenges, such as climate change (SDG13)
* explain why large socio-technical systems typically only undergo slow transitions and how effective policies can accelerate the process
* recognize the opportunities and threats of sustainabilty transitions for developing countries
* realize the criticality of finance and investment for large transitions
* link their own actions and sphere of influence to sustainability challenges with a refined understanding of different impact channels

Teaching and Learning Methods:
The module will include a mix of teaching methods containing a lecture and a seminar. In the lecture students will be introduced to the frameworks, concepts and recent empirical evidence on the drivers of and barriers to sustainabiltiy transitions. They will learn about the policy, politics and historical background of sustainabilty transitions. In the accompanying seminar students will then be able to utilize their knowledge to critically discuss and evaluate related literature and current events. The seminar will be accompanied by real-world assignments involving data analysis and writing.

Media:
PowerPoint, Audio (e.g., podcast), Whiteboard, Case studies, Data

Reading List:
Howlett, M., Cashore, B. (2014). Conceptualizing Public Policy. In: Engeli, I., Allison, C.R. (eds) Comparative Policy Studies. Research Methods Series. Palgrave Macmillan, London.
Raworth, K. (2018). Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist. Random House Business.
Obama, B. (2017). The Irreversible Momentum of Clean Energy. Science 355(6321), 126-129.

These are background reads, the syllabus will cover state-of-the art research papers.

Responsible for Module:
Egli, Florian; Prof. Dr.sc. ETH Zürich

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86085) Sustainable Transitions - Lecture (Vorlesung, 2 SWS)
Lehofer C, Egli F, Toetzke M

(SOT86085) Sustainable Transitions - Seminar (Seminar, 2 SWS)
Lehofer C, Egli F, Toetzke M
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86111: Sustainability and Development: Causal Methods to evaluate Policy Impact | Sustainability and Development: Causal Methods to evaluate Policy Impact

Version of module description: Gültig ab winterterm 2025/26

Module Level: Master	**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:
The module examination is a research brief with a prefixed supplementary presentation.
The group presentation (10 minutes) of a research paper (individual grading) introduces students to the specific sustainability challenges developing countries face. The topics will be assigned during the kick-off meeting and the presentation accounts for 40% of the final grade. With the presentation the students demonstrate their understanding of the various empirical methods used in current research.
With this understanding, students will write an individual research brief (Approx. 3000 words) based on their own data analysis, accounting for 60% of the final grade. The deadline will be communicated in class, it is usually around two weeks after the block course. With the research brief, students show their ability to visualize data and critically reflect on the generalizability and policy conclusions that can be drawn from it. They also demonstrate that they are able to prepare evidence-based policy recommendations.

Repeat Examination:

(Recommended) Prerequisites:
Proficiency in English; motivation to engage in in-person debates and presentations; basic knowledge of statistics and econometrics (e.g., statistical significance levels, OLS). Experience with R is recommended (otherwise, students are expected to self-study R basics prior to the module).

Content:
Developing countries face both opportunities and challenges in sustainable transitions. For instance, transitions offer potential for carbon reduction, more resource equity, and economic diversification, but they may also induce short-term costs, be limited by technological capabilities, and require policy and behavior change. This course focuses on the methods and tools needed to evaluate the impact of policies aimed at fostering such change in developing countries, as well as the broader effects these transitions have on people, economies, and the environment.
Using real-world examples, we will explore three methods to evaluate causal impacts: willingness-to-pay (WTP), randomized controlled trials (RCTs) and difference-in-differences (DiD). Students will learn to apply these methods in an in-class “R data clinic” using datasets provided during the course. To illustrate, an example would be to assess whether training increases the share of small-scale farmers who apply sustainable fertilization in Indonesia. Group discussions, presentations, and hands-on activities will provide opportunities to critically examine the advantages and limitations of different approaches in various contexts.
By the end of the course, students will be able to apply the three causal methods in policy advisory work or further research, with a clear understanding of when and why specific methods are most appropriate.

Please only register if you can attend the kick-off session and all in-person sessions.

Intended Learning Outcomes:
After successful completion of the module students will be able to:
* recognize the opportunities and challenges of achieving sustainability in developing countries
* understand different methodological approaches for impact evaluation
* explain when and why specific methods are most appropriate
* apply data analysis tools to real world data sets

Teaching and Learning Methods:
The module consists of a block seminar.
The module includes a mix of teaching methods comprising lectures, group discussions, and practical sessions involving data analysis. Lectures will introduce students to recent empirical evidence focusing on energy and agriculture. Through these sectoral lenses, students will learn about the challenges, opportunities, and impacts of the green transition in developing countries. Students will critically discuss quantitative methods applied in recent academic research based on their presentations and hands-on coding sessions in R.

Media:
PowerPoint, Whiteboard, Case studies, Data

Reading List:

Gass, P., Gerasimchuk, I., Kuehl, J., Roth, J., & Wooders, P. (2021). Just transition to a green economy: Employment, economic, and social consequences of the transition to an ecologically sustainable economy in developing countries. Eschborn: GIZ, Deutsche Gesellschaft für Internationale Zusammenarbeit. https://www.iisd.org/publications/report/just-transition-green-economy

Gertler, P. J., Martinez, S., Premand, P., Rawlings, L. B., & Vermeersch, C. M. (2016). Impact evaluation in practice. Washington DC: World Bank Publications. https://hdl.handle.net/10986/25030

ILO (2012). Working towards sustainable development: opportunities for decent work and social inclusion in a green economy. Geneva: ILO. https://www.ilo.org/publications/working-towards-sustainable-development-opportunities-decent-work-and

OECD & Net Zero. (2024). Green industrial policies for the net-zero transition. OECD and Net Zero + Policy Papers No. 2.
https://www.oecd.org/en/publications/green-industrial-policies-for-the-net-zero-transition_ccc326d3-en.html

Responsible for Module:

Egli, Florian; Prof. Dr.sc. ETH Zürich

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

(SOT86111) Sustainability and Development: Causal Methods to evaluate Policy Impact (Seminar, 3 SWS)

Krämer C, Egli F, Fritz M, Luck N

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

Module Description

SOT86608: Advanced Methods for Measurement and Modeling of Choice Behavior (with Application to Mobility Policy) | Advanced Methods for Measurement and Modeling of Choice Behavior (with Application to Mobility Policy)

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
The module examination consists of a project work with a corresponding final presentation. The project work is completed over the semester. It follows the project objective of investigating the impact of a mobility policy on individual travel-related behavior, e.g., the impact of an increase in parking charges on car use in cities.
The project work is developed in different phases. In the first phase, students develop an online survey. This survey contains a mobility policy experiment that the students must design themselves. This includes selecting a certain policy and its context and defining its policy attributes. In this phase, students demonstrate the ability to reduce the complexity of travel-related behavior decisions to a meaningful experimental setup using the relevant methodology.
In the second phase, students will distribute the survey, e.g., among class members, to collect data. This is followed by analyzing their collected data using econometric methods, in particular, discrete choice models. In this phase, students demonstrate their ability to select appropriate statistical methods and procedures as well as the ability to make model estimates meaningful for policy making.
At the end of the semester, the project's results are presented and explained in class. The duration of the presentation is 10 minutes. With this presentation, students demonstrate their communication competency in presenting scholarly work to a specialist audience.
In addition to the presentation, a detailed written report of ten to fifteen pages is submitted after the final presentation that summarizes project work according to academic standards. With the report, students demonstrate their ability to concisely and scientifically report their progress during the project. They further show their ability to adequately justify decisions, e.g., in the selection and design of the mobility policy for the survey, using scholarly reasoning. The students further demonstrate their ability to discuss the limitations of their project adequately, to make recommendations for future research, and ultimately to derive policy implications.

Overall, with this project work, students demonstrate their ability to independently investigate the impact of mobility policies on individual behavior from problem definition, implementation, and assessment.
The grading is based on the written report (90%) and the final presentation (10%). The partial grade for the written results from 40% for the work in the first phase, 40% for the work in the second phase, and 20% for scientific conduct.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge of statistics, statistical programming, or machine learning is recommended, though not strictly required. A general interest in mobility poilcy would be beneficial for the design of the policy experiments.

Content:
This module focuses on using surveys, discrete choice experiments and econometric modeling to analyze mobility policies, e.g., congestion pricing, long-distance traveling policies, improved public transport systems, or introducing a new mode of transport. The module is organized in three parts: the first part introduces surveys and discrete choice experiments and teaches methods on how to conduct these in practice to obtain data. The second part focuses on building econometric choice models to analyze the collected data. The third part is about applications in mobility policy analysis. The module is structured in such a way that the methods taught in parts one and two can be understood and applied by students in other fields, e.g., health or international relations, too.

Intended Learning Outcomes:
This module introduces the students to the approaches of measuring and modeling the responses of (travel) behavior to (mobility) policies. The learning outcomes of this module allow also students from other fields to learn the methodological fundamentals and apply them to policy analyses in their field. The ultimate objective of this module is to enable students to understand and apply the tought approaches themselves. Upon successful completion of this module, students will be therefore able to ...
(1) ... outline and describe existing approaches in measurement and modeling [remembering, understanding],
(2) ... identify and conceptualize appropriate approaches given requirements from a (mobility) policy analysis question [remembering, creating],
(3) ... prepare, conduct, and analyze a survey and a discrete choice experiment [apply, creating],
(4) ... differentiate and discuss the strengths and weaknesses of approaches under different environments [analyzing],
(5) .. appraise policy insights, recommend policies from surveys and models, and identify limitations of chosen methods [evaluating],

(6)... present their work and results in a comprehensible, appropriate and scholarly manner as well as summarize this in a collected report.

Teaching and Learning Methods:
The module consists of a lecture and an exercise. The lecture introduces the students to the field discrete choice experiments and econometric modeling to analyze mobility policies. During the semester will develop and conduct their own survey with discrete choice experiment with subsequent analysis using econometric modeling of the choices.

Media:
presentations, statistical programming in R

Reading List:
Hensher, David A., John M. Rose, and William H. Greene. Applied Choice Analysis. Applied Choice Analysis. Cambridge: Cambridge University Press, 2015. https://doi.org/10.1007/9781316136232.
Rose, John M., and Michiel C.J. Bliemer. "Stated Choice Experimental Design Theory: The Who, the What and the Why." In Handbook of Choice Modelling, edited by Stephane Hess and Andrew Daly. Edward Elgar Publishing, 2014. https://doi.org/10.4337/9781781003152.00013.
Train, Kenneth E. Discrete Choice Methods with Simulation. Cambridge: Cambridge University Press, 2009.

Responsible for Module:
Loder, Allister; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86608) Understanding Human Decisions in Mobility and Beyond: Advanced Survey Design and Discrete Choice Modelling - Lecture (Vorlesung, 2 SWS)
Loder A (Beck F)

(SOT86608) Understanding Human Decisions in Mobility and Beyond: Advanced Survey Design and Discrete Choice Modelling - Exercise (Übung, 2 SWS)
Loder A, Beck F, Wessling V
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86611: Sustainability Politics and Policy | Sustainability Politics and Policy

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
The exam (100%) will consist of a portfolio of tasks that will relate to the different parts of the course which is co-taught by faculty teaching in the concentration area. The aim of this portfolio is to document the student’s major activities and accomplishments throughout the course.

The portfolio will include a presentation (about 30 min, 50%) in the context of which they will interact with their peers. This will help them reflect on their academic goals and their progress as learners as regards the defined course objectives (see below).

Building on their presentations as well as on their reflections on the discussions in the lectures, they will later compile a report (about 10 pages, 50%) that will document what they have proceeded to learn. In the report, students will demonstrate that they have acquired the defined competencies (see below) and will reflect on their learning process.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
This module introduces students to theoretical debates about sustainable development and links the concept of sustainable development to different economic, social, environmental, and health policy areas. The lecture in this module examines the goals of "sustainable development" and the concepts of inter- and intra-generational justice. The module includes a historical overview of the sustainability concept looking into competing definitions and understandings. It investigates key theoretical and methodological approaches to examine such issues as rising government debt,

growing global competition for innovation, and intensifying global environmental degradation and resource scarcity. The lecture considers how policies differ in their "sustainability profiles" and the economic, social and political factors which are responsible for this variance.

Intended Learning Outcomes:
Upon completion of this module, students will be able to understand the roles and contributions different scientific and technological solutions as well as different social and behavioural approaches can play in designing, implementing and monitoring sustainable solutions. They will also be able to understand how different sustainability areas (e.g. economic, financial, educational, research, health, family, pension, mobility, environmental and energy policy) are being governed on the local, national and international levels. They will be able to highlight the interdisciplinary dimensions of sustainability, to analyse complex sustainability problems, and to develop concrete solutions.

Teaching and Learning Methods:
The course will be given as one lecture and will employ fitting methods to deepen the content such as exercises, group work or a laboratory.

Media:
Media like presentations, exercises, scripts and other media

Reading List:
Bornemann, Basil/ Knappe, Henrike/ Nanz, Patrizia (Ed.) 2022: The Routledge Handbook of Democracy and Sustainability. London: Routledge, 431-446. (https://www.lehmanns.de/shop/technik/52507134-9780367109585-the-routledge-handbook-of-democracy-and-sustainability)

Wurster, Stefan 2013: Comparing ecological sustainability in autocracies and democracies, in: Contemporary Politics, 2013, Vol. 19, No.1, 76-93. (http://www.tandfonline.com/doi/abs/10.1080/13569775.2013.773204)
A reader of texts with up-to-date and cutting edge scienitific literature will be made available at the start of the semester.

Responsible for Module:
Wurster, Stefan; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
(SOT86611) Sustainability Politics and Policy (Vorlesung, 4 SWS)
Schreurs M (Mohammed N)
For further information in this module, please click campus.tum.de or here.

SOT60302: Media & the Public | Medien & Öffentlichkeit

SOT603021: 1 Credit Modules | 1 Credit Module

Module Description

CLA10718: Speech Training for University Life | Sprecherziehung für den Uni-Alltag

Version of module description: Gültig ab winterterm 2010/11

Module Level: Bachelor/Master	Language: German	Duration: one semester	Frequency: winter semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:** 15	**Contact Hours:** 15

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

Description of Examination Method:
Die Studierenden fertigen am Anschluss an die Veranstaltungen einen schriftlichen Erfahrungsbericht (3-5 Seiten) an, in dem sie die Lernziele des Workshops dokumentieren (Prüfungsleistung).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Die Stimme ist unser wichtigstes „Instrument" der Kommunikation. Die täglichen Anforderungen im Uni-Alltag könnten sein: langes und lautes Sprechen, die Notwendigkeit immer gut verstanden zu werden, eine Stimme, die einerseits durchdringend und tragfähig, andererseits interessant und angenehm für den Zuhörer sein soll. Und das soll alles nebenher funktionieren, ohne dass man sich darauf konzentrieren muss.
Aber wer kennt nach langem Reden z.B. bei Vorträgen nicht das kleine Kratzen im Hals, das Räuspern, die mangelnde stimmliche Belastbarkeit? Das Hantieren mit den eigenen Sprechwerkzeugen muss gelernt sein! Daher ist es ein absolutes Muss, diese präventiv zu pflegen und zu wissen, wie man mit der eigenen Stimme umzugehen hat.
Sie lernen worauf es beim deutlichen Sprechen ankommt und Sie üben klangvollen und lauten Stimmgebrauch. Darüber hinaus erfahren Sie, wie man durchs Sprechen seine Zuhörer

erreichen kann und welche Möglichkeiten es gibt, mit Lampenfieber umzugehen. Außerdem wird theoretisches Hintergrundwissen vermittelt, sowie Tipps zur stimmlichen Pflege gegeben. Die Inhalte werden in der Gruppe erarbeitet und an Texten erprobt.

Intended Learning Outcomes:
Nach erfolgreicher Teilnahme am Workshop wissen die Studierenden worauf es beim deutlichen Sprechen ankommt und wie sie einen klangvollen und lauten Stimmgebrauch bekommen. Die Studierenden sind in der Lage, Ihre eigenen Stärken und Schwächen zu benennen sowie ihre persönlichen Lernerfolge hinsichtlich Sprechstimme, Artikulation, Atmung und Körperpräsenz zu bewerten.

Teaching and Learning Methods:
Die Workshopinhalte werden praktisch anhand von Körper-, Atem- und Stimmübungen erfahrbar gemacht. Außerdem wird theoretisches Hintergrundwissen durch Präsentationen vermittelt.

Media:
Präsentationen

Reading List:
Allhoff, D. W., & Allhoff, W. (2021). Rhetorik & Kommunikation: Ein Lehr-und Übungsbuch. Ernst Reinhardt Verlag.
Lang, A., & Saatweber, M. (2010). Stimme und Atmung. In :. Schulz-Kirchner Verlag.
Pawlowski, K., & Riebensahm, H. (2005). Konstruktiv Gespräche führen. Fähigkeiten aktivieren, Ziele.

Responsible for Module:
Slanitz, Alfred; Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Sprecherziehung für den Uni-Alltag (Workshop, 1 SWS)
Molin V
For further information in this module, please click campus.tum.de or here.

SOT603023: 3 Credits Modules | 3 Credits Module

Module Description

SOT10138: Project Weeks: Media World and Media Use | Projektwochen: Medienwelt und Mediennutzung

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
Die im Rahmen des Seminars angestrebten Kompetenzen zur Projektarbeit, zur Reflektion und zur Präsentation werden über folgende Prüfungsleistungen erfasst:
Projektarbeit mit verschiedenen Teilleistungen:
Exposé Zukunftsentwurf (250-300 Wörter, 20%),
Gruppenpräsentation (10-15 Minuten plus Diskussion, 20%),
Interaktive Darstellung oder Poster Zukunftsentwurf (40%),
Kurzpräsentation (5 - 10 Minuten, 20%)

Repeat Examination:

(Recommended) Prerequisites:
Deutschkenntnisse

Content:
Das Modul setzt sich mit der Bedeutung verschiedener Medien für unsere Gesellschaft, mit der Reflexion der eigenen Mediennutzung und mit möglichen zukünftigen Medienwelten auseinander.
Wesentliche Aspekte hierbei sind:
- Einführung: Was sind Medien bzw. Massenmedien, welche Finanzierungsmodelle haben Medien, welche Herausforderungen stellen sich in unserer aktuellen Medienwelt, welche Vorstellungen existieren bereits über die Zukunft der Medienwelt?,
- Reflexion des eigenen Medienkonsums und Einordnung der Bedeutung verschiedener Medien,
- gesellschaftliche Funktionen von Medien kennen lernen,
- Entwickeln und Präsentieren eines eigenen Zukunftsentwurfs zur künftigen Medienwelt

Intended Learning Outcomes:
Nach erfolgreicher Teilnahme am Modul sind die Studierenden in der Lage:
- die Bedeutung von Medien für unsere Gesellschaften und unsere eigene Wahrnehmung einzuordnen
- sich selbst und ihr Medienverhalten zu reflektieren ebenso wie gesellschaftliche Funktionen und Rahmenbedingungen von Medien
- Zukunftsentwürfe zu ihren Vorstellungen einer künftigen möglichen Medienwelt zu entwickeln und gegenüber professionellen Kommunikatoren zu präsentieren
- disziplinübergreifend in Projekten zu arbeiten, deren Fragestellungen über einzelne Disziplinen herausreichen

Teaching and Learning Methods:
Projektbasiertes Lernen, Reflektion, aktive Mitgestaltung seitens der Studierenden, Team-Arbeit: Arbeit in heterogenen, disziplinübergreifenden Teams, Zusammenarbeit in Zweier- und Dreier-Teams, Diskussionen in größeren Gruppen

Media:
Moodle-Kurs, Beamer, verschiedene Medien zur Bearbeitung des Projektseminar-Themas

Reading List:
https://mpfs.de/studie/jim-studie-2024/, https://mpfs.de/studie/sim-studie-2024/

Responsible for Module:
Voß, Miriam; Dr. phil. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Medienwelt und Mediennutzung reflektieren (Seminar, 2 SWS)
Voß M [L], Voß M
For further information in this module, please click campus.tum.de or here.

SOT603024: 4 Credits Modules | 4 Credits Module

Module Description

ED0312: Science and Technology Communication at the Deutsches Museum | Wissenschafts- und Technikkommunikation im Deutschen Museum

Version of module description: Gültig ab summerterm 2025

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 90	**Contact Hours:** 30

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

Description of Examination Method:
Die Modulprüfung erfolgt in Form einer Projektarbeit (z.B. eines Kurzvideos, Magazin- oder Radiobeitrags oder wissenschaftlichen Posters), in der die Studierenden ein aktuelles Technikthema auf Objekte im Deutschen Museum beziehen, damit ihr Verständnis von Problemen und Möglichkeiten der Wissenschafts- und Technikkommunikation dokumentieren und die Fähigkeit zur prägnanten und zielgruppengerechten Darstellung komplexer Technikthemen unter Beweis stellen.
Die Projektarbeit umfasst (1) ein Exposee in Form einer Kurzpräsentation (5-10 Minuten), (2) die konkrete Realisierung eines Mediums zur Wissenschaftskommunikation (z.B. Poster, Video, Radiobeitrag) und (3) eine Reflexion über Herausforderungen und aktuelle Bezüge der konkreten Realisierung in Form einer Kurzpräsentation (5-10 Minuten) plus Diskussion (Gewichtung: 1:1:1). In den unterschiedlichen Teilen der Projektarbeit zeigen die Studierenden jeweils im Bezug auf unterschiedliche Zielgruppen, inwieweit sie Herausforderungen und Möglichkeiten der Wissenschafts- und Technikkommunikation verstanden haben und anwenden können.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
keine

Content:
Es gibt zahlreiche Möglichkeiten der Wissenschaftskommunikation. Welche spezifischen Möglichkeiten der Vermittlung gibt es in Technikmuseen? Wie kann man daran aktuelle

Technikdebatten anknüpfen? Wie lassen sich komplexe Sachverhalte in Form von Kurzvideos aufbereiten? Wie wird dabei die gesellschaftliche Relevanz wissenschaftlicher Themen dargestellt?

Intended Learning Outcomes:
Nach der Teilnahme an den Modulveranstaltungen sind die Studierenden in der Lage, Herausforderungen und Möglichkeiten der Wissenschafts- und Technikkommunikation zu verstehen und Techniken für eine effektive und zielgruppenorientierte Kommunikation anzuwenden.

Teaching and Learning Methods:
Das Modul besteht aus Vortrag und Präsentationen der Dozenten zu Formen, Herausforderungen und Möglichkeiten der Wissenschaftskommunikation und Vermittlungsformen im Technikmuseum, Einzel- und Gruppenarbeit zu praktischen Beispielen im Deutschen Museum und einer kritischen Diskussion zum Medium Kurzvideo.

Media:
PowerPoint, Filmausschnitte, Übungsaufgaben

Reading List:
Marc-Denis Weitze, Wolfgang Heckl: Wissenschaftskommunikation - Schlüsselideen, Akteure, Fallbeispiele, Springer 2015.

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Wissenschafts- und Technikkommunikation im Deutschen Museum (Seminar, 2 SWS)
Weitze M, Decker M
For further information in this module, please click campus.tum.de or here.

SOT603033: 3 Credits Modules | 3 Credits Module

Module Description

SOT53503: Applied Philosophy of AI: Public Dialog on Future Practices | Applied Philosophy of AI: Public Dialog on Future Practices

Version of module description: Gültig ab summerterm 2025

Module Level: Bachelor/Master	**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:
Students will engage with philosophical concepts through collaborative presentations and discussions, applying theoretical insights to real-world applications. The assessment consists of three components:

In-Class Presentations (40%)
Students will deliver a 25-minute group presentation analyzing philosophical texts and applying philosophical concepts to AI issues, and engage in the consequent discussion. Each student will be evaluated individually based on their contribution, analytical depth, didactic clarity, ability to answer questions, and engagement in the discussion.

Public Presentation (30%)
Building on feedback from the in-class presentation, students will adapt and refine their analysis for a second presentation and discussion in a new context involving non-academic audiences. These presentations will facilitate dialogue with professionals who incorporate AI into their work processes. Assessment will focus on how effectively students integrate feedback, contextualize philosophical concepts for different audiences, and engage with diverse perspectives.

Discussion Engagement (30%)
Students will actively participate in class discussions and prepare two structured responses (approximately 5–10 minutes each):
- Content-related questions that deepen understanding of presented material
- Constructive collegial feedback on peer presentations

This assessment structure evaluates students' ability to comprehend philosophical texts, apply theoretical frameworks to practical scenarios, communicate complex ideas clearly, and engage in meaningful intellectual exchange.

Repeat Examination:

(Recommended) Prerequisites:

Content:
- Concepts of the digital, data, text, information, models, digitization, and computation
- The relation of computation to interpretation, meaning, understanding, emotions, and lived experience
- Stochastic patterns in generative AI and their relationship to human language use
- Design and implementation of generative AI systems
- Types of meaning producible through computational processes
- Societal implications of AI influence
- Philosophical perspectives on the mind and AI
- Economic factors driving AI development
- Impact of AI on work
- Ethical challenges of AI development and deployment

Intended Learning Outcomes:
After completing the module, students will be able to:
- describe arguments from today’s philosophical discussions on (generative) AI#
- describe insights from classical philosophical discussions of pertinent topics
- delineate features of meaning, interpretation, and understanding, and their relation to stochastic patterns
- understand ways in which (generative) AI can influence human thought, emotion, and behavior
- discuss implications of the use of AI for business and society
- present philosophical thought to a public audience

Teaching and Learning Methods:
The seminar employs a progressive pedagogical approach that prepares students to engage with AI professionals while developing critical philosophical perspectives. Through a combination of theoretical exploration and practical application, students will:
Methodological Framework
- Conceptual Analysis:#Examine core philosophical ideas and their implications for AI integration
- Hermeneutic Textual Engagement:#Interpret primary texts to extract relevant insights for contemporary AI challenges
- Collaborative Inquiry:#Participate in structured group work to develop multifaceted perspectives

Applied Learning Components

- In-Class Practice Presentations:#Deliver initial analysis in a supportive academic environment
- Comprehensive Feedback Process:#Receive structured critique from peers and instructors
- Professional Engagement:#Present refined arguments to AI industry professionals, facilitating authentic dialogue between philosophical theory and practical application

The seminar bridges academic philosophy with real-world technological developments through a scaffolded learning experience. Students first develop and refine their ideas within the classroom community before engaging with AI practitioners, allowing them to effectively communicate philosophical insights to audiences beyond academia while gaining valuable perspectives on how theoretical concerns manifest in professional contexts.

Media:
Online reader

Reading List:
Bisk, Yonatan, Ari Holtzman, Jesse Thomason, Jacob Andreas, Yoshua Bengio, Joyce Chai, Mirella Lapata, et al. 2020. “Experience Grounds Language.” arXiv. http://arxiv.org/abs/2004.10151.

Durt, Christoph, and Thomas Fuchs. 2024. “Large Language Models and the Patterns of Human Language Use.” In Phenomenologies of the Digital Age, by Marco Cavallaro and Nicolas De Warren, 1st ed., 106–21. New York: Routledge. https://doi.org/10.4324/9781003312284-7.

Manning, Christopher D. 2022. “Human Language Understanding & Reasoning.” Daedalus 151 (2): 127–38. https://doi.org/10.1162/daed_a_01905.

Stuart, Susan Aj. 2024. “Why Language Clouds Our Ascription of Understanding, Intention and Consciousness.” Phenomenology and the Cognitive Sciences, March. https://doi.org/10.1007/s11097-024-09970-1.

Responsible for Module:
Please open Export to see the person responsible for the module

Courses (Type of course, Weekly hours per semester), Instructor:
Philosophy of AI Meets Business AI (Seminar, 2 SWS)
Durt C
For further information in this module, please click campus.tum.de or here.

SOT603043: 3 Credits Modules | 3 Credit Module

Module Description

SOT53504: Responsible Quantum Computing | Responsible Quantum Computing [RQC]

Socio-technical Perspectives on Innovation and Responsibility in Quantum Computing

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
Students submit a concept of approximately 2000 words, in which they independently develop a workshop on responsible quantum computing for schools or adult education facilities. With this assignment, students demonstrate that they are able to apply theoretical knowledge to the practical design of outreach workshops, integrate different perspectives on responsible quantum computing, and link them to relevant theoretical frameworks. In doing so, they show their ability to critically assess the societal implications of responsible quantum computing and to translate academic insights into accessible learning formats.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
There are no specific prerequisites for participation in this module. Basic knowledge of technology, sociology, or innovation research is advantageous. A strong interest in interdisciplinary perspectives on technology and society is recommended, as the module combines various methodological and theoretical approaches.

Content:
The module focuses on analyzing regional innovation cultures and the associated socio-technical challenges. Students examine how responsibility is embedded in technological development and identify key influencing factors. Using selected case studies from science, politics, and industry, they explore different strategies for fostering responsible innovation. Additionally, methodological

approaches from STS research and ethnographic fieldwork are practically applied to contemporary developments in quantum computing.

Intended Learning Outcomes:
Upon successful completion of this module, students will be able to systematically analyze and compare regional innovation cultures in quantum computing. They will evaluate how innovation processes in this field are co-produced and critically assess their impact on societal and economic contexts. Additionally, students will acquire knowledge of planning outreach workshops and apply their theoretical knowledge in designing a workshop on responsible quantum computing for schools or adult education facilities. In doing so, they will be able to integrate different perspectives on responsible quantum computing and link them to theoretical frameworks.

Teaching and Learning Methods:
This module employs a combination of teaching and learning methods to create an interactive and practice-oriented learning environment. In addition to traditional lectures that introduce fundamental concepts, seminar discussions encourage students to actively engage with the content. Possible excursions to quantum computing laboratories provide direct insights into technological developments and their applications. Group projects enable students to independently analyze case studies in teams and critically reflect on them, while the use of ethnographic methods supports structured scientific investigations. Students actively participate in seminar discussions to engage with theoretical and practical aspects of the subject.

Media:
A variety of media formats support the learning process. Lecture scripts and scientific articles serve as the foundation for in-depth engagement with the module topics. Online discussion forums provide a platform for continuous student exchange and collaborative reflection on seminar content.

Reading List:
Coenen, C., & Grunwald, A. (2017). Responsible Research and Innovation (RRI) in Quantum Technology. Springer Science+Business Media, 19, 277–294. https://doi.org/10.1007/s10676-017-9432-6
Faullimmel, N. (2020). Responsible Research and Innovation in Quantum Technologies. Engineering and Physical Sciences Research Council (EPSRC).
Gibney, E. (2019). The Quantum Gold Rush. Nature, 574, 22–24.
Glickman, S. (2022). The History of Technoscientific Promises and the Promises of Technoscientific History. EASST Review, 41 (2). https://www.easst.net/article/the-history-oftechnoscientific-promises-and-the-promises-of-technoscientific-history/
Hilgartner, S. (2015). Capturing the Imaginary. Vanguards, Visions and the Synthetic Biology Revolution. In Science and Democrary (1. Aufl., S. 33–55). Routledge.
Hilgartner, S., Miller, C., & Hagendijk, R. (2015). Science and Democracy (1. Aufl.). Routledge. https://doi.org/10.4324/9780203564370
Inglesant, P., Hartswood, M., & Jirotka, M. (2016). Thinking Ahead to a World with Quantum Computers The Landscape of Responsible Research and Innovation in Quantum Computing.

Networked Quantum Information Technologies (NQIT); UK Quantum Technologies Programme; University of Oxford.
Jasanoff, S. (2004). The Idiom of Co-Production. In States of Knowledge. The Co-Production of Science and Social Order.
Roberson, T. (2023). Talking About Responsible Quantum: “Awareness Is the Absolute Minimum that … We Need to Do”. Nanoethics, 17(2). https://doi.org/10.1007/s11569-023-00437-2
Robertson, T., Leach, J., & Raman, S. (2021). Talking about Public Good for the Second Quantum Revolution: Analysing Quantum Technology Narratives in the Context of National Strategies. Quantum Science and Technology, 6, 1–8. https://hbr.org/2022/01/quantum-computing-for-business-leaders
Seskir, Z. C., Korkmaz, R., & Aydinoglu, A. U. (2022). The Landscape of the Quantum Start-Up Ecosystem. EPJ Quantum Technology. https://doi.org/10.1140/epjqt/s40507-022-00146-x
Smith III, F. L. (2020). Quantum Technology Hype and National Security. Security Dialogue, 51(5), 499–516.
Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a Framework for Responsible Innovation. Research Policy, 42, 1568–1580. http://dx.doi.org/10.1016/j.respol.2013.05.008
Ten Holter, C., Inglesant, P., & Jirotka, M. (2021). Reading the Road: Challenges and Opportunities on the Path to Responsible Innovation in Quantum Computing. Routledge, 1–13. https://doi.org/10.1080/09537325.2021.1988070
Ten Holter, C., Inglesant, P., Srivastava, R., & Jirotka, M. (2022). Bridging the Quantum Divides: A Chance to Repair Classic(al) Mistakes? Quantum Science and Technology, 7, 1–5. https://doi.org/10.1088/2058-9565/ac8db6

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:
Responsible Quantum Computing (Seminar, 2 SWS)
Stein J
For further information in this module, please click campus.tum.de or here.

Module Description

SOT63306: Project: Ethics of Responsibility in the Field of Interdisciplinary Research Activities | Projekt: Verantwortungsethik im Bereich interdisziplinärer Forschungsaktivitäten

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor/Master	**Language:** German/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:
Within the scope of a project work the examination will take the form of various interrelated exercise performances in which the students demonstrate their ability to analyze and evaluate social challenges and ethical conflicts inside of the case, to develop a problem-solving strategy, and to present their findings in a clear and concise manner: (1) presentation on problem identification (15 minutes / 25% of exam grade), (2) presentation on problem-solving strategies (15 minutes / 25% of exam grade) and (3) an individual reflection report on learning outcomes (800 – 1000 words / 50 % of exam grade) by analyzing and summarizing the process of the realization of knowledge in a structured and comprehensible manner.

Repeat Examination:

(Recommended) Prerequisites:

Content:
This module imparts knowledge in the following fields:
- complexity of interdisciplinary research projects with different coping strategies in an inter- and transdisciplinary perspective;
- insight into different normative conflicts, their ethical implications in the science of technologies, their special questions, problems, and strategies of ethical problem-solving;
- the analysis of case studies and specific current projects, and arising normative conflicts and social challenges caused by technology (e.g. environment, ecosystem, interrelationship between nature and culture, etc.);
- strategies for ethical problem-solving in specific fields of technology and sciences.

Intended Learning Outcomes:
Upon successful completion of this module, students are able to:
- identify different research perspectives of different disciplines, their abilities, opportunities and limitations.
- understand the complexity of research in the interrelationship of humans, nature and technology in an inter- and transdisciplinary perspective.
- identify specific normative conflicts in selected fields of techno- and / or natural sciences and society (e.g. scientific research and technological innovation vs. normative (e.g. ethical) acceptance in society in the field of different case studies).
- analyze normative conflicts and their potential ethical implications.
- evaluate these conflicts ethically and apply them to specific current projects
- develop a problem-solving strategy for a particular interdisciplinary project (e.g. different managing strategies, ethics commission within non-human and human centered)
- present their findings in a clear and concise manner

Teaching and Learning Methods:
We constructed this course series in order to support you to find your personal approach towards the big questions of our time. The recent developments in science and technology calls for an interdisciplinary discourse and the need for ethical guidelines within the ethical subdomains. In order to develop communication strategies, we use traditional definitions and methods from the different domains and find new ways of translation for the discourse. During each teaching session we invite you to choose among a bid variety of case studies in order to trigger your personal dilemma.
Research input of different disciplines (by lecturers) and studying key literature familiarize students with different perspectives of scientific disciplines, their opportunities and the possibilities of an interdisciplinary approach. Discussing case studies and other sources (e.g. historical or regional documents) trains students to identify the interdisciplinary challenges (knowledge), evaluate relevant issues and ethical conflicts caused by technological development, and to develop strategies of problem-solving and interdisciplinary research approaches. By being immersed in a concrete technology project and its implementation, students learn how to address research, normative and ethical conflicts, and to implement different concepts of decision-making and problem-solving. Presenting and discussing their work trains students to structure their arguments in a concise manner and defending their own findings and positions in academic debate.

Media:
Readings, presentation, discussion

Reading List:
Allhoff, Fritz, What Are Applied Ethics? http://files.allhoff.org/research/What_Are_Applied_Ethics.pdf
Archie, Lee; G. Archie, John, Introduction to Ethical Studies. An Open Source Reader, https://philosophy.lander.edu/ethics/ethicsbook.pdf
Deigh, John, An Introduction to Ethics, http://dx.doi.org/10.1017/CBO9780511750519.002

Felt, Ulrike: Responsible Research and Innovation, July 2017; file:///C:/Users/49173/Downloads/RRIGenomePreprint_2017.pdf.
Resnik, David B.: The Ethics of Science. An Introduction, // http://library.mibckerala.org/lms_frame/eBook/Resnik%20-%20The%20Ethics%20of%20Science%20(Routledge).pdf).
Singer, Peter: Ethics, in: Encyclopaedia Britannica, Chicago, 1985, pp. 627 – 648, (https://www.britannica.com/topic/ethics-philosophy, download 04.04.2022).
Van den Hoven, J. (et al.) (Eds.): Responsible Research and Innovation Actions in Science Education, Gender and Ethics. Cases and Experiences, New York (Springer) 2014.

Responsible for Module:
Slanitz, Alfred; Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Projektwoche: Verantwortungsethik im Bereich interdisziplinärer Forschungsaktivitäten (Seminar, 3 SWS)
Sandmann E
For further information in this module, please click campus.tum.de or here.

SOT603052: 2 Credits Modules | 2 Credits Module

Module Description

SOT62501: Stories and Histories. Experience Literature in Its Historical Context. | Geschichte und Geschichten. Literatur im historischen Kontext erleben

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor/Master	**Language:** German/English	**Duration:** one semester	**Frequency:** irregularly
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 22	**Contact Hours:** 38

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

Description of Examination Method:
Das Modul wird mit einem literarischen Text (800-1200 Wörter) abgeschlossen, in dem die Studierenden zeigen, dass sie philosophische, politische, soziale oder persönliche Fragestellungen im Kontext historischer Konstellationen in narrativer Form thematisieren können. Grundlage für die Erstellung des Textes ist eine fundierte Recherche, deren Vorgehensweise und Ergebnisse in einem Kurzreferat (13-17 Minuten) nachvollziehbar dargestellt werden.

Repeat Examination:

(Recommended) Prerequisites:

Content:
Der Workshop beschäftigt sich mit historischen Persönlichkeiten, Ereignissen oder Konstellationen auf Grundlage von historischen Quellen und literarischen Texten. Dadurch wird einerseits Geschichte in Geschichten lebendig, andererseits im kreativen Schreiben neue Reflexions- und Orientierungspotentiale erfahren. Der Blick auf historische Kontexte durch die persönliche Brille ermöglicht durch die individuelle Erfahrung des anderen eigene Positionen, Rollen und Wünsche zu hinterfragen.

Intended Learning Outcomes:
Die Studierenden sind in der Lage, unterschiedliche Materialien im Hinblick auf ihre Eignung als Quellen zu bewerten und im Hinblick auf exemplarische Fragestellungen zu interpretieren sowie

diese Quellen in einem literarischen Text (Kurzgeschichte, Brief, Song etc.) zur Vermittlung einer philosophischen, politischen, sozialen oder persönlichen Fragestellung adäquat einzusetzen. Darüber hinaus sind die Teilnehmenden in der Lage, durch sachbezogene Fragen und konstruktives Feedback Recherche- und Gestaltungsprozesse zu unterstützen.

Teaching and Learning Methods:
Im Workshop wird sowohl historische Quellenarbeit praktiziert als auch die Reflexion mittels literarischer Schreibprojekte geübt. Ein Rechercheprojekt, dessen Vorgehensweise und Ergebnisse in einer Kurzpräsentation vorgestellt werden, bildet die Grundlage für einen kurzen literarischen Text, der im Kurs besprochen wird.
Geführter Rundgang in Ausstellungen und Archiven, Lektüre von literarischen Texten, Recherche und Interpretation von Quellenmaterial, Übungen zum kreativen Schreiben, Feedbackgespräche.

Media:
Vortrag, Reader, Ausstellungen, historische Quellen inkl. Film- und Fotomaterial

Reading List:
Leonie Schöler: Beklaute Frauen. Denkerinnen, Forscherinnen, Pionierinnen: Die unsichtbaren Heldinnen der Geschichte, München 2024.
Stefan Zweig: Sternstunden der Menschheit. Vierzehn Miniaturen, Fischer TB oder Reclam UB u.v.a. (erstmals Leipzig 1927).

Responsible for Module:
Slanitz, Alfred; Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Geschichte und Geschichten: Erika Mann – ein „kühnes Kind“ ihrer Zeit? (Workshop, 1,5 SWS)
Rehn H
For further information in this module, please click campus.tum.de or here.

SOT603053: 3 Credits Modules | 3 Credits Module

Module Description

SOT63502: Arts & Technology. A Practice-oriented Introduction to Applied Cultural Studies | Arts & Technology. Eine praxisnahe Einführung in angewandte Kulturwissenschaften

Version of module description: Gültig ab winterterm 2025/26

Module Level: Bachelor/Master	**Language:** German/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:
Das Modul schließt mit einer Prüfungsleistung in Form (1) eines Kurzreferats zu einem Kunstwerk (10-15 Minuten plus Fragen) sowie (2) in der mündlichen oder schriftlichen Präsentation (10-15 Minuten oder 2 DIN A 4 Seiten inkl. Bildmaterial) eines Konzepts zur medialen Vermittlung eines Zusammenhangs im Kontext von Kunst und Technologie. In (1) zeigen die Studierenden, dass sie ein Kunstwerk verständlich beschreiben und in ausgewählten Aspekten nachvollziehbar interpretieren können. Mit (2) demonstrieren die Studierenden, dass sie in der Lage sind, in einer konkreten medialen Vermittlungssituation exemplarische Aspekte der Begegnung von Kunst und Technologie auszudrücken (z.B. Posterpräsentation zum Einsatz von VR-Technik in einem Theaterprojekt oder Entwurf eines Beitrags zu einer virtuellen Ausstellung). Details zu Vorgaben für die konkrete Ausgestaltung werden in der Lehrveranstaltung kommuniziert.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Für Kunst und Technik verwendeten die alten Griechen ein und dasselbe Wort. Wo begegnen sich Kunst und Technik heute? Wie verstehen und verwenden Kunstschaffende neue Technologien? Als Erweiterung der Werkzeugtasche, als herausforderndes Thema oder als existentielle Bedrohung menschlicher Kreativität? Und welche Rolle spielen künstlerische Sicht- und Herangehensweisen für die Gestaltung neuer Technik? Mit diesen Fragen beschäftigt sich der

praxisorientierte Workshop sowohl in der Auseinandersetzung mit Kunstwerken als auch im Gespräch mit KünstlerInnen, KulturmanagerInnen und KulturwissenschaftlerInnen.
Die Lehrveranstaltungen führen in künstlerische Werke ein, erproben deren Interpretation im zeitgeschichtlichen und kunsthistorischen Kontext, fördern den Austausch in multidisziplinär zusammengesetzten Gruppen und ermutigen zur eigenständigen orientierenden Reflexion, z.B. über:
• Mensch und Natur: von Mutter Erde zum Metaversum
• Mensch und Maschine: von Prometheus zum Cyborg
• Entmystifizierende Maschinenästhetik vs. fetischistische High Tech Kultur

Intended Learning Outcomes:
Nach Absolvieren des Moduls sind die Studierenden in der Lage, ausgewählte Kunstwerke zu beschreiben und im Hinblick auf deren technologische Aspekte zu interpretieren. Darüber hinaus können sie Bezüge zu aktuellen Diskursen und/oder persönlichen Erfahrungen und Erwartungen herstellen und ein mediales Konzept zur exemplarischen Vermittlung dieser Bezüge entwerfen.

Teaching and Learning Methods:
Durch gezielten Input exemplarischer wissenschaftlicher Methoden und deren Anwendung an konkreten Kunstwerken üben die Studierenden Beobachtung, Beschreibung und Interpretation. Durch Lektüre, Ausstellungsbesuche und Gespräche mit KünstlerInnen und KuratorInnen wird sowohl Kontextwissen erworben als auch die Basis für die eigenständige Reflexion und Vermittlung von Kunst-Erlebnissen geschaffen. Dadurch werden die Studierenden in die Lage versetzt ihre disziplinären oder persönlichen Kompetenzen praxisorientiert einzubringen.

Media:
Präsentationen, Reader, Ausstellungen, Videos

Reading List:
R.L.Rutsky: High technē: art and technology from the machine aesthetic to the posthuman, Minneapolis 1999

Responsible for Module:
Slanitz, Alfred; Dr. phil.

Courses (Type of course, Weekly hours per semester), Instructor:
Von Pixeln und Gärten – die digitale Kunst von Miguel Chevalier in der Kunsthalle München (Workshop, 2 SWS)
Gierling J
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:

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

Module Description

WZ1978: Green Chemistry | Green Chemistry

Version of module description: Gültig ab winterterm 2021/22

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

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

Description of Examination Method:
The achievement of the learning outcomes will be tested in a written exam and in a seminar. The students are expected to be able to reproduce the course contents correctly and transfer them to different contexts in written form.
The written exam has a duration of 90 minutes. Aids are not permitted. In addition, the contents of the course will be enhanced in a seminar. The proportion of the written exam to the module grade is 80 %. In the seminar, students analyze selected case studies from current literature in the context of Green Chemistry with respect to their sustainability and present these to their co-students and instructor in an oral presentation with short discussion and a brief written composition. The proportion of the seminar grade to the module grade is 20 %.

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:

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

Bachelor's Thesis | Bachelor's Thesis

Module Description

CS0205: Bachelor's Thesis | Bachelor's Thesis

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:** 360	**Contact Hours:** 0

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

Description of Examination Method:
The Bachelor's Thesis is a final paper with a duration of 3 months, where the students concentrate on a specific topic in business administration and economics. Here the students frame the state of research and discourse and evolves the own specific topic. Based on scientific knowledge and methodical skills, students autonomously discribe the topic. The Bachelor's Thesis is supported by a professor of the TUM School of Management.

Repeat Examination:
Next 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:
The Bachelor's Thesis focuses on a research topic in business adminstration and economics, usually at the interface to engineering and natural sciences. The Thesis is always supervised by a professor of TUM School of Management, often in co-operation with an organization of industry or research. The topic of the Thesis is created so that it can be treated extensively within three months.

Intended Learning Outcomes:
At the end of the module "Bachelor's Thesis" students are able to handle and develop a project in an autonomic, systematic and scientific way. Therefore the students deploys scientific knowledge and methodical skills to the specific subject. They script the state-of-the-art knowledge, based on

research, and classify the findings within the scientific and/or practical discussion. The students are able to cope with new and complex subjects in an autonomous way.

Teaching and Learning Methods:
The creation of the thesis encourages the students to deal soundly with a scientific subject. Therefor they apply the knowledge and methodical skills, acquired during the studies, and create an elaborated scientific documentation within the set time frame.

Media:
Literature, presentations

Reading List:
specific literature based on the topic

Responsible for Module:
Prof. Alexander Hübner

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

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

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