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

Module Catalog

M.Sc. Biomass Technology

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

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

Module Catalog: General Information and Notes to the Reader

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

Notes to the reader:

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

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

Elective modules
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Electives Category 1 | Wahlmodule Kategorie 1

Module Description

CS0295: Principles of Life Cycle Assessment | Principles of Life Cycle Assessment

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
none

Content:
The module contains units covering the following topics:
• Principles of life cycle thinking
• LCA following the ISO 14040/14044 and ILCD standards
• Selected Life Cycle Impact Assessment Methods such as for
- Climate Change
- Land use and land use change
- Water use
- Resource use
• Attributional and consequential assessments
• Principles of Multi Criteria Decision Analysis (MCDA)
• Presentation and visualization of results
• Handling of data uncertainty

• Current trends and developments
• Software systems and data bases for material flow analysis and life cycle assessment
• Case study

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

Teaching and Learning Methods:
Format: lecture and exercises to introduce the content, to repeat and deepen the understanding as well as practice based on a simple case study.
Teaching / learning methods:
- Media-assisted presentations
- Group work / individual case study
- Computer lab exercises using LCA software systems and Life Cycle Inventory data bases.

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

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

Responsible for Module:
Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Principles of Life Cycle Assessment (Exercise) (Übung, 2 SWS)
Röder H [L], Füchsl S, Röder H

Principles of Life Cycle Assessment (Lecture) (Vorlesung, 2 SWS)
Röder H [L], Füchsl S, Röder H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0254: Introduction to Management of Renewable Resources | Introduction to Management of Renewable Resources

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination is a written exam (120 minutes). The students demonstrate that, within a limited time and without tools, the economic relationships involved in the use of renewable raw materials have been understood and can be analyzed and further developed in connection with individual company activities. The exam also examines the extent to which the students can characterize the various markets for renewable raw materials and show possible solutions for material and energetic use.

The lecture and exercise "Economics of Renewable Resources" accounts for 65% and the lecture "Markets for Renewable Resources" for 35% of the overall grade.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The lecture is divided into 3 parts. Although these are independent of each other in terms of content, they address different facets of the economy of renewable resources.

1. Lecture Economics of Renewable Resources
Introduction to the basics of economics using selected conversion paths based on renewable raw materials, from location decisions to procurement and logistics, production, inter-company connections to external reporting.

2. Lecture Markets of Renewable Resources

Presentation of different markets for renewable raw materials. These are divided into material use (bio-lubricants, materials, base chemicals and fine chemicals) and energetic use (heat, electricity and mobility).

3. Exercise Economics of Renewable Resources
The content of the lecture is to analyze and critically evaluate the economics of renewable resources using case studies, so that the participants can independently develop the content further based on the content of the lecture.

Intended Learning Outcomes:
After completion of the module, the students can apply the economic principles of using renewable raw materials in a differentiated manner and analyze and evaluate the economics using case studies from individual companies. Furthermore, they are able to critically assess the business and market relationships in the utilization of renewable raw materials and to include current developments. In addition, the students can assess and compare the different forms of marketing and market sizes of renewable raw materials.

Teaching and Learning Methods:
Lecture; discussions; case studies
With the help of the lectures and exercises, all sub-areas of the module are presented. With the help of this method, the extensive volume of material can be communicated in the best way. In the discussions, the students learn to integrate different perspectives and to correctly classify and critically assess the module content.

Media:
Presentations, script, case studies

Reading List:
Wacker, H., Blank, J. E.: Ressourcenökonomie, Bd. 2 Einführung in die Theorie erschöpfbarer natürlicher Ressourcen, München, Oldenbourg Verlag, 1999.;
KALTSCHMITT, M. und H. HARTMANN (Hrsg.): Energie aus Biomasse. Grundlagen, Techniken und Verfahren. Springer Berlin, 2009;
Vahs, D., Schäfer-Kunz, J.: Einführung in die Betriebswirtschaftslehre. Schäffer-Poeschel Verlag Stuttgart. 2012

Responsible for Module:
Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Management of Renewable Resources (Exercise) (Übung, 1 SWS)
Brunner J, Röder H

Overview Markets of Renewable Resources (Lecture) (Vorlesung, 1,5 SWS)
Decker T

Management of Renewable Resources (Lecture) (Vorlesung, 1,5 SWS)
Röder H [L], Röder H
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

CS0136: Energetic Use of Biomass and Residuals | Energetic Use of Biomass and Residuals [EBR]

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics, Energy Process Engineering

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

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

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

Media:
Presentation, script, examples, excursion

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

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

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

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

Module Description

CS0014BOK: BOKU: Post-harvest Technology | BOKU: Post-harvest Technology

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 75	**Self-study Hours:** 45	**Contact Hours:** 30

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

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

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Importance of post-harvest technology for the food chain
Biological and physical principles of post harvest technology
Selected post harvest technologies in agriculture:
Treatment of seed (drying, cleaning, sieving,?)
Alternative methods of seed treatments (warm-humid, microwave, high frequency energy)
Drying technology (principles and application; Ddying of agricultural products)
Crop conservation with silage making (principles and processes)
Storage of crops (potato, fruit, vegetable,?); Principles and applications
Special post-harvest technologies in horticulture and viticulture

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

Qualification for systematic analyses of post harvest technology

Qualification for planning of post harvest technology

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

Teaching and Learning Methods:
interactive lecture

Media:
Lecture, simulation software, presentations

Reading List:
PDF-files of the content are accessible via BOKU learn after login
Additional information will be made available via BOKU learn.
Recommended books will be discussed in the lecture

Responsible for Module:
Viktoria Motsch viktoria.motsch@boku.ac.at Andreas Gronauer Andreas.gronauer@boku.ac.at

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

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

Module Description

CS0015BOK: BOKU: Gender, Food Systems and Natural Resources | BOKU: Gender, Food Systems and Natural Resources

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

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

Description of Examination Method:
50% written annotated bibliography (individual grade) 50% presentation/podcast (graded as group work) Both components must be passed in order to pass the course. Students are expected to attend every session. For successful completion of the course attendance of at least 80% of lectures is required.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Interest in the topics relating to this course. Students from a diversity of disciplines and backgrounds are invited to join.

Content:
This course critically assesses how the use, management and knowledge of land, water and the wider ecology is gendered. While women's importance as users, guardians and managers of natural resources and their roles in enabling family food and nutrition security are highlighted globally, the rights to land, water and trees, as well as access to other resources, infrastructure and services, are vested in men. In this course we aim to understand these contradictions, and their implications in different farming systems, practices and socio-political contexts. We will investigate the theory, policy and practice of gender in the governance of food systems and natural resources; and analyse the shortcomings of attempts to integrate women into development programmes. This course will further introduce alternative rights-based approaches to food systems and natural resources, such as food sovereignty, food justice and the right to food, from the perspective of social movements and civil society. In order to achieve a more sustainable use of natural resources it is crucial to understand how and by whom they are used, managed and governed and what are the challenges and barriers, but also the opportunities for different actors. In order

to leverage a transformation toward food and nutrition security for all, a societal transformation is urgently required and more attention has to be paid to underlying structural power dynamics and inequalities among the actors involved. We will assess relevant Sustainable Development Goals (e.g., SDG2, SDG5, SDG12) and the role they play in these processes. To enable students to analyse and/or undertake research on people-nature-food linkages, we will explore conceptual frameworks, analytical insights and methodological tools stemming from different approaches to addressing gender. These frameworks will be based on thematic case studies that will provide deeper insights into different geographic, socio-economic and socio-cultural contexts.

Intended Learning Outcomes:
On completion of this course, students will be able to:
1. Understand meanings and interpretations of gender in theory, policy and practice, and how these impact on the development and governance of food systems and natural resources.
2. Assess how structural inequality and different forms of violence undermine diverse rights of people, with a focus on how this relates to the sustainability of natural resources.
3. Explore how social movements and civil society challenge the dominant agri-food system, focusing in particular on the concept and practice of food sovereignty, food justice and the right to food.
4. Critically assess diverse research approaches and methodologies and the positionality of researchers as well as ethical implications of research.
Students will gain key competences in:
- scientific reading and writing, working with academic literature through guided reading, presenting and discussing readings in class, writing an annotated bibliography (as part of the assessment, 50%)
- media-supported presentation skills, producing a podcast
- team work capacity
- facilitation skills, through active participation in different interactive formats (e.g., World Café, Fishbowl discussion) and online facilitation
- discussions and plenary debate
- peer review: receiving and providing guided feedback

Teaching and Learning Methods:
Learning will be facilitated through a variety of methods which may include lectures, seminars, workshops, presentations by guest speakers, group work and online activities. Students are expected to engage in both class and online activities and discussions. This course also requires students to participate in guided reading and self-directed study to support the learning gained from timetabled sessions. Required and optional readings will be uploaded in advance on BOKUlearn. The emphasis is on student participation and fostering dialogue and debate. Students should feel able to explore and develop their understanding of key concepts introduced in the sessions through discussions in a supportive but challenging environment. Each session will consist of lectures, interactive group activities and/or guest speakers. Case studies presented by guest speakers from academia and civil society, based on research, project and advocacy work, will enable students to gain insights into the social, political, economic and cultural conditions of development and practice in various regions of the world. Through in-class discussions and guided

learning activities, such as peer-review, students will receive continuous feedback, giving an early indication of progress towards the intended learning outcomes.

Media:

Reading List:
Doss, C., Meinzen-Dick, R.S. (2020). Land tenure security for women: A conceptual framework. Land Use Policy 99, 105080. Doi:

Portman, A. (2018). Food Sovereignty and Gender Justice. Journal of Agricultural and Environmental Ethics (2018) 31:455–466. https://doi.org/10.1007/s10806-018-9739-2 Titel anhand dieser DOI in Citavi-Projekt übernehmen

Right to Food and Nutrition Watch (2019). Women's Power in Food Struggles, Issue 11, October, Global Network for the Right to Food and Nutrition. Heidelberg/Berlin: Brot für die Welt & FIAN International.

Tsikata, D., Yaro, J.A. (2013). When a good business model is not enough: land transactions and gendered livelihood prospects in rural Ghana. Feminist Economics, http://dx.doi.org/10.1080/13545701.2013.866261 Titel anhand dieser DOI in Citavi-Projekt übernehmen.

Further required and optional readings will be made available on Moodle

Responsible for Module:
Stefanie Lemke Stefanie.lemke@boku.ac.at

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

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

Module Description

CS0016BOK: BOKU: Aspects of Product Quality in Plant Production | BOKU: Aspects of Product Quality in Plant Production

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**Total Hours:** 100	**Self-study Hours:** 55	**Contact Hours:** 45

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

Description of Examination Method:
Written
Student Seminar Presentation + Seminar Paper

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic knowledge of plant cultivation, plant breeding and chemistry

Content:
General Section:
- Criteria of crop product quality
- Crop composition (proteins, oils, carbohydrates, fibres, vitamins, toxic components etc.)
- Analytical methods for crop quality determination

Section on Breeding for Quality Characters:
- Genetics of quality characters and quality breeding goals
- Wheat and rye (bread making quality)
- Malting barley, durum wheat and other special-use-cereals
- Oilseed rape and sunflower (oil content, fatty acid profile, ANF´s etc.)
- Soybean (protein and oil content, protein quality, trypsin inhibitor content)
- Fibre crops (fibre content and fibre quality)
- Starch- and carbohydrate-crops

Section on Agronomy:
- Environmental implications of crop quality

- Influence of agronomic treatments and cultivation techniques on crop quality

Practical Section:
- Introduction to NIRS (near-infrared reflectance spectroscopy)
- Breadmaking quality (baking tests, mini-extensograms, dough hardness, dough stickiness, ...)
- Rapid screening methods (tests for Kunitz trypsin inhibitor and for linolenic acid)
- Molecular genetic methods of quality analysis (protein- and DNA-markers)

Processing of crops
- Examples from the food/non-food industries (sugar, oil)

Intended Learning Outcomes:
Understanding the complex of product quality of harvest products. Integrating the effects of agronomy, genotype, environment on crop quality and harvest product utilisation. Experiencing important analytical screening methods used for determination of product quality.

Teaching and Learning Methods:
Lecture, student seminars, laboratory exercises, excursions

Media:

Reading List:
Presentation files are available

Responsible for Module:
Heinrich Grausgruber Heinrich.grausgruber@boku.ac.at

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

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

Module Description

CS0017BOK: BOKU: Plant and Environment | BOKU: Plant and Environment

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Written
written exam, 10 questions, mostly one per chapter, the overall grade results from the sum of the marks for individual questions, (max 11). Points/ grades: <5 points: 5, ≥5: 4, ≥6.5: 3, ≥8: 2, ≥9.5: 1

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Introduction - stress, temperature - energy balance, light - quality and quantity, water and drought, flooding and oxygen deficiency, salt, heavy metals and phytoremediation, nitrogen and the N cycle, CO2 and the global carbon cycle; herbivores, pathogenes and defence; genetically modified crops; invasive plants, ecosystem services

Intended Learning Outcomes:
Participants have theoretical and practical knowledge about the interactions between plants and their environment, how different environmental factors affect plants, plant adaptations to and also how plants affect their environment. They understand important local and global cycles. The knowledge establishes a basis for working on applied botanical and ecological problems.

Teaching and Learning Methods:

Media:

Reading List:
script and presentations will be made available via moodle
recommended books:
Schulze et al. Plant Ecology, Springer 2005
Larcher: Physiological Plant Ecology, Springer 2002

Responsible for Module:
Peter Hietz peter.hietz@boku.ac.at

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

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

Module Description

CS0013BOK: BOKU: Chemistry and Technology of Sustainable Resources | BOKU: Chemistry and Technology of Sustainable Resources

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Written and oral
written (4-5 questions, 60% are required to pass), followed by an oral exam (10 - 15 min) Exams in person at Muthgasse 18, DCH, 3rd Floor, SEM 03/03

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic courses in chemistry

Content:
The lecture will cover selected topics on cellulose, cellulosic materials, starch and lignin. Including: Cellulose structure, dissolution, chromophores, cellulose solvents, fibers Aging and Degradation: Basic reactions of cellulose degradation, corrosion phenomena, mass-deacidification lignin structure, technical lignins and processes to obtain them, lignin analysis

Intended Learning Outcomes:
Deeper insights into lignocelluloses and biorefineries

Teaching and Learning Methods:
interactive lecture

Media:
interactive lecture

online lecture

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

Responsible for Module:
Thomas Rosenau thomas.rosenau@boku.ac.at

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

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

Module Description

CS0135BOK: BOKU: Biorefinery and Products from Renewable Resources | BOKU: Biorefinery and Products from Renewable Resources [CS0135BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Written
Multiple choice/multiple response 14 questions (2 per subject area), all questions are equally weighted. Multiple answers are possible (one, multiple or all answer options can be correct). Points are given for checking the correct answer options, but also for leaving the wrong options unchecked. If all options remain unchecked, the question is considered as incorrectly answered. Exam duration: 30 min Questions and answer options are given in German and English. Grading: < 60 % - nicht genügend (5) ≥ 60 % - genügend (4) ≥ 70 % - befriedigend (3) ≥ 80 % - gut (2) ≥ 90 % - sehr gut (1)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Biorefinery is a concept towards processing biomass to a variety of products. These products may range from materials, base and fine chemicals, to energy such as gasoline, electrical power or heat. This course will introduce the broad range of applications for renewable resources.

Topics:
- Introduction Biorefineries
- Overview Renewable Resources (oils, waxes, proteins, carbohydrates),
- Green Chemistry: Trends, Opportunities and Limits
- Enzymatic Degradation of Lignocellulosic Materials

- Post-harvest Technologies, Biogas Technologies and Ecological Assessment
- Biomass to Materials
- Bioenergy and Energy Technology
- Tour of Facilities

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

Teaching and Learning Methods:
class lecture

Introductory lectures by persons who are also engaged with the "Material and energetic use of renewable resources (NAWARO)" study

Media:

Reading List:

Responsible for Module:
BOKU Department of Agriobiotechnology, IFA-Tulln Mautner Andreas, Bauer Alexander, Baumgartner Sabine, Böhmdorfer Stefan, Neureiter Markus, Pröll Tobias, Ribitsch Doris

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

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

Module Description

CS0136BOK: BOKU: Gender, Nutrition and Right to Food | BOKU: Gender, Nutrition and Right to Food [CS0136BOK]

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:** 60	**Contact Hours:** 120

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

Description of Examination Method:
Continuous assessment (immanenter Prüfungscharakter) 50% written essay (individual grade) 50% presentation (graded as group work) Both components must be passed in order to pass the course. Students are expected to attend every session. For successful completion of the course attendance of at least 80% of lectures is required.

50% written essay (individual grade) 50% presentation (graded as group work) Both components must be passed in order to pass the course. For successful completion of the course attendance of at least 80% of lectures is required.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Interest in the topics relating to this course. Students from a diversity of disciplines and backgrounds are invited to join.

Content:
Worldwide hunger and malnutrition are largely caused by structural inequalities, characterized by chronic lack of access to adequate food. The majority of those affected are smallholder farmers, pastoralists, Indigenous Peoples, landless people, non-farm rural households and poor urban populations. Our current food systems not only fail to address hunger, but at the same time encourage diets that are a source of overweight and obesity. This food system failure ultimately undermines the capacity of individuals and communities to be resilient in the face of environmental and social change, including the climate crisis. Women and girls face specific gender-based risks and are especially vulnerable to food insecurity and hunger. Combatting hunger and malnutrition is in many countries a legally binding human rights obligation, with the right to food and nutrition

placing legal obligations on States to realize food and nutrition security for all. In light of on-going conditions of intersecting rural, racial, gender, class and other structural power inequities a human rights framework can offer a more precise analysis of the root causes of these inequities, and provides an analytical tool for exploring the policy and practical dimensions of implementing the right to food. The purpose of this course is to introduce students to the history and development of various UN Conventions in the context of the Right to Food and women's rights. Students will gain insights into how gender, nutrition and the right to food are linked and have to be considered in a holistic way in order to address structural causes of food and nutrition insecurity. This will be illustrated by research and case studies undertaken in different geographic, socio-economic and socio-cultural contexts, in collaboration with civil society organisations and other local actors, applying innovative trans- and interdisciplinary approaches. Guest speakers from the academic and civil society sector, including international organizations working on the right to food, food sovereignty, large-scale land acquisition, rural development, gender, climate change and related issues, will share experiences from practice. This module will enable students to analyze the underlying social, political, economic and cultural conditions that pose gendered barriers to the Right to Food. Students will further be introduced to rights-based methods and gender-transformative approaches in research. We will further assess relevant Sustainable Development Goals (SDG2, SDG3, SDG5, SDG6, SDG12).

Intended Learning Outcomes:
On completion of this course, students will be able to:
1. Gain an understanding of the concepts gender and intersectionality
2. Be familiar with the development of and difference between the concepts food/nutrition security, right to food/nutrition, food systems, sustainable diets, food justice, food sovereignty
3. Know about the history and development of various UN Conventions in the context of the right to food and nutrition, women's rights and gender, as well as the linkages with related programmes in international development, such as the Sustainable Development Goals
4. Gain insights into how gender, nutrition and the right to food are interlinked and have to be considered in a holistic way to address structural causes of food and nutrition insecurity
5. Recognise and analyse the underlying social, political, economic and cultural conditions that pose gendered and other barriers to the right to food and nutrition

Students will gain key competences in:
- Scientific reading and writing, working with academic literature through guided reading, presenting and discussing readings in class, essay writing (as part of the assessment)
- Communication and media-supported presentation skills
- Team work capacity
- Facilitation skills, through active participation in different interactive formats (e.g., World Café, Fishbowl discussion) and online facilitation
Discussions and plenary debate
- Guided peer review: receiving and providing feedback

Teaching and Learning Methods:
Learning will be facilitated through a variety of methods which may include lectures, seminars, workshops, presentations by guest speakers, group work and online activities. Students are expected to engage in both class and online activities and discussions. This course also requires students to participate in guided reading and self-directed study to support the learning gained from timetabled sessions. Required and optional readings will be uploaded in advance on BOKUlearn. The emphasis is on student participation and fostering dialogue and debate. Students should feel able to explore and develop their understanding of key concepts introduced in the sessions through discussions in a supportive but challenging environment. Each session will consist of lectures, interactive group activities and/or guest speakers. Case studies presented by guest speakers from academia and civil society, based on research, project and advocacy work, will enable students to gain insights into the social, political, economic and cultural conditions of development and practice in various regions of the world. Through in-class discussions and guided learning activities, such as peer-review, students will receive continuous feedback, giving an early indication of progress towards the intended learning outcomes.
Workload: 150 hrs (1 ECTs = 25 hrs)

Media:

Reading List:
Required and optional readings will be made available on Moodle before the start of the course.

Responsible for Module:
BOKU Institute of Development Research Lemke Stefanie, Stadlmayr Barbara

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

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

Module Description

CS0137BOK: BOKU: Fundamentals of the Climate System | BOKU: Fundamentals of the Climate System [CS0137BOK]

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:** 30	**Contact Hours:** 60

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

Description of Examination Method:
Course grade is based on an exam focusing on theoretical course content (70%) and problem sets (30%), one negative partial fulfillment can be repeated.

One exam at the end of term (repeatable as partial fulfillment), information is provided on boku learn.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
A fundamental understanding of the key drivers and mechanisms in the climate system is required to assess and comprehend the manifold changes emerging across temporal and spatial scales (past, present, and future). This course covers the fundamentals of thermodynamics, the Earth's radiation and energy balance, feedback mechanisms in the climate system and processes through which the atmosphere, biosphere and global oceans interact over different time scales. The course provides a broad overview about the evolution of the atmosphere and climate over Earth's history and the core physico-chemical processes in the atmosphere, hydrosphere, and pedosphere. Students will comprehend among others the Earth's radiation and energy balance, and fundamentals of energy and mass transport and conservation, water cycle and water resources management, soil respiration and (de)nitrification in the climate system.

Intended Learning Outcomes:
After course completion the students will be able to describe and explain the fundamental physico-chemical processes in the climate system, the relationships and feedbacks between the atmosphere, hydrosphere and pedosphere and climate evolution past to present. Students will be able to comprehend, describe and quantify changes in the Earth's radiative and energy budget and critically assess changes in climate system components and their contribution to climate variability and change.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Institute of Meteorology and Climatology Rieder Harald, Formayer Herbert, Fiebig Markus, Schulz Karsten, Zechmeister-Bolternstern Sophie

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

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

Module Description

CS0138BOK: BOKU: Land Use and Global Change: Socio-ecological Interactions | BOKU: Land Use and Global Change: Socio-ecological Interactions [CS0138BOK]

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:** 30	**Contact Hours:** 60

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

Description of Examination Method:
Written exam and evaluation of contributions of students (written statements on documents, presentation, participation in discussions)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in interdisciplinary sustainability studies and sustainable resource use

Content:
Land use is a pervasive driver of global environmental change, considerably contributing to climate change, biodiversity loss, soil degradation and many other ecological detriments. But at the same time, land ecosystems provide key resources to society such as food, fuel and fiber, including powerful means to mitigate climate change, thus representing a key fundament of food security and human well-being. The course introduces the scientific field of land system research in the context of sustainability science and Social Ecology. It presents the basic conceptual approaches to socio-ecological land system research, such as the concepts of ‘social metabolism’ and ‘colonization of ecosystems’ with a particular focus on their contribution to prevailing research frontiers related to global change and land use. The course introduces indicator frameworks for assessing socioecological dimensions of land use, explores approaches on the nexus of land use and climate change, as well as land use and biodiversity. A central topic are systemic interrelations such as trade-offs in the global land systems, with a particular focus on the potentials and caveats that relate to land-based climate change mitigation. In the seminar, socio-ecological approaches to land system science are presented and, based on seminal research articles and influential reports,

students analyze and present insights into current mainstream in research including prevailing research frontiers.

Intended Learning Outcomes:
After successful completion of the course:
• students know the basic concepts, theories and methods of land use research and the central contributions of "social ecology" and its application in sustainability research.
• students have a basic understanding of global land use and its relationship to environmental challenges in the context of sustainable development.
• Students develop skills in applying and critically reflecting social-ecological concepts and methods in land-system science.
• Have achieved improved abilities to critically read, analyze and interpret current academic literature, policy documents and assessment reports and participate in related discussions in a constructive and well-informed manner

Teaching and Learning Methods:
Six inputs in key themes in land-system science will be given by the course leaders. Students will then, for each course unit, read and analyze one or more (depending on the size of the audience) key article(s) or document(s), resulting in short written responses to specific questions for each of the documents. Each participant contributes to summarizing at least one of the documents to kick-off the discussion of the document. This is followed by an in-depth discussion of the article or document that are moderated by the course leaders in a manner that fosters critical reading and analysis of the scientific arguments and methods used to back up main findings of each of the documents.

Media:

Reading List:
Will be announced at the start of the course (academic literature and policy documents will be made available as pdf in BOKU learn)

Responsible for Module:
BOKU Institute of Sociol Ecology Erb Karlheinz, Haberl Helmut

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

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

Module Description

CS0139BOK: BOKU: Land Use, Climate Change and Biodiversity | BOKU: Land Use, Climate Change and Biodiversity [CS0139BOK]

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:** 30	**Contact Hours:** 60

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

Description of Examination Method:
The assessment will include several criteria: (1) minimum attendance of two-thirds (compulsory), (2) literature work of students with oral presentations (40% of grade), (3) short written contributions (30% of grade) and (4) active participation (30% of grade)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
The course is intended for advanced students who have completed the compulsory introductory modules
• Climate Change and Social Ecology
• Grand challenges in the Anthropocene
• Scenarios and models as tools to understand complex systems
• Transformation pathways
• Inter- and transdisciplinary approaches and processes
and within Specialization 2: Social Ecology of Climate Change
• Biophysical concepts and methods of social ecology
• Climate change mitigation: A socio-ecological perspective

Content:
Land use plays a crucial role in the Earth's climate systems. The global food system is a key driver of global heating, and changes in land use, such as deforestation due to agricultural expansion considerably reduce carbon stocks of the biosphere. This occurs mainly in the global South, while forests are returning in area and stock in many countries of the global North. Land use does not only affect the global climate system, it is a key driver of biodiversity loss and the land degradation, while at the same time it is pivotal for society, providing essential ecosystem services such as food

and energy, water and air purification or climate regulation. Understanding these interactions is essential for effective climate change mitigation and adaptation strategies.
The course is dedicated to the in-depth exploration of the various components and implications of the global land system and their interrelations. It focuses on key dynamics and methods for assessing the past and future role of land use in the Earth system. Topics include IPCC approaches for AFOLU-LULUCF accounting, methods for mapping land use and land-cover changes, and their implications for carbon dynamics and biodiversity. It provides an overview of Land Use Models and focuses on approaches suitable for identifying and quantifying trade-offs within the land system.

Intended Learning Outcomes:
The seminar provides an overview of the research field land system science. After completion of the course, the students have gained knowledge in following topics in the field of land systems and the climate system: Key dimensions of land-use (change), drivers of land use change, (historic) linkages of energy use and land systems, global land use trends, land-use and the carbon state of ecosystems, teleconnections in the land system, trade-offs and synergies in the land system: nexus energy, food, biodiversity, ecosystem services and climate change, natural climate solutions, principles of IPCC AFOLU and LULUCF accounting, opportunity carbon costs of land use, full carbon accounting, solutions/option spaces (e.g. land sharing vs. land sparing), demand-side solutions vs. production side solutions (e.g. diets, organic farming, intensification).

After completion of the course, students will be able to correctly interpret statistical data for land-based / carbon accounting; they are knowledgeable about empirical methods of land-use research as well as to discuss aspects of nexus between land-use, climate, and their change over time and biodiversity. Key skills further include the ability to analyze land-use processes and to discuss and present scientific results.

Professional competencies include systemic thinking related to the interlinkages between land use and climate dynamics in order to understand potentials and implications of natural climate solutions; the ability to discuss and interpret land-use analyses and AFOLU / LULUCF accounting and competencies to understand and evaluate trade-offs in the land systems and of land-based mitigation, in the light of the interwoven nature of the land use, climate and biodiversity crises.

Students develop skills in interdisciplinary communication and in cooperative research with colleagues from other scientific backgrounds. They have trained their skills in presenting and discussing scientific results.

Teaching and Learning Methods:
The course includes lectures by instructors, a seminar part during which students critically read current literature, prepare short texts and give presentations.

Media:

Reading List:

Responsible for Module:
BOKU Institute of Social Ecology Erb Karlheinz, Hietz Peter, Mattson Brady

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

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

Module Description

CS0141BOK: BOKU: The Climate Crisis as a Grand Challenge in the Anthropocene | BOKU: The Climate Crisis as a Grand Challenge in the Anthropocene [CS0141BOK]

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:** 30	**Contact Hours:** 60

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

Description of Examination Method:
Written

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Manifold progress has been made in climate science over the last decades, leading to substantial advancements in our understanding of key processes in the climate system, system changes and the role of individual forcings and feedback mechanisms on different time-scales. A central issue in this lecture is the attribution of observed and projected climate change to the different forcings and especially human societies' (i.e. anthropogenic) contribution to climate change past and future. The concept of radiative forcing, its temporal development and the main contributors to its change is discussed in detail and the role of different sources and sinks of greenhouse gases is addressed. The course explores the different emission pathways considered in IPCC assessment reports, their creation and the resulting global warming levels and projected impacts on global to regional scale (including feedbacks and tipping point considerations). What do we know about when and how humanity got into a situation that is now described as "Anthropocene"? How did the underlying transition to a nuclear-fossil socio-metabolic regime proceed in different regions of the world? Based on a socio-ecological understanding of the long-term evolution of the current sustainability challenges, this course propels an understanding of the transformative change, concepts and pathways needed to achieve the sustainable development goals (SDGs) and important aspects of the embedding of climate change mitigation strategies in the framework

of sustainable development with its goals, principles, concepts and and interdisciplinary-oriented approach. This includes examples in climate friendly and sustainable lifestyle.

Intended Learning Outcomes:
After participation students will have gained an overview of the Grand Challenges in the Anthropocene, and a systemic socio-ecological understanding of climate change in the context of the Grand Challenges. They developed a particular understanding of challenges related to the climate crisis as well as of principles, concepts and pathways of sustainable development. Synergies between climate mitigation strategies and sustainable development will become clear in an exemplary manner. Regarding the human contribution to climate change, students have developed an in-depth understanding of the contribution of changes in atmospheric composition from land-use change, burning of fossil fuels and other anthropogenic activities from the preindustrial to present and the overlaying natural drivers of inter-decadal to inter-annual climate variability. Students will understand positive and negative contributions to radiative forcing and how these forcings and feedbacks are projected to change the climate system over coming decades. Students will also have obtained an understanding of chemical life times of individual greenhouse gases, their sources and sinks and the time-scales of greenhouse gas removal (through natural and technical processes). Through numerical exercises and practical examples students are improving their analytical skills. Students will gain a general understanding of the societal processes that shaped the emergence of the climate crisis. They will understand the role of technological change for the extent and social and ecological impacts of anthropogenic interventions into natural systems in a long-term perspective. Students will improve their skills regarding interdisciplinary and system-oriented thinking and scientific reasoning in various settings such as break out groups in class or plenary discussions.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Institute of Meteorology and Climatology Rieder Harald, Formayer Herbert, Gingrich Simone, Körner Daniel, Lindenthal Thomas

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

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

Electives Category 2 | Wahlmodule Kategorie 2

Production and Supply of Biogenic Resources | Produktion und Bereitstellung biogener Rohstoffe

Module Description

CS0300: Agroforestry Systems | Agroforestry Systems

Version of module description: Gültig ab winterterm 2024/25

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in Silviculture

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

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

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

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

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

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

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

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

Module Description

CS0018BOK: BOKU: Soil Protection | BOKU: Soil Protection

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Written

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Fundamentals of soil science (at least bachelor level, ideally the level after passing the exam of 911.014 - Soil Science Refresher) Proficient English

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

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

- Know about sources of soil information and their application - Recall important sources of soil information in Austria, Europe and at global level - Make informed use of soil information - Know about instruments / measures of soil protection - Apply your knowledge to a case study

Teaching and Learning Methods:
interactive lecture

Media:

Reading List:

Responsible for Module:
Walter Wenzel walter.wenzel@boku.ac.at

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

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

Module Description

CS0020BOK: BOKU: Agricultural Engineering in Plant Production | BOKU: Agricultural Engineering in Plant Production

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**Total Hours:** 100	**Self-study Hours:** 55	**Contact Hours:** 45

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

Description of Examination Method:
The overall course grade is compiled from evaluations in the following three areas: 1. Evaluation of active participation during course meetings with mandatory attendance (15 points) 2. Evaluation of the final paper (40 points) 3. Evaluation of the final presentation (45 points) Grades The grades for the course will be calculated according to the number of points achieved and based on the following grading scale: 90 – 100 Points = very good (1) 78 – 89 Points = good (2) 66 – 77 Points = satisfactory (3) 55 – 65 Points = adequate (4) 0 – 54 Points = inadequate (5)

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Precense in the first lecture. Mainly students from 455 plant science and other free places for other master students. Others will be given to students by the system: first come first serve.

Content:
The course focuses on special topics in the field of agricultural engineering in plant production. This course builds upon the content of the courses “Fundamentals of Agricultural Engineering“ (931.103), “Agricultural Engineering in Plant Production“ (931.100) as well as „Agricultural Engineering in Plant Production - practical course“ (931.101). Students will delve into various aspects of agricultural engineering by researching and writing literature comparison papers. One focus of the course is to work with scientific literature in English and correctly use English technical terms. The course is designed to be interdisciplinary and covers process engineering (through the detailed examination of process engineering aspects of agricultural engineering), plant production aspects (by conveying the technical requirements based on plant

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

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

Teaching and Learning Methods:
The topic of the course paper can be chosen from a pool of topics, however each topic may only be researched once. The topic will be presented and clarified during the last course units. The content of the course paper will be a critical examination of one technology. The final paper should be structured as follows: 1. A short summary of the technology and its current state of development (ca. 500 words) 2. A summary of the technologies/innovations as described in the literature (ca. 1,000 words) 3. A critical evaluation of innovations (benefits, drawbacks, practical applicability), discussion supported by literature data (ca. 1,000 words) 4. A conclusion (max. 100 words) The course paper will be written about the individual technologies in 3-person groups. The course paper should be as short and concisely written as possible (no comprehensive "summary" of the literature); the suggested length of the paper is approximately 5-6 pages (2,600 words not counting the bibliography). The course papers should be based on the content of at least 10 scientific publications written in English. Results of the course paper will be presented visually in the concise format of a poster. Course leaders will make a template for the poster available to all course participants. Upon positive evaluation, posters will be approved for printing.

Media:

Reading List:

Responsible for Module:
Christoph Pfeifer

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

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

Module Description

CS0063BOK: BOKU: Crop Production | BOKU: Crop Production

Version of module description: Gültig ab winterterm 2022/23

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

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

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

Repeat Examination:
Next semester / End of Semester

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

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

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

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

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

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

Students can draw conclusions on suitable crop management practices

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

Teaching and Learning Methods:
Classroom lecture, assisted by moodle

Media:
course material available at BOKUlearn (Moodle)

Reading List:

Responsible for Module:
Hans-Peter Kaul (BOKU)

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

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

Module Description

CS0021BOK: BOKU: Crop Production Systems in Organic Agriculture | BOKU: Crop Production Systems in Organic Agriculture

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
written
Calculation of balances: example should calculated on student´s notebook and have to be submitted to BOKUlearn during the examination period

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in organic plant production (crop rotation)

Content:
Investigation and development of cropping systems with balance and planning instruments:

- designing of crop rotation
- fodder and straw balance
- organic manure planing
- nutrient balances (field, farmyard balance)
- humus balance

Intended Learning Outcomes:
Qualification for the system approach of organic farming land use systems:
- understanding of crop rotation interactions with soil, weeds and pests
- understanding connection between crop rotation, plant nutrition, fertilizer distribution, nutrient and humus balances
- understanding of nutrient and carboncycles between field and live stock (fodder budget)

Teaching and Learning Methods:
Lecture with exercises

Media:

Reading List:
Freyer, B. 2003: Fruchtfolgen - konventionell, integriert, biologisch. Verlag Eugen Ulmer, Stuttgart

Responsible for Module:
Gabriele Gollner Gabriele.gollner@boku.ac.at

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

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

Module Description

CS0044BOK: BOKU: Procedures of Plant Production in Organic Agriculture I | BOKU: Procedures of Plant Production in Organic Agriculture I

Version of module description: Gültig ab winterterm 2022/23

Module Level:	Language:	Duration:	Frequency:
Credits:* 1	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

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

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

Module Description

CS0045BOK: BOKU: Global Waste Management I | BOKU: Global Waste Management I

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

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

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

Module Description

CS0046BOK: BOKU: Waste Management Seminar | BOKU: Waste Management Seminar [CS0046BOK]

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4.5	**Total Hours:** 135	**Self-study Hours:** 45	**Contact Hours:** 90

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

Description of Examination Method:
The final grading is calculated based on two separate outputs: Presentation of the topic (intermediate and final presentation): - 35% - main focus on the content - presentation technique Paper on the specific topic: - 65% - main focus on the content - formal criteria such as quotation are also taken into account

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
basic knowledge in waste management and circularity is required (eg. how is waste collected, sorted, recycled? treatment technologies, re-use and waste prevention)

Content:
A selected topic in the field of waste management is elaborated under supervision.

Important note: Students can select a topic according to their preference. A choice of different topics will be provided at BOKUlearn:

https://learn.boku.ac.at/course/view.php?id=47723#section-1

The topic assignment will be finalised at the introduction session.

Intended Learning Outcomes:
Objective: after completing this course participants are able to analyse a well defined topic as well as to bring the results into a scientific format.

The participants of this course apply basic knowledge in waste management to a specific question. For this purpose, they investigate papers from the literature and critically analyse the state of knowledge. After completion of this course, the participants are able to present a scientific question and the result of their investigation, systematically and clearly arranged both in written form as well as in an oral presentation.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Institute of Waste Management and Circularity (ABF-BOKU) Salhofer Stefan, Zafiu Christian, Kopecká Romana

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

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

Chemical-Material Use | Chemisch-stoffliche Nutzung

Module Description

CS0003: Production of Renewable Fuels | Production of Renewable Fuels

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
The learning results are going to be proven in form of a written exam of 90 Minutes. Along the problem set, it is checked whether the student is able to understand, improve and assess industrial processes for the production of renewable fuels. No aids permitted.

Repeat Examination:
End of Semester

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

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

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

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

Media:
Hybrid live lectures & asynchronous mini-videos allowing distance learning, lecture Script and exercises via online platform, excursions to fuel production plants

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

Responsible for Module:
Prof. Jakob Burger

Courses (Type of course, Weekly hours per semester), Instructor:
Production of renewable fuels (Tutorial, Garching) (Übung, 2 SWS)
Burger J [L], Burger J, Rosen N, Staudt J, Wolf A

Production of renewable fuels (Tutorial, Straubing) (Übung, 2 SWS)
Burger J [L], Burger J, Rosen N, Staudt J, Wolf A

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

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

Module Description

CS0265: Biorefinery | Biorefinery [BioRaff]

Version of module description: Gültig ab winterterm 2025/26

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

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

Description of Examination Method:
Students answer questions in a written examination (60 minutes) that will be graded. They thereby show that they have understood, can explain and are able to assess the various steps and processes involved in biorefinery. In an additional voluntary coursework (Mid-term), which is not part of the written exam, students individually study selected topics in the field. Here, they apply their knowledge acquired in lectures to deduce and/or evaluate processing methods. Findings are presented in a "research paper" or a short presentation (5 min). Bonus points (up 10/60 depending on the quality) will be awarded for the coursework on the written exam.

Repeat Examination:
Next semester

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

Content:
Contents of the module include:
comparison of biorefinery and mineral oil refinery; role of biorefineries for the development of a sustainable biobased economy; presentation and analysis of different biorefinery systems (e.g. green biorefinery, lignocellulose biorefinery);
selected procedures for the extraction of resources (focused on lignocellulose);
selected biogenic compounds for further processing (e.g. saccharides, lipids/oils, lignin);
selected pathways of their use (e.g. bioalcohols, polylactic acid, proteins, succinate and other components);
cascade use of materials and energy.

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

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

Media:
PowerPoint presentation, blackboard

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

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

Courses (Type of course, Weekly hours per semester), Instructor:
Biorefinery (Seminar) (Seminar, 1 SWS)
Schieder D

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

Module Description

CS0266: Sustainable Chemistry | Sustainable Chemistry

Version of module description: Gültig ab summerterm 2024

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

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

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

Repeat Examination:
Next semester

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

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

Intended Learning Outcomes:
By attending the module events, students are able to highlight the principles of sustainable chemistry. Students can analyze the efficiency and waste quantities of chemical reactions and evaluate various alternative processes. Furthermore, they are able to discuss further chemical aspects of the conversion of renewable raw materials into valuable products. Through the

independent development of case studies, the students master all the steps that are important in the critical examination of problems (consideration of the example, development of criteria for evaluation, assessment, presentation of the results to an audience).

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

Media:
Presentation, script, examples

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

Responsible for Module:
Prof. Cordt Zollfrank

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

Module Description

CS0245: Advanced Electronic Spectroscopy | Advanced Electronic Spectroscopy

Version of module description: Gültig ab summerterm 2022

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

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

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

Repeat Examination:
End of Semester

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

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

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

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

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

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

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

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

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Electronic Spectroscopy (Lecture) (Vorlesung, 2 SWS)
Costa Riquelme R [L], Atoini Y, Costa Riquelme R, Gutierrez Armayor D

Advanced Electronic Spectroscopy (Exercise) (Übung, 2 SWS)
Costa Riquelme R [L], Atoini Y, Costa Riquelme R, Gutierrez Armayor D, Lipinski S
For further information in this module, please click campus.tum.de or here.

Module Description

CS0332: Environmental Technology | Environmental Technology [EnTe]

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 exam lasts 60 minutes. Students should be familiar with the topics covered in the lecture and be able to name and explain their knowledge of environmental technology. Calculations and interpretations of measurements from environmental technology are carried out in the same way as the examples presented in the lectures. The necessary physical fundamentals are assumed, but are also repeated during the lecture. The terminology learned should be used to answer the questions in the exam.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The lecture provides students with a broad overview of the subject of environmental technology. After a general introduction to the topic, environmental policy and environmental protection are examined, including the relevant authorities, responsibilities and legal framework. This is followed by ecological principles and interrelationships relating to the main topics of soil, air and water, in order to bring all students to the same level of prior knowledge. The main focus is on the different types of environmental pollution, their occurrence and spread, and the applicable limit values. Subsequently, the various technical processes for eliminating environmental pollution are discussed. A special focus of the lecture is on biological processes for pollutant removal and the reduction of environmental pollution. The equipment and methods developed for this purpose are presented. Particular attention is paid to the microorganisms/biofilms required for this purpose and their special properties in the degradation of pollutants. In addition, measurement methods are presented with which the success of the cleaning process can be verified. Finally, the various methods for preventing environmental pollution are discussed.

Intended Learning Outcomes:
After completing the lecture ‘Environmental Technology’, students will have a basic understanding of environmental and climate problems, their causes and protective measures. They will be able to name the legal regulations (Germany) and waste, water, air and soil and know the responsible authorities. Participants will gain an understanding of environmentally friendly measures for energy use and processes for removing pollutants from water, air and soil, as well as various measurement methods. The lecture places a particular focus on innovative biological processes that use microorganisms and biofilms to clean the environment. Students also learn about various measurement methods, limit values and the limitations of these methods. This gives them an understanding of environmental processes and enables them to assess environmental problems and discuss ways of avoiding them in the future.

Teaching and Learning Methods:
PowerPoint presentations, quizzes, films, images and books are used in class as needed. This is done partly in the form of lectures, but also through joint work on the blackboard or whiteboard. Where possible, small group work is assigned during the lecture and the results are then discussed together.

Media:
Media types include scripts, PowerPoint, quizzes, films and sample objects.

Reading List:
German books:
Einführung in die Umwelttechnik - Grundlagen und Anwendungen aus Technik und Recht; https://link.springer.com/book/10.1007/978-3-322-83867-4
Praxiswissen Umwelttechnik — Umweltmanagement - Technische Verfahren und Betriebliche Praxis; https://link.springer.com/book/10.1007/978-3-322-84908-3
Umwelttechnik: Ein Lehr- und Übungsbuch; https://www.google.de/books/edition/Umwelttechnik/0NvVEAAAQBAJ?hl=de&gbpv=0
Anaerobtechnik; file:///C:/Users/ga73vub/Downloads/b137857.pdf
Books in English:
Handbook of Environmental Engineering
https://onlinelibrary-wiley-com.eaccess.tum.edu/doi/book/10.1002/9781119304418#aboutBook-pane
Sustainable Approaches to Environmental Design, Materials Science, and Engineering Technologies
https://link-springer-com.eaccess.tum.edu/book/10.1007/978-3-031-76025-9
Sustainable Energy and the Environment: A Clean Technology Approach
https://link-springer-com.eaccess.tum.edu/book/10.1007/978-3-319-29446-9
Applied Environmental Biotechnology: Present Scenario and Future Trends
https://link-springer-com.eaccess.tum.edu/book/10.1007/978-81-322-2123-4

Responsible for Module:
Dr. Yvonne Gmach

Courses (Type of course, Weekly hours per semester), Instructor:
Environmental Technology (Vorlesung, 2 SWS)
Gmach Y
For further information in this module, please click campus.tum.de or here.

Module Description

CS0023BOK: BOKU: Biochemical Technology | BOKU: Biochemical Technology

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Written and oral
oral exam dates can be arranged individually alternative, students can hand in a term paper (approx. length should be 15 pages) on a topic of biochemical technology which must be based on original literature and cover microbiological, biochemical and technological aspects of the production of selected chemicals / industrial products. These topics for the term paper can be selected individually

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
basic knowledge in microbiology and biochemistry (main metabolic pathways in microoragnisms) as wel as in biotechnology (cultivation of microorganisms, fermentation technology)

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

4. biocatalysis, definition, challenges and major examples

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

Teaching and Learning Methods:
multimedia-supported

Media:
multimedia-supported

Reading List:

Responsible for Module:
Dietmar Haltrich dietmar.haltrich@boku.ac.at

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

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

Module Description

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

Version of module description: Gültig ab winterterm 2017/18

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

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

Description of Examination Method:
written

Repeat Examination:
End of Semester

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

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

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

The lecture is held in 2 parts:

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

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

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

Teaching and Learning Methods:
multimedia-supported

Media:

Reading List:

Responsible for Module:

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

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

Module Description

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

Version of module description: Gültig ab winterterm 2017/18

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

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

Description of Examination Method:
oral

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
General and organic chemistry

Content:
Master HTM - Modul Bioraffinerie

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

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

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

Teaching and Learning Methods:
Class lecture

Media:

Reading List:

Responsible for Module:

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

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

Module Description

CS0142BOK: BOKU: Biobased and Biodegradable Plastics | BOKU: Biobased and Biodegradable Plastics [CS0142BOK]

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
Written
12 questions from all subject areas. Duration: 60 min Score key: 5 points for each question answered completely and correctly (maximum: 60 points). 54 points and more: Sehr gut (1) 48 points and more: Gut (2) 42 points and more: Befriedigend (3) 36 points and more: Genügend (4) In addition, at least 50% of the points for each of the 4 sub-sections (Questions 1-4; 5-6; 7-10; 11-12) must be scored for a positive grade.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
- Terminology; overview regarding the market situation, role of bioplastics within the bioeconomy
- Biotechnological processes for the production of biobased materials and/or their monomeric precursors:
Feedstocks for fermentation and their availability; background in microbiology and process engineering; biotechnological production of selected materials (PHAs, lactic acid and PLA, succinate/butandiol and PBS, 1,2 propanediol and PTT, biopolyethylene, ...)
- Processing and forming
Chemical derivatisation/synthesis; moulding (especially thermoplastic moulding); examples for applied moulding processes
- Characterisation of material properties:
Structures and microstructure; mechanical properties and corresponding analytics and measuring techniques (thermal resistance; deformation resistance, ...)

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

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

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU Department of Agrobiotechnology, IFA-Tulln Neureiter Markus, Fritz Ines, Mautner Andreas

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

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

Module Description

CS0022BOK: BOKU: Processes in Enzyme Technology | BOKU: Processes in Enzyme Technology

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Oral

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

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

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

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

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Thu Ha Nguyen thu-ha.nguyen.ac.at

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

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

Energetic Use | Energetische Nutzung

Module Description

CS0132: Energy Process Engineering | Energy Process Engineering [EP]

Energy Process Engineering

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Technical Thermodynamics and Balancing, Energy and Economics

Content:
Students learn about the properties of solid fuels, fuel preparation and the fundamentals of thermal and thermochemical conversion as well as the technical components involved - such as furnaces, gasifiers, heat exchangers, gas treatment plants, exhaust gas purification plants, reactors and synthesis stages, combined heat and power generation, the planning of local heating networks and emission regulation aspects. The practical exercises focus on the design and planning of plants.

Intended Learning Outcomes:
Students can understand thermal and chemical processes for energy and fuel production from biomass and other solid fuels and are able to recognize and explain the necessary requirements and process steps and technologies. They have a broad overview of the technical possibilities and

necessary boundary conditions. They are therefore able to develop an appropriate concept, argue for it and estimate the economic benefits.

Teaching and Learning Methods:
The module consists of lectures and exercises. The content is taught in lectures and presentations.

Media:
Lecture, digital whiteboard, presentation

Reading List:
Spliethoff, H., Power generation from Solid Fuels, Springer, ISBN 978-3-642-02855-7, 2010
Karl, J.: Dezentrale Energiesysteme, Oldenbourg, ISBN 3-486-27505-4, 2004/

Responsible for Module:
Matthias Gaderer

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

Energy process engineering (Exercise) (Übung, 3 SWS)
Gaderer M [L], Gaderer M, Putra L
For further information in this module, please click campus.tum.de or here.

Module Description

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

Energy & Economis

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
The examination takes the form of a written examination lasting 90 minutes. Students demonstrate that they understand and can answer questions and correlations between energy conversion, the conversion of renewable raw materials, energy supply in general and the energy industry situation. In addition, they will be able to explain technological and functional aspects of various energy conversion technologies.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prior participation in the module Technical Thermodynamics and Balancing is strongly recommend.

Content:
The basics of energy sources, climate change and the technology of the heat, electricity and fuel markets as well as the use of renewable raw materials are explained, including an introduction to technical systems and current topics in the energy industry. Economic aspects such as electricity trading, CO2 trading and the current situation of various energy technologies are discussed. In the exercises, examples of energy technology tasks and their economic efficiency - such as the production costs of heat and electricity plants - are calculated.

Intended Learning Outcomes:
By participating in the module, students are able to understand and explain the resources for energy use, the principles of energy conversion into heat and electricity and the technical processes involved. They can carry out engineering-oriented economic assessments of energy systems based on different costs and revenues and understand the associated market mechanisms of the electricity and heat market.

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Teaching and Learning Methods:
The module consists of a lecture with exercises. The contents of the lecture are conveyed through presentations, calculations and small group work.

Media:
Presentations and calculation of examples in the form of digitally presented transcripts.

Reading List:
- Peter Zweifel , Aaron Praktiknjo , Georg Erdmann: Energy Economics, Theory and Applications, 2017, Springer
- Subhes C. Bhattacharyya: Energy Economics, Concepts, Issues, Markets and Governance, 2019, Springer
- Kaltschmitt, M.; Hartmann, H.; Hofbauer, H.: Energie aus Biomasse, 2. Auflage, Springer, ISBN 978-3-540-85094-6, 2009
- Karl, J.: Dezentrale Energiesysteme, Oldenbourg, ISBN 3-486-27505-4, 2004

Responsible for Module:
Matthias Gaderer, Bernhard Huber

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

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

Module Description

CS0026BOK: BOKU: Energy Engineering | BOKU: Energy Engineering

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
written
Multiple Choice Test: 30 Fragen in 60 minutes, 1-5 answers could be correct

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Physics including thermodynamics (e.g. VO 892.104 + VO 893.103 or VO 892.105 + VO 893.112)

Content:
Steam power plants • Combined heat and power (CHP) production • Waste incineration plants • Gas turbine combined cycle power plants • CO2 capture and storage • Power to Fuel (Gas / Liquid) • Heat grids and district heating systems • Heat pumps and active waste heat recovery • Energy technology in buildings

Intended Learning Outcomes:
The students know the essential parts of the present energy system and the approximate share of the different primary energy sources in Austria. • The students know the basic principles of energy conversion including the conversion of thermal energy to electrical energy. • The students know examples of practical energy conversion units and are able to explain the processes. • The students are able to discuss different energy conversion routes on a comparative basis.

Teaching and Learning Methods:
class lecture

Media:

Reading List:

Responsible for Module:
Tobias Pröll tobias.proell@boku.ac.at

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

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

Module Description

CS0058BOK: BOKU: Renewable Energy Resources | BOKU: Renewable Energy Resources

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 41	**Contact Hours:** 34

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

Description of Examination Method:

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Fundamentals of physics and thermodynmacis

Content:
Energy demand and energy supply for Austria / EU. Overview of the thermodynamic fundamentals of energy conversion and introduction to the energy use (heat, electricity, fuels).
Renewable energy sources: use of solar energy for thermal use and photovoltaics, combustion calculation, thermo-chemical biomass conversion (pyrolysis, gasification, combustion, hydrothermal processes), hydropower (run-of-river, reservoir and storage power plant), geotherma energy, wind energy, biogas (anaerobic fermentation)

In the winter semester, the lecture will be offered live on the dates listed below via Zoom. Details and teaching materials can be found in the relevant BOKUlearn course.

Excursion:
It is not clear if the field trip can be provided in the winter term 2020/21. In case of cancellation a homework will be given (details can be found in the BOKUlearn course). Participation/homework contributes to the assessment of the course to 20% but is not mandatory.

Intended Learning Outcomes:
Understanding of the processes for energy utilization, competence in explaining processes and being able to compare them with one another, knowledge of thermodynamic fundamentals and physical terms

Teaching and Learning Methods:

Media:

Reading List:
Vorlesungsunterlagen werden über BOKUlearn bereitgestellt.

Responsible for Module:
Rafat Al Afif rafat.alafif@boku.ac.at

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

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

Module Description

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

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
Assessment is done as a written examination (duration 90 minutes). The main part of the exam is to solve typical problems by applying the methods aquired in the course. This typically involves writing small Matlab programs on paper. All course materials (slides, programs) can be brought as printouts and used as templates for this. Additionally, questions have to be answered to check the understanding of basic methods and principles as learned during the course.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Bachelor modules Mathematics & Physics; Module Basics of Numerical Methods, programming experience (ideally with Matlab)

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

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

Basics of process modelling & control theory
The methods treated in this course are complemented with practical examples that are chosen to show both the wide scope of application (engineering, natural sciences) and their relation to sustainability.

Intended Learning Outcomes:
After attending the course the participants understand basic methods for creating models, simulation and optimization. In addition, they are able to apply these methods by creating appropriate program code in Matlab. Furthermore, the participants acquire Matlab programming experience.

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

Media:
PP presentation, blackboard, demonstration of programs

Reading List:
S. R. Otto & J.P. Denier, An Introduction to Programming and Numerical Methods in MATLAB, Springer, London, 2005
O. Nelles, Nonlinear System Identification, Springer, Berlin, 2010

Responsible for Module:
Prof. Josef Kainz

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

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

Economics | Ökonomie

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

CS0102: Introduction to Game Theory | Introduction to Game Theory [IGT]

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
Learning outcomes are verified in a written exam (90 minutes). Students show the extent to which they have understood the taught game-theoretical definitions and terminology. They show to which extend they are able to use games in order to model problems from economics and engineering. They are also expected to apply important solution concepts to concrete games and answer comprehension questions concerning the properties and the advantages and disadvantages of the different solution concepts.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Module Mathematics (WZ1601) or Advanced Mathematics 1 (CS0175)

Content:
Cooperative and non-cooperative games, solution concepts for cooperative games, core, Shapley value, solution concepts for non-cooperative games, pure Nash equilibria, mixed Nash equilibria, dominant strategies, Bayesian games, modeling concrete case studies related to sustainability as cooperative and non-cooperative games

Intended Learning Outcomes:
Students have aquired basic theoretical and practical knowledge on cooperative and non-cooperative games. They know the basic definitions and terminology and are able to model sustainability-related problems from economics and engineering as games. Students know the most important solution concepts for cooperative games (such as the core and the Shapley value) and non-cooperative games (such as Nash equilibria and dominant strategies). They have gained a good understanding of these concepts and are able to analyze concrete games by using them.

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

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

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

Responsible for Module:
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

CS0123: Advanced Seminar in Behavioral Economics | Advanced Seminar in Behavioral Economics

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 7	**Total Hours:** 210	**Self-study Hours:** 150	**Contact Hours:** 60

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

Description of Examination Method:
The examination consists of a written seminar paper and an oral presentation with discussion. The seminar paper should cover 15-20 pages and is written in the style of a journal article. At the end of the module students present their work in a 30 minutes presentation. Weighting: Seminar paper 2, Presentation 1. The seminar paper demonstrates the student's ability to summarize the literature, explain research methods, present research findings and discuss them approbriately.

Repeat Examination:

(Recommended) Prerequisites:
-

Content:
This advanced seminar focuses on recent developments in Behavioral Economics. After being introduced to adequate research themes in the area of behavioral economics, students explore the academic literature on a chosen topic and develop their own research question. The topics are typically related to human behavior in an economic context and potential behavioral interventions.
Potential topics are:
-Green Nudges
-Social Comparison
-Choice Architecture

Intended Learning Outcomes:
The objective of the module is to equip the participants with the necessary skill and tools for a successful master thesis project.

Specifically, students will learn to:

- Read and understand recent research contributions
- Develop and pursue interesting research questions
- Conduct a literature review
- Eventually, design and conduct an experimental or empirical study
- Write a seminar paper in which they summarize the literature and explain research methods and results
- Present research findings and defend them in a discussion

Teaching and Learning Methods:
In an introductory session, the theme of the seminar is introduced and elaborated in detail. The introduction will also introduce the relevant behavioral economics literature. Based on the introduction, students will develop their own research question and decide on the adequate research methods. During the term students have to reach different milestones (e.g., choose a topic, choose a research method, collect data, outline their paper, write the paper, present the results) on specific dates. Following the submission of the seminar paper, students will present and discuss their research question and findings. During all stages of the seminar students will be assisted by the lecturer(s).

Media:
Research papers; presentation slides

Reading List:
Cartwright, E. (2018). Behavioral economics. Routledge.
Davis, D. D., & Holt, C. A. (2021). Experimental economics. Princeton university press.
Additional current research articles will be provided during the seminar

Responsible for Module:
Prof. Sebastian Georg

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

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

Module Description

CS0068: Intermediate Microeconomics | Intermediate Microeconomics [Micro II]

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Microeconomics

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

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

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

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

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

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

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

Responsible for Module:
Prof. Sebastian Goerg

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

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

Module Description

CS0027BOK: BOKU: Resource Efficiency and Bioeconomy of Bio-based Materials | BOKU: Resource Efficiency and Bioeconomy of Bio-based Materials

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Ongoing evaluation within the framework of the course (examination immanence)

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
•Environment and society: regional and global developments
•Resource efficiency, material efficiency, sustainability
•Cascading usage concepts with wood and their evaluation
•The cradle-to-cradle principle and product and process innovations derived from it
•Bioraffineriekonzepte
•Material resource efficiency and economic development
•Evaluation of resource and material efficiency
•Improving resource efficiency and innovation strategies
•Resource efficiency in agriculture, forestry, wood industry, industrial biotechnology and its assessment (case studies)
•Definitions of the bioeconomy as well as international strategies and scenarios
•Sustainable bioeconomy, the bioeconomy "at any price", ethical aspects
•Products made from renewable raw materials and residues (building materials, insulation materials, bio-based composites, adhesives, biopolymers, bio-based lightweight materials, special products, etc.)

Intended Learning Outcomes:
•Define "resource efficiency" qualitatively and quantitatively.
•A sound understanding of the term bioeconomy is available, including currently defined strategies for implementation.
•Ability to discuss and evaluate critical and controversial issues in the context of resource efficiency or bioeconomy, including ethical and societal aspects.
•Cradle-to-Cradle is understood as a possible guiding principle of the future.
•Students are familiar with best-practice examples.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Georg Gübitz Georg.guebitz.boku.ac.at

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

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

Module Description

CS0036BOK: BOKU: Resource and Environmental Economics | BOKU: Resource and Environmental Economics [CS0036BOK]

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Written

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Introductory economics and concepts of sustainability. Students are provided with refreshment slides/material in BOKUlearn and a short self-assessment quiz.

Content:
1. Principles of welfare economics;

2. Environmental Economics (Concept of Externalities: Environmental Targets and Policy Instruments);

3. International Environmental problems (Economic analysis of Climate Change, Biodiversity)

4. Economics of renewable and non-renewable Resources;

5. Irreversibility, Risk, and Uncertainty

Intended Learning Outcomes:
The Course shoul help

* to develop a strong understanding of the fundamental principles of environmental and resource economics;

* to strengthen the ability to read and synthesize papers in applied economics;

* to foster creative and independent thinking about problems in the area of environmental and resource.

Teaching and Learning Methods:
class lecture

Media:

Reading List:
Recommended Reading
Perman, Roger, Yue Ma, Michael Common, David Maddison and James McGilvray (2011): Natural Resource and Environmental Economics. 4thedition. Pearson Education Limited, Edinburgh Gate. (see library)

Responsible for Module:
BOKU Karner Katrin Institut für Nachhaltige Wirtschaftsentwicklung

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

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

Module Description

CS0078BOK: BOKU: Innovation Processes in the Forest-based Bioeconomy | BOKU: Innovation Processes in the Forest-based Bioeconomy [CS0078BOK]

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:
Written
Continuous assessment with following weightings: -WIKI-documentation 50% -attendance and participation 25% -final presentation 25%

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Familiarity with good practice in methods of scientific work is strongly recommended

Content:
The course focuses on innovation research in context of the bioeconomy and presents examples of current research in the forest-based sector. It extends current discourses by systemic perspectives to adequately consider technological innovations in light of environmental, economic and social framework conditions.

Intended Learning Outcomes:
• Students are familiarized with various definitions of the term innovation and settings of innovation processes and reflect in particular on the concept of sustainable innovation in the light of social challenges.

• Students learn about current discourses as a research context and as a framework for innovation processes.

• Students get insights into current research on the integration of sustainability assessment into innovation processes and conduct an approach.

• Students acquire the competence to reflect on problems in the forest-based bioeconomy and to identify research gaps.

• Students will hone their ability to engage in substantiated academic discussion based on scientific sources, structure their arguments and formulate research questions on innovation processes in the forest-based bioeconomy.

Teaching and Learning Methods:
•Keynote lectures by the teacher provide topical knowledge, insights into current research and impetus for reflexion.

• Students prepare for some lectures with guided reading of thematic papers which are provided via BOKUlearn.

•Students identify sustainability issues of technological innovations in small group works and present their findings.

•Students document their learnings along the course in their personal WIKI provided via BOKUlearn.

Media:

Reading List:
Will be made available on Bokulearn (https://learn.boku.ac.at/)

Responsible for Module:
BOKU Institut für Marketing und Innovation Hesser Franziska

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

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

Module Description

CS0034BOK: BOKU: Computer Simulation in Energy and Resource Economics | BOKU: Computer Simulation in Energy and Resource Economics

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Weekly Assignments (50% of points) Final oral examination (50% of points) Extra points in the human-zombie deathmatch

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic programming knowledge in any programming language (R, Python, C, Java, VB-Script, etc...) is a prerequisite.

Content:
Economic agents that show bounded rationality or strategic behaviour and markets that are out of equilibrium pose serious problems to traditional economic modelling techniques.

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

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

Intended Learning Outcomes:
The students learn to understand the concept of agent based modelling, get to know important agent based models and learn how to apply them appropriately. Students will also learn to implement, verify and validate basic agent based models in the programming language NetLogo.

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

Media:

Reading List:

Responsible for Module:
Johannes Schmidt johannes.schmidt@boku.ac.at

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

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

Management | Management

Module Description

CS0121: Sustainable Production | Sustainable Production [SP]

Version of module description: Gültig ab winterterm 2020/21

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

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

Description of Examination Method:
Written exam (90 minutes): By solving problems from the thematic field of the module students have to prove their understanding of the management of industrial production processes and technologies under consideration of sustainability aspects. In doing so they have to prove their techno-economic understanding, knowledge on quantitative methods for the analysis, assessment and optimisation of production systems, as well as their analytical and verbal skills in the field. They need to show that they are able to discuss the treated approaches and to derive further research needs. Learning aids: pocket calculator.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
-

Content:
The module covers inter alia the following topics:
• Sustainability aspects of industrial production and consumption
• Reasons for considering sustainability aspects in production management
• Measuring sustainability of production and operations
• Sustainable product and service design
• Sustainable sourcing
• Sustainable production management
• Sustainability of logistics
• Managing wastes, waste water, air emissions and product returns

Intended Learning Outcomes:
The module aims at enabling students to approach management tasks of production systems under consideration of sustainability aspects. This covers especially , especially the analysis, assessment and optimisation of these using a quantitative systems analysis approach.

The students understand that production and consumption activities have sustainability impacts and why these have to be considered in the management of production systems. They apply quantitative approaches for the analysis, assessment and optimisation of these systems on example planning tasks. They are capable to discuss the approaches critically, derive further development needs and transfer these approaches to other fields.

Teaching and Learning Methods:
Format: Lecture with exercise to introduce, train and deepen the contents of the module.

Teaching / learning methods:
- Media-assisted presentations
- Group work / case studies with presentation
- Individulal assignments and presentation

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

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

Reading List:
Recommended reading:
• Stark R; Seliger G, Bonvoisin J (2017): Sustainable Manufacturing - Challenges, Solutions and Implementation Perspectives , Springer
• Reniers G, Sörensen K, Vranken K (2013): Management principles of sustainable industrial chemistry, Wiley VCH
• McKinnon A, Browne M, Piecyk M, Whiteing A (2015): Green Logistics, Kogan Page
• Mangla S, Luthra S, Jakhar S K, Kumar A, Rana N P (2019): Sustainable Procurement in Supply Chain Operations, CRC Press

Further related reading, especially articles in international peer reviewed journals, will be provided in the kick-off meeting of the module.

Responsible for Module:
Magnus Fröhling

Courses (Type of course, Weekly hours per semester), Instructor:
Sustainable Production (Vorlesung) (Vorlesung, 2 SWS)
Fröhling M [L], Heinrich V, Schirmeister J, Fröhling M

Sustainable Production (Übung) (Übung, 2 SWS)
Fröhling M [L], Schirmeister J, Heinrich V
For further information in this module, please click campus.tum.de or here.

Module Description

CS0128: Corporate Sustainability Management | Corporate Sustainability Management [CSM]

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
The exam is held as seminar report (30 - 40 pages) at the end of the semester based on case studies which have to be solved by the students working in small groups (group size 2 - 4 participants). Thereby the students have to prove through the solution of an advanced problem that they are capable to apply methods and approaches of strategic and operational sustainability management to emerging topics from the field of sustainable corporate development based on a selected case example.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The Corporate Sustainability Management module includes a detailed discussion of the term sustainability (three-pillar model) and the history of the content. Based on this, the basic premises for sustainable management and sustainable economic activity are derived and discussed in a social, political, environmental, economic and corporate context. The national, European and international strategies for sustainable management are presented (e.g. bioeconomy, circular economy, green economy). Furthermore, established measurement concepts and key performance indicators (KPIs) for sustainability (e.g. resource productivity, life cycle costing) are discussed and applied to exemplary products and value chains within the framework of "Corporate Social Responsibility Reporting".

Intended Learning Outcomes:
After completion of the module, the students are able to understand sustainability concepts and to compare sustainability-oriented corporate profiles as a supplement to value-added corporate development. They can develop and apply concepts for the derivation, evaluation and operational integration of economic, ecological and social indicators. This enables the students to carry out sustainability assessments based on common and innovative new measurement concepts and indicators and to apply the results in the company.

Teaching and Learning Methods:
The module includes a lecture and an exercise. During the lecture, the content is communicated by presentations and discussions. The lectures serves to communicate the theoretical basics and terms of sustainability management including small exercises for group work. The students are encouraged to further deepen their knowledge of the proposed literature. As the highest level of competence, the lecture communicates an understanding of the evaluation of various sustainability concepts for use in operational management.
In the exercise, the students deepen the knowledge they have acquired by case studies. The content of the lectures and exercises is deepened both in small working groups and in individual work. As the highest level of competence, the exercise conveys the step-by-step development and incorporation of sustainability concepts using case studies of real and fictitious company concepts to achieve strategic and operational targets for sustainable development of the selected company.

Media:
Presentations, slide scripts, case descriptions of real and fictitious companies with sustainability management problems

Reading List:
Müller-Christ, G. (2010) Sustainable Management. Introduction into Resource Orientation and Contradictory Management Rationalities. Baden-Baden: Nomos
Schellnhuber, H. J.; Molina, M.; Stern, N.; Huber, V.; Kadner, S. (2010): Global Sustainability. A Nobel Cause. New York: Cambridge University Press
Seliger, G. (2012): Sustainable Manufacturing. Shaping Global Value Creation. Berlin: Springer
Von Hauff, M.; Kleine, A. (2009): Nachhaltige Entwicklung (Sustainable Development). Grundlagen und Umsetzung (Basics and Implementation). München: Oldenburg Wissenschaftsverlag

Responsible for Module:
Prof. Hubert Röder

Courses (Type of course, Weekly hours per semester), Instructor:
Corporate Sustainability Management (Lecture) (Vorlesung, 1 SWS)
Röder H [L], Röder H

Corporate Sustainability Management (Exercise) (Übung, 3 SWS)
Röder H [L], Röder H
For further information in this module, please click campus.tum.de or here.

Module Description

CS0098: Operations Research | Operations Research

Version of module description: Gültig ab winterterm 2023/24

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

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

Description of Examination Method:
Assessment takes the form of a written examination. In that examination, students must demonstrate their ability to formulate and solve decision models with appropriate methods. Type of assessment: in writing duration of assessment: 90 minutes

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Bachelor Business administration; advanced knowledge of mathematics and statistics

Content:
The module is divided into six distinctive areas:

Part 1: Basic Concepts
Part 2: Quantitative Modelling
Part 3: Linear Optimization
Part 4: Graph Theorie
Part 5: Integer and Combinatorical Optimization
Part 6: Dynamic Optimization

Intended Learning Outcomes:
The course introduces fundamental and advanced methods for modeling and solution of business problems with concepts from Operations Research (OR). Students will be introduced to using quantitative methods for planning and decision-making in companies and societies. Students will apply analytical methods of problem-solving and decision-making that is useful in the management of organizations.

Teaching and Learning Methods:
Lecture (theory), tutorials with group work and presentation

Media:
Seminaristic tution using beamer, overhead projector, flipchart

Reading List:
Hilier, F. and Lieberman, G., Introduction to Operations Research, McGraw-Hill, 2009
Kallrath, J and Wilson, J. M., Business Optimisation using mathematical Programming, London (Macmillan) 1997
Winston, W.: Operations Research - Applications and Algorithms. 4th ed. (internat. student ed.), Belmont, Calif. (Duxbury), 2004.
Taha, H. A., Operations Research, 7th ed., Upper Saddle River, N.J. (Prentice Hall) 2003.
Domschke, W., Drexl, A., Klein, R., Scholl, A, Einführung in Operations Research, Berlin (Springer) 2015.
Domschke, W. et al., Übungen und Fallbeispiele zum Operations Research, Springer, Berlin–Heidelberg, 2015

Responsible for Module:
Alexander Hübner

Courses (Type of course, Weekly hours per semester), Instructor:
Operations Research (Vorlesung mit integrierten Übungen, 4 SWS)
Hübner A [L], Hübner A, Huertas Morales D, Yang K
For further information in this module, please click campus.tum.de or here.

Module Description

CS0174: Marketing for Biobased Products | Marketing for Biobased Products [MBBP]

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:** 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 in form of a written exam. By answering questions students have to show that they have understood and can apply the thaught specific principles of the marketing of bio-based products and industrial marketing. No additional tools are allowed during examination with a duration of 60 minutes. In a students' project, the students demonstrate the scientific analysis and possible solutions of specific questions related to a defined topic concerning the marketing of biobased products including industrial marketing. The results of the project work will be presented (20 min; passed/non-passed) by the students with subsequent discussion with the other students and the lecturers.
In this students' project, the students demonstrate understanding of specific questions related to a defined topic concerning the marketing of bio-based products and services. Students have to show in their presentation that they can analyse, solve and answer defined problems and questions related to this topic. Participants of the course show that they have done appropriate research work and are able to present their results. By answering follow-up questions related to their presentation they show that they have learned to put their research outcome into the relevant product and market context.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic know-how related to marketing and markets of biobased products is recommended

Content:
The content of the module comprises in one part specific aspects of the marketing of biobased products and services. This part includes in particular the modification of methods and instruments of strategic marketing to this specific group of products and services (e.g. holistic character

of change in raw material basis, use of by-products and cycle approaches), the particular target groups of such products and their behavior (e.g. characteristics of related target groups, attitude-behaviour gaps), adaptations in the marketing-mix (e.g. specific benefits, labelling and identification of biobased products, avoidance of greenwashing, biomass logistics) as well as specific aspects related to the marketing of sustainability-oriented products and services (e.g. sustainable consumption and its barriers, sustainability evaluation and standards, Fair trade). Industrial marketing will be thaught in a second part of the module with a focus on specific tasks of industrial marketing, characteristics of different transaction types, specific features of transactions and service offers in the business-to-business area, as well as the combination of value chains, customer integration and service offers. Additionally, the procurement of business and state organisations will be considered with a focus on uncertainty and information as important factors in the buying process as well as concepts to analysing a buying center.
Besides, the students will use the taught methods and tools in a students' project in which actual questions and case studies related to the marketing of biobased products and services under consideration of industrial marketing will be analysed and answered.

Intended Learning Outcomes:
After attending the module, students will be able to use the instruments and methods of strategic and operational marketing related to biobased products and services thereby considering the specific aspects of industrial marketing in this context. They can deflect specific target groups for biobased products and services, analyse their behavior and derive targeted marketing strategies and their operationalization. Additionally, students can analyse the specific characteristics and challenges of sustainability-oriented products and services and are able to assess these in form of adapted marketing strategies and concepts. Students can evaluate the principles and specific tools of industrial marketing and can use these in the field of biobased products and services. Besides, students can distinguish important theoretical and practical approaches related to the procurement of business or state organisations and rate those with the specific characteristics of biobased products and services.

Teaching and Learning Methods:
The lecture will be done using Powerpoint with specifically worked out presentation scripts. In addition, published studies, scientific papers and statistical data will be integrated into the lectures. In the students' project, students use the taught methods and instruments of the marketing of biobased products and services, industrial marketing as well as their factual knowledge to analyse actual questions and cast studies related to the application fields of biobased products and services and derive adapted marketing strategies and concepts. They will present and discuss their approach and solutions with their colleagues and the lecturers.

Media:
Presentation slides, actual literature and studies, online discussion forum (all lecture materials are available via Moodle)

Reading List:
Specific literature and documents will be provided to the topics of the lectures as well as the topics that are worked on in the student projects

Responsible for Module:
Prof. Klaus Menrad

Courses (Type of course, Weekly hours per semester), Instructor:
Specific aspects of the marketing of biobased products (Vorlesung, 1 SWS)
Menrad K [L], Menrad K

Applied marketing for biobased products (Projekt, 2 SWS)
Menrad K [L], Menrad K, Stelzl B

Industrial marketing (Vorlesung, 1 SWS)
Menrad K [L], Stelzl B
For further information in this module, please click campus.tum.de or here.

Module Description

CS0228: Technology and Management of Renewable Energies in a Global Context | Technology and Management of Renewable Energies in a Global Context [REAE]

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
The exam will be in form of two oral presentations of the students. The interim presentation will be 15 minutes + 10 minutes discussion and feedback (30 % of the grade). The final presentation will be 20 minutes + 5 minutes discussion and feedback (70 % of the grade).

In this students' project, the students demonstrate understanding of specific questions related to a defined topic concerning the technology and management of renewable energies in a global context. Students have to show in their presentation that they can analyse, solve and answer defined problems and questions related to this topic. Participants of the course show that they have done appropriate research work and are able to present their results. By answering follow-up questions related to their presentation they show that they have learned to put their research outcome into the relevant technical or country context. The presentation slides will be handed over to the lecturers and will be included in the grading.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic know-how related to specific techniques of renewable energies (e.g. solar energy, wind energy, hydropower, biomass conversion technology, geothermal energy) as well as management of energy systems either on a company or on state level.

Content:
A) Technical aspects of different forms of renewable energies (e.g. current state of technology, technical options for the future, technical bottlenecks, scale-up possibilities)
- Wind power

- Hydropower
- Photovoltaics, solarpower
- Geothermal energy
- Biomass use for energy purposes
- Biofuels, electric vehicles, E-fuels
- Hydrogen
- Other forms of renewable energies

B) Economic aspects related to defined renewable energies (e.g. cost of use/production, cost structure and development in the past, learning curves, innovation and diffusion of renewable energies)
C) Influencing factors for adoption and use of renewable energies (e.g. natural/local conditions, availability of renewable resources, technical infrastructure, user structure of energy, cost and economic factors, financing, political and regulatory issues, social acceptance, behaviour of stakeholders and people)
D) Situation and development in a specific (country) context (e.g. governance, policy goals and activities, competing factors and interests (e.g. by fossil energy use or related companies/ stakeholders), legal and regulatory stability)

Intended Learning Outcomes:
At the end of the module, students will be able to analyse and elaborate solutions for existing problems related to the technology and management of renewable energies and apply such solutions to the specific context of selected countries worldwide. They consider both the technical side as well as the economic and management dimension in order to develop integrated solutions for a specific question related to renewable energies. Additionally they take the specific context and situation (e.g. technical infrastructure and know-how, maintenance, electrical or other grids, political and regulatory rules, economic framework, company and user structure) in one or several countries or regions into account when analysing and elaborating solutions for the question on-hand. They are able to apply their knowledge to create an oral presentation and a written summary of their findings. Presented results are discussed with the audience so that students are able to defend their solution and put it in an appropriate context.

Teaching and Learning Methods:
The module is a seminar, where course participants form (preferably international) teams that investigate a given topic by autonomously doing research work and discussing results within the team. During regular meetings with the lecturers questions can be discussed, next steps are defined and (interim) results are presented. Lecturers will provide basic and background material for the students as well as actual information for the given topics that are elaborated by the student teams.

Learning activities: Literature/document research, student group project

Media:
Presentation slides, online discussion forum (all lecture materials are available via Moodle)

Reading List:
Specific literature and documents will be provided to the topics that are worked on in the student projects

Responsible for Module:
Prof. Dr. 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

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

WI000997: Marketing Entrepreneurship Lab | Marketing Entrepreneurship Lab

Version of module description: Gültig ab summerterm 2013

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:
The grading is based on a presentation, a reflection paper and participation.
final presentation as a group (40%)
individual written reflection paper (40%)
class participation (20%)
mandatory participation of all
The seminar is on application:
https://academy.unternehmertum.de/programs/marketing-entrepreneurship-lab

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Learn from Max Wittrock, marketing expert and co-founder of jokolade and mymuesli, practical marketing and business knowledge and apply your marketing skills to real world Start-ups.
At the Marketing Entrepreneurship Lab students get the opportunity to improve their marketing knowledge and apply it to a real world challenge. Support a Start-up of your choice with a course-related project in the areas of strategic marketing, market research, product launch, etc (also possible as a team). The following topics are covered among others in the course:
• How do you create a marketing plan and decide on a strategy?
• How do you measure marketing effectiveness?
• The basics of Public Relations, Storytelling, and Social Media Marketing
• How to plan a Start-up market entry?
• How to balance budget and goals?

• The correlation of startup business models and marketing

Intended Learning Outcomes:
Have better understanding of marketing challenges and tools. Enable students to apply their theoretical knowledge about marketing and gain new capabilities in a professional and more practical direction by relating to real life startup marketing challenges.
Equip student with practical skills beyond the traditional marketing curriculum and thus close bridge students with startup founders to better equip them for working in a startup.

Teaching and Learning Methods:
lectures
group works
project-based learning
real Start-up cases

Media:
hybrid format, blocked seminar, presentation, discussion, clinic

Reading List:
will be presented at the start of the seminar

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

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

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

Module Description

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.

Life Cycle Assessment | Life Cycle Assessment

Module Description

CS0097: Advanced Environmental and Resource Economics | Advanced Environmental and Resource Economics

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Micro- and Macroeconomics

Content:
Many environmental issues, such as climate change, need to be considered globally. This course conveys concepts of optimal use of renewable and non-renewable resources in ex-ante viewing. In addition, the economics of water, energy markets, and natural resources such as fish and forest are deepened. Foundations of the New Institutional Economics illustrate the problem of the tragedy of common goods. Indicator systems such as Driver-Pressure-Stae-Impact-Response show the importance and complexity of environmental and sustainability measurement at national and international level.

Intended Learning Outcomes:
After attending the module, students will understand the role of renewable and non-renewable resources in the economy. Students can differentiate between the highest possible economic and sustainable return. They understand the functioning of energy and water markets. The

students gain an understanding of the New Institutional Economy, especially land ownership and the sustainable use of public goods. In addition, students understand the measurement of sustainability at the international and national level as well as the mathematical laws for the calculation of aggregated indices.

Teaching and Learning Methods:
The lecture and the seminar will be done by PowerPoint. In addition, articles from newspapers and journals are integrated into the lectures. In the seminar the students develop their own current case studies and discuss them from different perspectives based on the learned concepts and theories from the lecture. Classroom experiments are carried out for selected topics. Web lectures by internationally renowned experts and researchers will be integrated into the lecture.

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

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

Responsible for Module:
Anja Faße

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

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

Module Description

CS0120: Advanced Sustainability and Life Cycle Assessment | Advanced Sustainability and Life Cycle Assessment

Version of module description: Gültig ab winterterm 2023/24

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

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

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Fundamental knowledge in Life Cycle Assessment as demonstrated e.g. by the successful participation of the module Material Flow Analysis and Life Cycle Assessment or Principles of LCA.

Content:
The module contains units covering the following topics:
• Systems and life cycle thinking
• LCA following the ISO 14040/14044 and ILCD standards
• Extension of Life Cycle Assessment to Life Cycle Sustainability Assessments
• Advanced Life Cycle Impact Assessment Methods such as for
- Land use and land use change
- Water use
- Resource use
• Attributional and consequential assessments
• Regionalisation of inventories and impact assessments
• Hybrid approaches
• Uncertainty handling

• Interface with Multi Criteria Decision Analysis
• Presentation and visualisation of results
• Handling of data uncertainty
• Current trends and developments
• Software systems and data bases for material flow analysis and life cycle assessment
• Case studies

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

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

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

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

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

Responsible for Module:
Prof. Huber Röder

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

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

Materials | Werkstoffe

Module Description

CS0104: Biogenic Polymers | Biogenic Polymers [Bioplar]

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester

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

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

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

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

Media:
Presentations, slide notes

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

Responsible for Module:
Cordt Zollfrank

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

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

Module Description

CS0264: Polymer Processing | Polymer Processing [PolyProc]

Processing of polymers intro plastic parts

Version of module description: Gültig ab summerterm 2024

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

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

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

Repeat Examination:
Next semester

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

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

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

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

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

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

Responsible for Module:
Prof. Cordt Zollfrank

Courses (Type of course, Weekly hours per semester), Instructor:
Polymer Processing (Lecture) (Vorlesung, 2 SWS)
Zollfrank C [L], Fang W, Helberg J

Polymer Processing (Practical) (Praktikum, 1 SWS)
Zollfrank C [L], Fang W, Helberg J
For further information in this module, please click campus.tum.de or here.

Module Description

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

From the basics to the application

Version of module description: Gültig ab summerterm 2023

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

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

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

Repeat Examination:
Next semester

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

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

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

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

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

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

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

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

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

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

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

Responsible for Module:
Prof. Marc Ledendecker

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

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

Module Description

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

Version of module description: Gültig ab summerterm 2024

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

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

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

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

Repeat Examination:
Next semester

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

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

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

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

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

Media:
Presentations, slide notes

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

Responsible for Module:
Bettina Fink (bettina.fink@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

CS0314: Sustainable Fibre Technologies | Sustainable Fibre Technologies [SFT/P]

Sustainable fibre technology

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
Assessment takes the form of a written examination (120 minutes).
The students can demonstrate their ability to distinguish the chemo-physical, structrual and mechanical differences between various natural fibres, processed biopolymer fibre and regenerate fibres. They can describe basic sustainable fibre process technologies and fibre applications, and can answer questions regarding sustainable fiber spinning technologies.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Organic Chemistry, Polymer Chemistry, Chemical- & Thermal Process Engineering, Mechanical Processing of biogenic Materials,
Biogenic Polymers

Content:
The module provides an overview of fundamental production methods for biogenic and biodegradable fiber and their processing, covering the fibre structures and mechanical properties. The module introduces various fiber spinning technologies and guides on selecting appropriate methods for converting different bio-based polymers into fibers. The course also explores the applications of natural and biodegradable polymers in various industries, including textiles, packaging, and composites. Furthermore, it briefly covers material characterization methods for natural and biogenic fibers and their fibre composites.

Intended Learning Outcomes:
After completing the module, students will be able to evaluate the properties and applications of various natural fibers, synthetic and regenerated fibers made from biodegradable polymers. They will be able to explain the most important fibre spinning technologies and the most important characterization methods for fibres.

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

Media:
Presentations, scripts, exercises

Reading List:
- Dieter Veit; 2022. Fibers: history, production, properties, market. Weinheim: Springer. ISBN 978-3-031-15308-2, ISBN 978-3-031-15309-9 (eBook).
- Vijay Kumar Thakur and Manju Kumari Thakur, 2015. Handbook of sustainable polymers: processing and applications. Taylor & Francis Group.
- Sabu Thomas, Ajitha AR, Cintil Jose Chirayil, Bejoy Thomas, 2023 Handbook of biopolymers. Springer. ISBN 978-981-19-0709-8, ISBN 978-981-19-0710-4 (eBook)
- David Plackett, 2011, Biopolymers – New Materials for Sustainable Films and Coatings, John Wiley and Sons. ISBN 9780470683415

Responsible for Module:
Wenwen Fang

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

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

Module Description

CS0024BOK: BOKU: Engineered Wood Products | BOKU: Engineered Wood Products

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Written and oral
written preparation, oral examination interview The material of the last semester is relevant for the examination.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Prior attendance of the course 892323 materials is recommended.
Basic knowledge of mechanics or statics is required.

Content:
Selected material properties and their significance
Engineering of new materials
Material
Supporting elements and beams made of wood-based materials (BMS, LVL, LSL, PSL, I-beam)
Panel materials for load-bearing purposes
Panel materials for non-load-bearing purposes
Wood composite materials

Intended Learning Outcomes:
Students have ...
Knowledge of the properties of materials and their possible use for wood-based materials
Knowledge of the basics of material testing and material properties as well as material selection
Basics of 'engineering' (physical, economic and process aspects)

Overview of the wood-based materials available on the market, their properties and know the relationships that lead to these properties, as well as the areas of application of these materials

Teaching and Learning Methods:
Lecture

Media:

Reading List:
Powerpoint-Folien

Responsible for Module:
Johannes Konnerth johannes.konnerth@boku.ac.at

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

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

Module Description

CS0028BOK: BOKU: Wood-Industrial Processes: Wood- and Fibre-based Materials | BOKU: Wood-Industrial Processes: Wood- and Fibre-based Materials

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Written and oral
basically written; 65% needs to be reached

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Wood-based composites; first lecture will be a recapitulation.

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

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

Teaching and Learning Methods:
Interactive lecture

this is a "blended learning" lecture, means half is given is given in a face-to-face classroom situation, the other half is provided through videos uploads on moodle.

Media:

Reading List:

Responsible for Module:
Rupert Wimmer rupert.wimmer@boku.ac.ar

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

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

Module Description

CS0029BOK: BOKU: Composite | BOKU: Composite

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Written and oral
In preparation for the exam, a calculation example must be solved. The information, for example, is handed over individually when registering for the exam. In the oral part of the exam, the solved example is discussed and further questions from the lecture material are asked.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Students taking the exam are expected to be familiar with the material of the lectures: natural fibers, wood physics, and natural fiber materials and technologies.

Content:
The focus of the lecture is on mechanical properties of reinforcing fibers and composites in the micro and macro range, as well as on special features of lignocellulosic fibers in composite materials.

Intended Learning Outcomes:
The course aims to provide a basic understanding of the mechanical properties of composite materials, as well as the special features of bio-based composites.

Teaching and Learning Methods:
Lecture

Media:

Reading List:

Responsible for Module:
Wolfgang Gindl-Altmutter wolfgang.gindl@boku.ac.at

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

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

Module Description

CS0030BOK: BOKU: Wood and Fibre Quality | BOKU: Wood and Fibre Quality

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

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

Description of Examination Method:
Written and oral
written exam

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

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

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

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

Teaching and Learning Methods:
multimedia-supported

Powerpoint-based lecture, group discussions, content flexibility depending on interest and interaction dynamics

Media:

Reading List:
Wimmer, R., Downes, G.M., Evans, R., French, J. (2008): Effects of site on fibre, pulp and handsheet properties of Eucalyptus globulus. Annals of Forest Science 65 (6)

Wimmer, R. (2002): Wood anatomical features in tree-rings as indicators of environmental change–a review. Dendrochronologia 20(1-2): 21-36.

Downes, G.M., Wimmer, R., Evans, R. (2002): Understanding wood formation: Gains to commercial forestry through tree-ring research. Dendrochronologia 20(1-2): 37-51.

.....more literature is discussed during the first lecture

Responsible for Module:
Rupert Wimmer rupert.wimmer@boku.ac.at

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

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

Electives Category 3 | Wahlmodule Kategorie 3

Technical Electives | Fachspezifische Wahlmodule

Module Description

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

Version of module description: Gültig ab summerterm 2024

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

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

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

Repeat Examination:
End of Semester

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

Content:
Technologies that generate analyses or predictions based on data can be found in almost all areas of our daily life (e.g. recommender systems, autonomous driving, and credit card fraud detection).

These methods are also important for analyzing biological and biomedical data, e.g. for finding novel patterns in biological data, predicting the disease state of a patient, or the 3D structure of proteins. In this course, we will learn the fundamentals of machine learning and will apply these methods to various real-world problems.
The following contents will be treated exemplarily:
- Similarity and Distance Metrics
- Data Preprocessing and Visualization
- Dimensionality Reduction (e.g., Principal Component Analysis)
- Classification (Nearest-Neighbor, Logistic Regression, Decision Trees, Support Vector Machines (SVM))
- Model Selection and Hyperparameter Optimization (Confusion Matrix and Evaluation Measures, Cross-Validation, Hyperparameter tuning techniques, Common problems such as Over- vs. Underfitting)
- Clustering (K-Means, Hierarchical Clustering)
- Regression Models (Linear Regression, Support Vector Regression)

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

Intended Learning Outcomes:
The students know the fundamental and most important artificial intelligence, especially machine learning, methods and are able to apply them independently on various real-world problems. The students learn the basics of the programming language Python (one of the leading programming languages in the field of machine learning) and are able to implement and apply machine learning algorithms in Python. In addition, students are able to visualize and interpret different types of data and results independently. Students will understand how artificial intelligence can support areas of biotechnology and sustainability and are able to assess the potential of AI-based approaches in sustainability projects.

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

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

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

Responsible for Module:
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

CS0113: Innovation in Bioeconomy | Innovation in Bioeconomy

Version of module description: Gültig ab winterterm 2024/25

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

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

Description of Examination Method:
The grading is based on a written exam (90 Minutes). The written form of the exam allows a comprehensive assessment of students' knowledge and understanding of the principles of innovation management and entrepreneurship with a focus on bioeconomic questions and concepts. Building on a core understanding of the principles of innovation management and entrepreneurship, students will answer questions about the more recent innovation and entrepreneurship concepts and have the ability to explain the adapted strategies and options for new ventures firms. They will also be able to assess the relevance of technologies and resources related to the bioeconomy and the different options to design sustainable business models in the context of bioeconomic questions.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Entrepreneurship, Introduction to Innovation Management

Content:
The module introduces students into advanced principles of innovation management and entrepreneurship from a sustainable perspective. Students will be equiped with basic knowledge on:
- design of business models to implement sustainable innovation
- advanced methods to generate and implement sustainable innovation
- role of ecosystems and networks

Beyond that, students will engage in break-out group workshops to personally experience the process of developing and evaluating sustainable innovation activities. Students give presentations to the audience and discuss their results.

Intended Learning Outcomes:
Following the completion of the course, the students will be familiarized with theoretical concepts and empirical methods to:
• assess the different forms and contents for identifiying and organising entrepreneurial ideas and innovative solutions in the context of the Bioeconomy by including broader economic, environmental and societal effects
• derive recommendations about the design and practices of innovation management and entrepreneurship and how to implement sustainable innovation
• identify and evaluate environmental technologies and design scenarios for firms to implement sustainable innovation

Teaching and Learning Methods:
The module will combine several learning methods.
- The basic knowledge as well as real world examples and case studies will be provided through the lecture.
- Discussions in the lecture and active participation are encouraged and will contribute to deepen the understanding of the concepts introduced.
- In the tutorial, the academic concepts will be discussed and applied in case studies. The students will further apply (part of) their theoretical knowledge to real-world problems and present their results in teams. This format fosters team work.
- Students will get additional background knowledge from the scientific literature in private reading.

Media:
Presentation, Power-Point Slides, Case Studies

Reading List:
The reading list is compiled from the latest contributions of relevant scientific journals, including the Academy of Management Journal, Research Policy, Strategic Management Journal, and will be made available to the students.

Responsible for Module:
Claudia Doblinger

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

Innovation in Bioeconomy (Exercise) (Übung, 2 SWS)
Doblinger C [L], Fischer D, Eichinger K, Zafirova K, Ullmann A
For further information in this module, please click campus.tum.de or here.

Module Description

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

Version of module description: Gültig ab summerterm 2022

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

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

Description of Examination Method:
The performance test will be in the form of a written examination. The students should demonstrate in the exam the understanding of the physicochemical principles governing natural systems. They will be asked about
Basic concepts of physical chemistry applied to energy conversion in natural systems and to the structure of biomolecules. No auxiliary means are allowed in the exam. 120 min examination time

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
This course will intend to consolidate basic concepts in Physics, Mechanics, Chemistry, and Mathematics having the focus on Nature examples. As such, basic knowledge in Physics, Chemistry, Mechanics, and Mathematics is required.

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

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

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

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

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

Responsible for Module:
Prof. Dr. Rubén D. Costa Dr. Juan Pablo Fuenzalida Werner

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

CS0245: Advanced Electronic Spectroscopy | Advanced Electronic Spectroscopy

Version of module description: Gültig ab summerterm 2022

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

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

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

Repeat Examination:
End of Semester

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

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

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

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

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

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

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

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

Courses (Type of course, Weekly hours per semester), Instructor:
Advanced Electronic Spectroscopy (Lecture) (Vorlesung, 2 SWS)
Costa Riquelme R [L], Atoini Y, Costa Riquelme R, Gutierrez Armayor D

Advanced Electronic Spectroscopy (Exercise) (Übung, 2 SWS)
Costa Riquelme R [L], Atoini Y, Costa Riquelme R, Gutierrez Armayor D, Lipinski S
For further information in this module, please click campus.tum.de or here.

Module Description

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

Version of module description: Gültig ab summerterm 2022

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

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

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

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Organic and anorganic chemistry, botany

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

Intended Learning Outcomes:
After their participation, students can explain the production of phytopharmaceuticals derived from typical medicinal plants (from collection to quality control). They can relate chemical compounds and medical effects of typical examples.

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

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

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

Responsible for Module:
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

CS0263: Geothermal Energy Systems | Geothermal Energy Systems [GeoE]

Potentials of geothermal energy supply

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

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

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

Repeat Examination:
End of Semester

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

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

This includes the design and working principle of a heat pump system and its integration in technical building equipment as well as the analysis of their ecological and economic sustainable operation on living quarter scale. The analysis is also done with regards to existing technical guidelines as well as legal boundary conditions. Practice-oriented tasks will be used to

demonstrate and critically evaluate the basic planning steps of heat pump systems and obtaining the relevant parameters. Existing and innovative geothermal exploration concepts will be analyzed and discussed against this background.

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

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

Teaching and Learning Methods:
The content is taught in lectures and presentations and strengthened by case studies and exercises. If applicable, the module is complemented by an excursion.

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

Reading List:
Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen (2005): Oberflächennahe Geothermie.
Bauer, M., Freeden, W., Jacobi, H., Neu, Th. (Hrsg.) (2018): Handbuch Oberflächennahe Geothermie. Springer Spektrum, 1. Auflage.
Stober, I. & Bucher, K. (2014): Geothermal Energy. Springer Spektrum, 1st edition.
Hölting, B., Coldewey, W.G. (2013): Hydrogeologie. Springer Spektrum, 8. überarbeitete Auflage.
Dassargues, A. (2018): Hydrogeology: Groundwater Science and Engineering, CRC Press, 1st edition.
Grotzinger, T. & Jordan, T. (2017): Press/Siever Allgemeine Geologie. Springer Spektrum, 7. Auflage
Grotzinger, T. & Jordan, T. (2014): Understanding Earth. W.H. Freeman & Company, 7th edition

Responsible for Module:
Prof. Thomas Vienken

Courses (Type of course, Weekly hours per semester), Instructor:
Geothermal Energy Systems (Vorlesung mit integrierten Übungen, 4 SWS)

Vienken T [L], Vienken T
For further information in this module, please click campus.tum.de or here.

Module Description

CS0103: Bioinspired Materials and Processes | Bioinspired Materials and Processes [BioinspMaterProc]

Version of module description: Gültig ab winterterm 2020/21

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

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

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

Repeat Examination:
Next semester / End of Semester

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

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

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

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

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

Media:
Presentations, lecture notes

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

Responsible for Module:
Cordt Zollfrank

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

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

Module Description

CS0149: Renewable Resources in Medicine | Renewable Resources in Medicine

Version of module description: Gültig ab summerterm 2023

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

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

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

Repeat Examination:
Next semester

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

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

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

from renwable ressources in medicine due to their aquired medical, chemical and materials science knowledge and they can set the base for the potiental application of such materials.

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

Media:
Presentation, script, examples, case studies

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

Responsible for Module:
Prof. Cordt Zollfrank

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

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

Module Description

CS0320: Biofilms and Biofouling | Biofilms and Biofouling [BiofBiof]

Version of module description: Gültig ab summerterm 2025

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 120	**Self-study Hours:** 30	**Contact Hours:** 90

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

Description of Examination Method:
The exam lasts 60 minutes. Students should be familiar with the topics covered in the lecture and be able to name and explain their knowledge of biofilms and biofouling. Calculations and interpretation of measurements from biofilm research will be carried out in a similar way to the examples given in the lectures. The results of the group work are part of the examination and should be discussed and evaluated using the terminology learned.
Participation and collaboration in the working groups is a mandatory requirement for the exam. However, this work will not be assessed and will not count towards your final grade.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The Biofilms and Biofouling module focuses on the formation, maturation and spread of biofilms. It also covers their structure, composition and the microbiological principles needed to better understand and assess their occurrence. Practical examples are used to discuss the existence of beneficial biofilms and harmful biofouling. The resulting consequences are also discussed and demonstrated for each topic, so that ultimately prevention and control can also be evaluated.

Intended Learning Outcomes:
After completing the module 'Biofilms and Biofouling', students will be able to give examples of the occurrence of biofilms and explain their formation and composition. They will be equipped to describe and classify the nutritional requirements and behaviour of various prokaryotic and eukaryotic organisms based on the microbiological principles they have learnt. This knowledge will then enable students to consider and evaluate the use and control of biofilms. Lecture-based

exercises and small group work will also help students to deepen their knowledge so that they are capable of giving a scientifically based presentation on their group topic.

Teaching and Learning Methods:
The module consists of two parts: a lecture with integrated exercises and a project part in which students work on their own topics in small interdisciplinary groups. PowerPoint presentations, quizzes, films, pictures and books are used as needed to teach the students, partly through lectures but also through collaborative work on the black or white board.

Media:
Media types include scripts, PowerPoint, quizzes, films and sample objects. Participants work on their own projects in small, interdisciplinary groups.

Reading List:
DONELLI, Gianfranco (Hg.). Microbial biofilms: methods and protocols. New York, NY, USA:: Humana Press, 2014.
KANEMATSU, Hideyuki; BARRY, Dana M. Formation and control of biofilm in various environments. 2020.

Responsible for Module:
Gmach, Yvonne; Dr. rer. nat.

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

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

Module Description

CS0305: Research Excursion Master | Research Excursion Master

Version of module description: Gültig ab summerterm 2024

Module Level: 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:
Passed/not passed:
The module is passed when the students deliver a learning portfolio consisting of the following elements::
1. 2 written pages or 20’ presentation on 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. 5-10 PPT slides reflecting the findings based on a case study visited during the excursion. The due date will be specified in the kick-off session;
4. Final report of case studies and results of the workshop;

All four 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 topics from modules and / or the study programs for which it is designed. On an individual basis, professors and lecturerers from these modules / study programs 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.

After the excursion the results of the applied methodologies are presented and discussed in a workshop. Key findings and the results of the workshop are included in a final excursion report by the students.

Intended Learning Outcomes:
The excursion aims to support the scientific profile building of students and the acquisition of scientific, practical and social competencies and the application to case studies visited during the excursion. It supports the competence acquisition in other modules and / or the study programs in general. The students get practical insights into the topical field of the research excursion, deepen their comptencies in this field regarding ongoing research and apply their competencies to real case studies in practice.

In particular, the intended learning outcomes are the following:
- Select relevant scientific and practical information and recall it for for visits of 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,
- Perform structured interviews and talks with experts and stakeholders in practice
- Apply methodologies from theoretical lectures and exercises on practical organizations

Teaching and Learning Methods:
The research excursion consists typically of the following elements (teaching, learning and application of methods):
- Kick-off session: To achieve a good get-to-know, brief the students about the module contents, course and required performance an interactive in-presence workshop will be carried out. This covers presentations, and interactive elements such as role games 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, interviews of experts 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,
- Workshop: the students will present and discuss their findings in a workshop to gain practical experience for their future working conditions and formulate a final excursion report.

Media:
Digital projector, board, flipchart, online contents, recent scientific journal publications, equipment and utilities demonstrating production processes in practice

Reading List:
Topic related reading, especially articles in international peer reviewed journals, will be provided during the course of the module.

Responsible for Module:
Prof. Cordt Zollfrank Prof. Hubert Röder Prof. Magnus Fröhling

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

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

Module Description

CS0324: BioTech Ventures | BioTech Ventures [Biotech Ventures]

Biotech Ventures

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's learning objectives are examined via exercises comprising the three elements outlined below. The grading will reflect both group performance and individual contributions, ensuring that each student is evaluated based on their collective and personal input.
(1) Individual written reflection paper of 1/2 page (font size 12; double line spacing) (10%): At the end of each session, you will submit a reflection paper 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 shows the progression of your group's biotech venture, reflecting how you incorporated the content elements of the course. In the session, you will present a part of your group's biotech venture. 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 on stage and within your team. The final pitch will be graded, while the first and intermediate pitches are designed as opportunities for practice, reflection, and feedback. These preliminary presentations provide a chance to refine ideas, incorporate constructive criticism, and enhance the overall approach in preparation for the final assessment.

(3) Group written reporting of approx. 10 pages (depending on group work and size; font size 12; double line spacing) (30%): As part of a group composed in the first two weeks of the course, you will work on a biotech venture project by assessing, analyzing and designing biotech 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 biotech ventures, determine and evaluate suitable 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, 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:
To ensure a well-rounded approach, the course values participants from both social and natural sciences, recognizing that addressing complex challenges requires expertise from both domains. Given the course's emphasis on interdisciplinarity, it seeks two distinct skill sets. You should (1) have a solid foundational understanding in the subject area of entrepreneurship, bioeconomy, policy and regulatory frameworks and/or the core principles of sustainable management or you should (2) have a solid technological understanding of biotechnology, natural sciences and/ or engineering sciences, demonstrated through prior coursework, practical experience, and/ or a strong academic or professional interest. Students from interdisciplinary backgrounds are encouraged to apply, as well as those with a strong foundation in any one of these fields and interest to work in interdisciplinary teams, to foster diverse perspectives and collaboration within the course.

Content:
Building biotech 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 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 biotech venture process in a real-world project. It introduces you to theories, concepts, and frameworks for biotech ventures. Students will work on a real-world, biotech-related problem and new technology to address that problem, resulting in a venture ideation. Students will gain hands-on experience in the startup process, learning how to identify, assess, analyze, design, build, and launch ventures.

Emphasis will be placed on effective collaboration within interdisciplinary teams to tackle real-world challenges. The course will help students build a strong biotech network and community, providing opportunities for collaboration and support. Students will work on creating new companies aimed at addressing high-impact problems, from ideation to market entry. In doing so, the teams continously ensure that positive pro-social and environmental impact is created by involving and engaging experts and potential customers through interviews. This also contributes to creating a network in this sector.

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. The course will teach customer-centric approaches to developing climate solutions, emphasizing the importance of understanding and addressing customer needs. Students will have the opportunity to translate the theoretical knowledge immediately into practice through testing and evaluating their venture idea in close relation with expert and customer feedback.

Navigating the regulatory and market landscapes influencing biotech 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 scientific, technical, business, and social drivers and barriers behind the complex biotech challenges 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 biotech ventures in practice
(2) Uncover and assess the implications relevant scientific, technical, business, political, and environmental drivers and barriers behind biotech ventures
(3) Determine and evaluate venture strategies considering venture-specific and contextual factors through research and external feedback
(4) Prioritize and initiate actions and decisions for implementing biotech ventures with impact (e.g., through circularity considerations)
(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
(6) Work in an interdisciplinary team with members of different academic and disciplinary backgrounds.

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

To enable building up a solid knowledge fundament, action-learning elements such as presentations and discussions of course material, interview results, and relevant publications; individual mentoring; and interactions with guest speakers are integrated.

Continuous mentoring on the biotech ventures will ensure that the newly acquired knowledge will be directly applied. Groups are asked to gather information on their venture cases through interviews.

Through presentations, discussions of intermediate findings, guest lectures, and feedback provided by the instructor(s), mentors, and industry experts, 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:
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

CS0327: Microenergy Harvesting and Conversion for a Sustainable Future | Microenergy Harvesting and Conversion for a Sustainable Future [MH]

Version of module description: Gültig ab summerterm 2025

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

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

Description of Examination Method:
The performance test for this course will be a 120-minute written examination. Students will be required to demonstrate their understanding of the physicochemical principles underlying energy conversion systems and the structure of biomolecules. The exam will emphasize the application of fundamental physical chemistry concepts to energy-harvesting mechanisms and the material properties of both natural and engineered systems. No supplementary materials will be allowed during the examination.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
While no formal prerequisites are required, prior coursework in physical chemistry, materials science, or nanotechnology is recommended, along with skills in analyzing scientific literature.

Content:
This course provides a detailed introduction to the principles, materials, and technologies involved in microenergy harvesting. Students will learn about the process of converting ambient energy from mechanical, thermal, light, and electromagnetic sources into usable electrical energy. Key topics include energy harvesting methods such as thermoelectric, piezoelectric, triboelectric, photovoltaic, and RF systems, as well as less conventional approaches like water interaction-based and biobased energy harvesters. The course focuses on the design, improvement, and application of energy harvesting systems, with an emphasis on materials like nanostructures, thin films, and biodegradable components. Students will also study how to integrate energy storage, fabrication techniques, and ways to improve efficiency and durability. Real-world uses

will be explored, including powering IoT devices, wearables, and technologies built for extreme environments, along with the challenges of scaling up these systems.
Through lectures, discussions, and reviews of recent scientific advancements, students will develop the skills to evaluate energy harvesting technologies and apply what they learn to design practical, sustainable solutions for modern energy challenges.

Intended Learning Outcomes:
By the end of this course, students will understand how microenergy harvesting works and how it is used to convert ambient energy—mechanical, thermal, light, and electromagnetic—into usable electricity. They will also learn why it is important for powering IoT devices, wearable electronics, and other low-power systems. Students will study the performance of key energy harvesting technologies, such as thermoelectric, piezoelectric, triboelectric, photovoltaic, and RF systems, along with less common methods like water-based and biobased approaches. They will look at the potential uses of these technologies and the challenges they face. Students will also learn about advanced ways to make these devices and explore the difficulties of scaling them up for real-world applications. In addition, they will look at the reliability, durability, and new trends in microenergy harvesting research.

Teaching and Learning Methods:
The lecture will follow a traditional format, using PowerPoint presentations to explain core concepts and including examples from scientific literature to provide practical context and highlight key ideas. The seminar will take a blended active learning approach, combining traditional exercises that reinforce technical concepts with creative activities, such as infographics, short films, and visual presentations, to build communication skills. It will also include debates and case study discussions to encourage critical thinking, teamwork, and a balanced understanding of the strengths and weaknesses of emerging technologies

Media:
The course will primarily use PowerPoint presentations, supported by examples from scientific literature and exercise sheets. Multimedia resources, such as videos and online platforms, will provide interactive learning, while seminars will include visual aids like infographics and creative presentations to enhance engagement.

Reading List:
1. Atkins' Physical Chemistry 8th Edition Peter Atkins and Julio De Paula, Oxford University Press, 2006, ISBN: 0-7167-8759-8
2. Energy Harvesting Technologies, 1st Edition Shashank Priya, Daniel J. Inman, Springer, 2008, ISBN: 978-0-387-76463-4
3. Materials Science and Engineering: An Introduction, 7th Edition William D. Callister, Wiley, 2007, ISBN: 978-0-471-73696-7
4. Electronic Properties of Materials, 4th Edition by Rolf E. Hummel, Springer, 2011 ISBN: 978-1-4419-8163-9

Responsible for Module:
Dr. Anna Zieleniewska

Courses (Type of course, Weekly hours per semester), Instructor:
Microenergy Harvesting and Conversion for a sustainable Furture (Lecture) (Vorlesung, 2 SWS)
Costa Riquelme R, Zieleniewska A

Microenergy Harvesting and Conversion for a Sustainable Furture (Exercise) (Übung, 2 SWS)
Costa Riquelme R, Zieleniewska A
For further information in this module, please click campus.tum.de or here.

Module Description

SOT86701: EuroTeQ Collider. Enhancing Connections for Sustainable Futures (MSc) | EuroTeQ Collider. Enhancing Connections for Sustainable Futures (MSc)

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
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:
Next 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 send 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 Technical University of Munich (TUM) joint forces within eight leading universities of science, technology and business to foster the European spirit in a EuroTeQ format to promote innovative engineering education across Europe. Together, we are created the first EuroTeQ Collider in 2022. Now, the journey goes into the second round. The Collider is an innovative learning format with the aim of bringing students together with vocational trainees and professionals to tackle challenges. The theme for the period 2024-2026 is “Enhancing connections for sustainable Futures”. The goal is to connect participants with different profiles and personalities to boost creativity, innovation, shared understanding, enabling participants to imagine new approaches and design disruptive solutions.

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:
- Select and apply appropriate design, engineering and business approaches and tools to create an innovative and science-based solution to a real-life challenge.
- Develop a profound interpretation of a complex, real-life problem and its context using a system-thinking approach, considering multiple perspectives.

- Develop a problem-driven, creative, and integrative design, demonstrated by a concrete prototype that balances desirability, feasibility, and viability.
- Use disciplinary knowledge and expertise in an inter-disciplinary team to develop an innovative and scientifically sound solution in a European context.
- Communicate your ideas, at different levels of elaboration, via several mediums in an international context to a diverse set of stakeholders.
- Define and regularly reflect on personal and team development.

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 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

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

Version of module description: Gültig ab winterterm 2022/23

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

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

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

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

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

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

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

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

Teaching and Learning Methods:
Lecture with integrated exercises

Media:

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

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

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

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

Module Description

CS0031BOK: BOKU: Mechanical and Thermal Process Technology II | BOKU: Mechanical and Thermal Process Technology II

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 75	**Self-study Hours:** 30	**Contact Hours:** 45

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

Description of Examination Method:
written and oral

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Lecture Mechanical and Thermal Process Engineering I (MTV I; LVA 893.122)

Content:
Part A: Modern separation processes

1 Modern extraction processes

2 Processes with supercritical gases (SFE, SFC, RESS, GAS´.)

3 Membrantrennverfahren

4 Process chromatography´ preparative chromatography

Part B: Reaction Process Engineering

5 The reaction balance

6 Reaction kinetics

7 reactors

8 Dwell time and dwell time spectrum

Intended Learning Outcomes:
Based on the lecture MTV I, modern separation processes, which are of growing importance for food as well as for biotechnology, are presented in more detail. In addition, reaction process engineering is a very important area of process engineering that is systematically presented from the basics to the application, which flows into many other courses, but has so far only been presented very briefly and incoherently. Towards the end of the course, it is taught how the previously acquired knowledge, which has largely been limited to individual process steps (unit operations), can be integrated into entire processes.

Teaching and Learning Methods:
Lecture with integrated exercises

Media:

Reading List:

Responsible for Module:
Senad Novalin senad.novalin@boku.ac.at

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

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

Module Description

CS0033BOK: BOKU: Applied Measurement and Control Systems | BOKU: Applied Measurement and Control Systems

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Examination immanent (attendance, cooperation, final test) Presentation of one technical term each 20 pts (1 measurement technology and 1 control technology), 2 homework of 30 pts each (1 measurement technology and 1 control task)

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basics of measurement and control technology (VO MRI I).

Content:
Practical examples from measurement and control technology. Participants learn typical problem definitions, solutions and modeling techniques.

Intended Learning Outcomes:
Students have the ability to develop solutions for typical measurement tasks.
Students can estimate measurement errors and consequential errors based on them.
Students are familiar with a modeling program (MATLAB or similar) for control systems.
Students have the competence to discuss measurement principles and their measuring ranges.
Students have the competence to discuss controller designs and their areas of application.

Teaching and Learning Methods:

Media:

Reading List:
Skript Mess- und Regeltechnik I, Teil 1 und 2; further literature will be given in the lecture.
Strohrmann G.: Meßtechnik im Chemiebetrieb, Verlag Oldenbourg.
Niebuhr J., Lindner G.: Physikalische Messtechnik mit Sensoren, Verlag Oldenbourg.
Weichert N., Wülker M.: Messtechnik und Messdatenerfassung, Verlag Oldenbourg.
Freudenberger A.: Prezessmesstechnik, Vogel Buchverlag.
Fritz W.: Regelungstechnik mit SPS, Vogel Buchverlag.

Responsible for Module:
Christoph Pfeifer Christoph.pfeifer@boku.ac.at

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

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

Module Description

CS0037BOK: BOKU: Seminar in Global Change and Ecosystems | BOKU: Seminar in Global Change and Ecosystems

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 50	**Self-study Hours:** 35	**Contact Hours:** 15

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

Description of Examination Method:
Evaluation of student presentation of a scientific publication. Evaluation of content and form of presentation; details will be announced in course. For a successful approbation, max. 2 missing dates will be tolerated.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basics in Ecology
advantageous: VO Global Change and Ecosystems

Content:
This seminar complements and extents the lecture VO 833.318 Global Change and Ecosystems. In the focus will be the following anthropogenic, global changes and their effects on organisms and ecosystem: greenhouse effect (atmospheric CO2 concentrations, warming, extreme weather events), ozone hole vs. surface ozone, increasing nitrogen deposition, land use change, decline in biodiversity, light pollution, noise pollution, plastic pollution, genetically modified organisms, pesticide use. In this seminar topics from the lecture will be complemented and deepened by student presentations. Great emphasis will be given on a critical discussion of the relevant scientific literature.

Intended Learning Outcomes:
1. Learn how to utilize relevant scientific data bases
2. Critical discussion of scientific literature and knowledge
3. Improvement of presentation skills

Teaching and Learning Methods:
Presentation of scientific articles

Media:

Reading List:

Responsible for Module:
Johann Gustav Zaller johann.zaller@boku.ac.at

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

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

Module Description

CS0038BOK: BOKU: Medicinal and Aromatic Plants | BOKU: Medicinal and Aromatic Plants

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Written

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
- Definitions of medicinal and spice plants, drugs, secondary substances

- Use and economic importance of medicinal plants, spice plants and essential oils

- main cultivation areas, main crops and production data

- Trade figures and business data

- Special features of medicinal plant production and spice plant production: formation, deposition and preservation of secondary plant substances

- Quality and quality-influencing factors: genetics, breeding, variety

- morphogenetic and ontogenetic variability

- Environmental influences and plant cultivation measures

- Possible applications for agrochemicals, residue problems

- Special features of "drug production": harvesting including special harvesting methods

- Post-harvest treatment and processing in the production plant (drying plants and distillation plants)

- Discussion of the CAP guidelines (Good Agricultural Practice) for medicinal and spice plant production

- Domestication of wild plants: native species: e.B. yellow gentian, arnica, yarrow, tropical and subtropical species: e.B. Ipecacuanha, Dioscorea, Lippia sp. u.a.

Arranged according to the classic secondary substance groups essential oils, glycosides and alkaloids are discussed in the individual species:

- Botany - Ingredients - Use

- Soil and climate demands, crop rotation

- Varieties and cultivation (no-till, cultivation)

- Fertilization, care, plant protection (diseases and pests)

- Harvesting, processing, quality requirements

- Essential oily species: mint, sage, thyme, marjoram, caraway, fennel, coriander, parsley, dill, chamomile, yarrow, calendula, iris, cloves, cinnamon, nutmeg, etc.

- Glycoside-containing species: foxglove, St. John's wort, medicinal rhubarb, Sennes leaves, etc.

- Alkaloid-containing species: poppy seeds, celandine, wild cherry, stecha apple, vinca, Chinese bark, etc.

- Other: coneflower; mallow, marshmallow; Aloe u.a.

Intended Learning Outcomes:

Medicinal plants and spice plants represent a small but economically interesting group of alternative crops in terms of cultivation area. Their importance has been steadily increasing in

recent years. The aim of the course is to impart knowledge about the diversity of this plant group, including its ingredients (secondary plant substances) and its use as renewable raw materials. In addition, it is important to get to know the framework conditions for this branch of production, which requires a special infrastructure in the production plant, such as .B drying plants or extraction plants.

Based on the teaching content of the winter semester, special knowledge about cultivation, harvesting and processing of ingredients and use of the most important domestic, but also selected subtropical and tropical medicinal plant species and spice plant species is to be developed.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Johannes Novak Johannes.novak@boku.ac.at

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

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

Module Description

CS0039BOK: BOKU: Practical Course in Energy Engineering | BOKU: Practical Course in Energy Engineering

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 65	**Contact Hours:** 10

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

Description of Examination Method:
95% arithmetic mean of the grades of the protocols. All modules have to be completed positively. 5% counts the oral performance at the introductory lectures. In the case of insufficient preparation / negative oral examination, participation in the practical course can be denied by one of the lecturers.

Minutes submitted after the deadline will be judged negative.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basic knowledge in energy technologies, but also in the fields of mechanics, fluid mechanics, thermodynamics and measurement engineering. Following LVA's are recommended for the practical course:
1) Process engineering I and II
2) Energy and environment engineering
3) Energy engineering

Content:
The practical course focuses on various energy- related topics, like energy production, energy conversion and energy consumption. The teaching content includes experiments in the field of renewable energy production, but also exercises for energy conversion (chemical, mechanical, electrical) and efficient energy consumption. In the practical course selected exercises from this themes are executed. The practical course focuses also on sustainable energy consumption. The practical course consists of 4 stations (wind turbine test facility, high temperature heat pump test bench, engine test bench and fan test bench).

For each station, a protocol has to be prepared.

Intended Learning Outcomes:
The focus of the course objects the practical application of theoretical knowledge in the areas of process engineering, energy engineering and measurement engineering.
Practical experience in case of sustainable energy production, energy conversion and energy consumption.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Jan Kotik jan.kotik@boku.ac.at

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

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

Module Description

CS0152BOK: BOKU: Ecology | BOKU: Ökologie [CS0152BOK]

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:** 30	**Contact Hours:** 60

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

Description of Examination Method:
Written
Five questions (6 points each, 30 points overall) are asked corresponding to the five focal subject areas. Points/grade <15: 5 15 - <19: 4 19 - <23: 3 23 - <27: 2 >=27 : 1

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
-

Content:
1. FUNDAMENTAL PRINCIPLES: environmental factors, bioindication, resources
2. INTERACTIONS: competition, predation, decomposers
3. BIOCOENOSES (COMMUNITIES): energy flow, nutrient balance, structure, stability, succession
4. POPULATIONS: adaptation, evolution, ecological niche, individuals - population, migration, dispersal, life cycle, frequency of occurrence, endangerment

Intended Learning Outcomes:
After successful completion of the course, the students have theoretical and practical knowledge of ecological cycles, interactions and population ecology. They know fundamental terms and facts and understand the great importance of interactions in ecosystems and organisms. Their gained knowledge establishes the basis for problem solving in conservation and management, but also for the understanding of biodiversity.

Teaching and Learning Methods:
-

Media:
-

Reading List:
Folienskripten zu den einzelnen Kapiteln stehen Boku-intern im Netz

Responsible for Module:
BOKU Organisation: Botanik Peter Hietz, Andrea Funk, Thomas Hein, Christine Sheppard, Karin Tremetsberger

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

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

Module Description

CS0059BOK: BOKU: Applied Biocatalysis | BOKU: Applied Biocatalysis

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Oral exam.

Repeat Examination:
Next semester / End of Semester

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

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

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

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

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

Media:

Reading List:

Responsible for Module:
Dietmar Haltrich (BOKU)

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

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

Module Description

CS0060BOK: BOKU: Automation of Bioprocesses | BOKU: Automation of Bioprocesses

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Continuous assessment

The lecture is split into a theoretical and a practical part. The evaluation criterion for the theoretical part is based on the assessment of involvement and active participation and represents 40% of the final grade.
The practical part is organized in form of teamwork practice. The task to be solved is an automation problem in industrial environment. This part contributes 60% to the final grade.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Lecture

- Basics of automation, definitions, layout of a biotech plant

- Hardware: signal acquisition, interfacing, visualisation, systems hierarchy and ´architecture (field bus, smart sensors, actors)

- Design, system specification, contract specification

- Validation (QA) (GAMP)

Practical:

- Layout of vessel, I scheme, I/O list, layout system specification, contract specification

- DEMO process control software

Intended Learning Outcomes:
After successful completion of this course, students will be able to explain general bioprocess automation concepts and process control strategies as well as hardware and software solutions. Students will be able to select required hardware components and software solutions for bioprocess automation. They can define specification requirements.

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
Gerald Striedner (BOKU)

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

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

Module Description

CS0061BOK: BOKU: Planning and Assessment of Waste Management Systems | BOKU: Planning and Assessment of Waste Management Systems

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 75	**Self-study Hours:** 51	**Contact Hours:** 24

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

Description of Examination Method:
The total grade consists of the following individual specification:

- Participation and self-dependence, small exercises: 30%
- LCA case study elaboration: 40%
- LCA case study epresentation and discussion: 30%

Continuous assessment

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
The content of the LVA Life cycle management (813.304) or similar knowledge to Life cycle Assessment, Impact categories, Assessment Methodologies... is expected.

Content:
- Introduction to the assessment of projects and plans - strategic environmental assessment (SEA) and life cycle assessment (LCA)
- Scenario development
- Details on impact assessment
- Modelling of waste treatment technologies in life cycle assessment
- Introduction to the life cycle assessment software GaBi
- Elaboration of a LCA case study using the GaBi-Software tool

Intended Learning Outcomes:
Participants are able to assess waste management measures and to use specific soft ware tools (e.g. GaBi 6.0). They know basic methods and instruments for environmental assessment and can also evaluate them practically. The participants are able to independently calculate a life cycle assessment.
They have theoretical and practical knowledge of basic methods and tools for environmental assessment (LCA) and strategic desicion-making in waste management planning

Teaching and Learning Methods:
lecture with exercises
The lecture is very similar to the procedure in reality. First, the basic scenarios of an SEA are discussed, and the LCA case studies are based on these. The calculation and presentation of the LCA results (preparation in small groups of 2-3 people) brings all participants to a comparable level of knowledge, which is necessary for the further discussion process.
The VO units are held in blocks (4 or 6 units each), each ending with a preparation for the exercises. Furthermore, pure "exercise blocks" are also carried out, which make it easier for the students to start the exercise by the presence of the lecturer. The attendance blocks correspond to 24 hours, whereby approx. 50-55 hours should be spent on the "home exercises".

Media:

Reading List:

Responsible for Module:
Gudrun Obersteiner (BOKU)

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

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

Module Description

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

Version of module description: Gültig ab winterterm 2022/23

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

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

Description of Examination Method:
Written exam

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

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

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

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

Teaching and Learning Methods:
Classroom lecture, self-study

Media:

Reading List:

Responsible for Module:
Georg Gübitz (BOKU)

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

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

Module Description

CS0148BOK: BOKU: Energy Efficient Heating, Cooling and Hot Water Supply of Buildings | BOKU: Energy Efficient Heating, Cooling and Hot Water Supply of Buildings [CS0148BOK]

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:** 30	**Contact Hours:** 60

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

Description of Examination Method:
Written
Written exam as online multiple choice test in BOKU-Learn. Presence in the lecture hall during the exam (students have to bring their own laptops/tablets) Theory questions (approx. 67%) and calculation examples (approx. 33%) At least 50% of the total number of points for positive evaluation Grading scale: 100 - 88: S1 87.9 - 76: U2 75.9 - 64: B3 63.9 - 50: G4 < 50: N5

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
Students are familiar with the design and operation of systems for heating and cooling of buildings. They are able to identify and analyse the most relevant components including DHW- (Domestic Hot Water) generation and distribution systems. The students know different systems for heat production, heat distribution and heat dissipation in a building. The same applies to the cooling case. They understand the thermodynamic processes of heat pumps and air conditioners and can calculate and discuss system performance figures. The students can perform simple design calculations of the technical systems and estimate reasonable applications.

1.) Basics in Thermal Science
2.) Heat generation systems in buildings
3.) Heat distribution in buildings
4.) Heat load calculation

5.) Cooling generation systems
6.) Cooling distribution
7.) Design and dimensioning of cooling systems
8.) Domestic hot water production
9.) Techno-economic Aspects

Intended Learning Outcomes:
Students know the terms "heat", "heat flow", "power", "exergy", "anergy", "efficiency", "coefficient of performance" and "Carnot efficiency" and can describe them.

Students know the fundamental laws of thermodynamics and thermal engineering as well as the limiting basic equations and can apply these to systems.

Students know the most important technologies for heating and cooling in building technology and can describe and outline these technologies.

Students are able to calculate system and efficiency parameters of heating and cooling systems using practical examples.

Students are familiar with technical options for heating and cooling in buildings and can outline these. They know the advantages and disadvantages of these technologies as well as key figures to describe the systems and their efficiency. They will be able to plan these systems conceptually and assess the plausibility of offers. They will also be able to make basic techno-economic assessments of the respective technologies.

Teaching and Learning Methods:

Media:

Reading List:
Recknagel (2022): Taschenbuch der Heizung und Klimatechnik (available as E-Book)

Seifert (2015): Repetitorium Heizungstechnik

Reddy et. al (2017): Heating and Cooling of Buildings: Principles and Practice of Energy Efficient Design (available as E-Book)

Watkins (2011): Heating Services in Buildings

Mitchell & James (2014): Principles of Heating, Ventilation and Air Conditioning in Buildings

McQuiston et. al (2012): Heating, Ventilating, and Air Conditioning: Analysis and Design

Responsible for Module:
BOKU Verfahrens- und Energietechnik Tobis Pröll; Magdalena Wolf

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

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

Module Description

CS0153BOK: BOKU: Research Desgin | BOKU: Research Design [CS0153BOK]

Version of module description: Gültig ab winterterm 2025/26

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 2	**Total Hours:** 60	**Self-study Hours:** 0	**Contact Hours:** 60

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

Description of Examination Method:
Part Dr. Tran: Presentation in the second lecture (4.11.), in case of absence the alternative is a seminar paper; Part Dr. Janesch: Students apply the learned skills to their own data (either to a open dataset, or - ideally to the data for their own thesis) and submit the commented code that documents the full process from research question through analysis to the final visualization. Part Dr. Riegler: Group presentation of exemplified research project in second unit; written exam about both units

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
No prior coding experience is required; all necessary materials and guidance will be provided.

Content:
Course Part Dr. Tran (two units): The lecture includes an introduction to scientific theory Learning objective: Basic understanding of the theory of science.

Course Part Dr. Janesch (four units): In this lecture, students learn how to take a dataset and turn it into insights in a hands-on, practical way. We begin with a quick refresher on basic statistics, then move on to exploring data through descriptive statistics and simple plots. From there, we ask questions and test them using core statistical methods such as t-tests, ANOVA, and non-parametric alternatives, before building simple regression models to examine relationships. Finally, we bring everything together in clear, publication-ready figures.

Course Part Dr. Riegler (two units): In the first unit, we will address aspects that need to be considered when designing a research project. Which resources are needed? Which stakeholders

are to be incorporated? What are technology readiness levels and how should they be addressed in a research project?
In the second unit, a simple design of experiments will be elaborated.

Participation in the seminar is mandatory! You must attend at least 80% of each seminar part in order to receive a positive grade for this course!

Intended Learning Outcomes:
Basic understanding of the philosophy of science; Using statistical tools to turn questions into answers; Creating clean and appealing figures for publication.
Students are able to understand the nature of fundamental and applied research, how research projects can be set up and which simple but powerful statistical tools are available for designing experiments.

Teaching and Learning Methods:
Part Dr. Tran: Fundamentals of philosophy of science: lecture, video material and reference to relevant literature.

Part Dr. Janesch: Teaching is supported by practical Jupyter Notebook exercises, including prepared examples and prewritten code for interactive learning.

Part Dr. Riegler: potential ways to design research projects will be discussed and examples afterwards elaborated in groups. Exemplified experiments will be designed in Design Experts and Excel.

Media:

Reading List:

Responsible for Module:
BOKU Organisation: Holztechnologie und Nachwachsende Rohstoffe Jan Janesch, Martin Riegler, Anita Tran

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

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

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

Module Description

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

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) and/or an Presentaion (20-30 minutes, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration and/or presentation are evaluated.

Repeat Examination:
Next semester

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

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

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

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

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

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

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

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

Courses (Type of course, Weekly hours per semester), Instructor:
Kleines Forschungspraktikum Master CBT (Niederholtmeyer) (Forschungspraktikum, 4 SWS)
Banlaki I, Crean E, Gaizauskaite A, Kalkowski J, Li Y, Niederholtmeyer H, Osmanova G, Sharma B

Research Internship Master 5 ECTS (Praktikum, 5 SWS)
Blombach B, Glawischnig E, Hädrich M, Vital S

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

Reseach Internship Master 5 ECTS (RES) (Praktikum, 5 SWS)
Gaderer M [L], Huber B, Putra L

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)

Sieber V [L], Al-Shameri A, Arana Pena S, Fuchs A, Giustino A, Grundheber J, Hofer N, Kinateder T, Köllen T, Lehmann V, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Rau M, Romeis D, Rühmann B, Scheerer J, Schieder D, Sieber V, Skopp A, Tong L

Research Internship Master 5 ECTS (Forschungspraktikum, 5 SWS)
Zavrel M [L], Beerhalter D, Bogran Linares G, Borger J, Dsouza V, Geisler N, Grundwürmer M, Kariuki E, Marino Jara J, Stegemeyer U, van der Walt H, Zavrel M
For further information in this module, please click campus.tum.de or here.

Module Description

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

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
The examination consists of a graded internship report (15-30 pages, depending on the topic) and/ or an Presentaion (20-30 minutes, depending on the topic) on the contents and contents of the internship results containing at least an overview of the state of knowledge on the project topic as well as the presentation of the working methods used and a presentation of the results with interpretation. In an overall grade, the quality of the familiarisation with the topic, the experimental work, the interpretation of the results and the written elaboration and/or presentation are evaluated.

Repeat Examination:
Next semester

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

Content:
Research-related work at the chairs and working groups of the TUM Campus Straubing. The students receive tasks from the research area of the supervising examiner, which they work on under guidance in the form of projects. The subject areas must be able to be assigned to the technical content of the study program. The students plan the project work largely independently under the guidance of the supervisors. The project work consists of 240 working hours, fixed in consultation with the supervisors, usually as a block internship on consecutive weeks, which can be deviated from in consultation. The project work is documented and evaluated in the form of an internship report. In addition, a supplementary presentation of the work progress takes place. The project work can also be done with external institutions, such as companies.

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

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

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

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

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

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

Research Internship Master 10 ECTS (Forschungspraktikum, 10 SWS)
Fang W [L], Fang W, Fortuna dos Santos Miranda C

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

Research Internship Master 10 ECTS (Sieber) (Forschungspraktikum, 10 SWS)
Sieber V [L], Al-Shameri A, Arana Pena S, Fuchs A, Giustino A, Grundheber J, Hofer N, Kinateder T, Köllen T, Lehmann V, Liu Y, Malubhoy Z, Marosevic M, Matena F, Mayer M, Ostertag T, Raga Carbajal E, Rau M, Romeis D, Rühmann B, Scheerer J, Schieder D, Sieber V, Skopp A, Tong L

Research Internship Master 10 ECTS (Praktikum, 10 SWS)
Zavrel M [L], Beerhalter D, Bogran Linares G, Borger J, Dsouza V, Geisler N, Grundwürmer M, Kariuki E, Marino Jara J, Stegemeyer U, van der Walt H, Zavrel M
For further information in this module, please click campus.tum.de or here.

General Electives | Allgemeinbildende Wahlmodule

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

CS0084BOK: Negotiating Change: Simulating an International Conference for Sustainable Development | Negotiating Change: Simulating an International Conference for Sustainable Development

Version of module description: Gültig ab summerterm 2023

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

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

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:
BOKU

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

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

Module Description

CS0150BOK: BOKU: Processes and Technologies for Waste Management | BOKU: Processes and Technologies for Waste Management [CS0150BOK]

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 1	**Total Hours:** 30	**Self-study Hours:**	**Contact Hours:** 30

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

Description of Examination Method:
Oral
3 to 4 students' groups will be created to prepare a 20 minutes presentation on a case study. The presentation will be prepared by each group during a 2-hours lesson and discussed in the last lesson of the course. The individual evaluation will be based on: - Comprehension of the topic; - Personal contribution; - Clarity of the presentation; - Ability to work as a team member.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
This course is particularly intended for students with knowledge of basics in waste management (at master level preferred) who wants to deepen their knowledge in specific, future-oriented technologies to valorise biogenic waste .

Content:
This year is the focus on:
BIOGENIC WASTE GENERATION, PROPERTIES, VALORIZATION AND CARBON FOOTPRINT

The course is aimed at providing fundamental knowledge on biogenic waste properties which should be taken into account for selecting and designing appropriate collection systems and valorization process. Technical aspects of biological waste treatment options will be pointed out. The design criteria of anaerobic digester (aimed at converting the biodegradable fraction of both urban and agro-industrial wastes into bio-methane and/or bio-H2) will be discussed.

Specific issues:

- Biogenic waste generation and properties: waste classification; waste composition; chemical, physical, biological and mechanical properties; methods for estimating waste production; statistical analysis of waste production data;
- Biogenic waste management, including bioH2 production;
- Basics of the greenhouse gas accounting systems

The course will be given by guest teacher Prof. Raffaella Pomi from the Dept. of Civil Environmental Engineering at Sapienza University of Rome!!!

Intended Learning Outcomes:
The students will gain insight to case studies addressing specific situations and technologies in biogenic waste management on a global perspective.
At the end of the course, the students will have acquired the basic knowledge of design and operation of waste treatment and valorization plants for biogenic waste.

Teaching and Learning Methods:
Interaktion Lehrende und Lernende

class lecture with strong interaction between students and teacher and some practical exercise.

Media:

Reading List:

Responsible for Module:
BOKU Institut für Abfall- und Kreislaufwirtschaft Huber-Humer Marion, Pomi Raffaella

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

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

Module Description

CS0258: Talking Green: Communication and Renewable Resources in Society | Talking Green: Communication and Renewable Resources in Society

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:
Over the course of the semester, students are expected to prepare presentations, participate in role plays and work on cases in groups with video analyses (ungraded). The graded examination is completed in two parts. The first part is a graded course (presentation: 20 minutes) in grammar schools and other secondary schools, in which the acquired didactic skills are to be applied (80 % of the grade). The second part of the examination consists of a written report (approx. 10 pages) on the course held at the grammar school (20 % of the grade).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
The basics of communication and didactics, communication methodology, communication rules and their application in everyday working life as well as goal-orientated dialogue management are taught. In addition, expression and language, presentation of the course, presentation of the contents and their practical teaching, the organisation of teaching units at the schools involved, the characterisation of teaching requirements and public relations issues are covered.

Intended Learning Outcomes:
After completing the module, students will be able to analyse basic counselling and communication models and assign the underlying theory to the models accordingly.
Furthermore, students will be able to apply counselling and communication models using case studies.

In addition, they can review their own basic attitude and reflect on their own counselling and communication behaviour. Students can formulate and define learning objectives appropriate to the respective target group and the content to be taught.
They can organise a teaching unit in a meaningful sequence according to the learning objectives and can select appropriate teaching methods to suit the objectives. They can design and implement a curriculum for their teaching unit. Furthermore, students will be able to explain their content-related topics in a binding manner and relate them to the fields of work of the TUM Campus Straubing, analyse the content-related needs of the school and plan the scope of teaching, and will be able to coordinate press and public relations work with content and intentions from the field of renewable resources.

Teaching and Learning Methods:
In addition to the lecture, exercises, role plays, case studies, excursions and video analyses of individual and group presentations will be carried out. There will also be a teaching rehearsal in front of a class at a grammar school in the region.

Media:
Presentations, script, videos, exercise sheets, flipchart, Powerpoint, illustrative objects (renewable raw materials), case descriptions, blackboard

Reading List:
Philipps, E. & Robles, R. (2023). Foundations of Educational Technology: Learning and Instructional Design, Vol 1. Middlesex: Kruger Brentt Publisher.
Philipps, E. & Robles, R. (2024). Foundations of Educational Technology: Learning and Instructional Design, Vol 2. Middlesex: Kruger Brentt Publisher.
McDonald, J.K. & West, R. (2021). Design for Learning: Principles, Processes, & Praxis. Provo: Brigham Young University.
Littlejohn, S.W., Foss, K.A. & Oetzel, J.G. (2021). Theories of Human Communication. Longrove: Waveland Press.
McQuail, D. & Deuze, M. (2020). Media and Mass Communication Theory. London: SAGE Publications Ltd.
Griffin, E., Ledbetter, A. & Sparks, G. (2022). A First Look at Communication Theory. London: McGraw-Hill Education.

Responsible for Module:
Claudia Martin

Courses (Type of course, Weekly hours per semester), Instructor:
Talking Green: Communication and Renewable Resources in Society (Vorlesung mit integrierten Übungen, 4 SWS)
Martin C [L], Martin 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:
(SOT86074) Aligning Generative AI to Social Values (part of 6 ECTS module) (Seminar, 2 SWS) Papakyriakopoulos O

(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

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: 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

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

Introduction to Children, Well-Being, and Digital Technologies (Vorlesung, 2 SWS)
Cortesi S, Hidalgo Avila C

Seminar to Children, Well-Being, and Digital Technologies (Seminar, 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. Impusle, 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:	Language:	Duration:	Frequency:
Master	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 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.

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

SOT86701: EuroTeQ Collider. Enhancing Connections for Sustainable Futures (MSc) | EuroTeQ Collider. Enhancing Connections for Sustainable Futures (MSc)

Version of module description: Gültig ab summerterm 2024

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

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

Description of Examination Method:
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:
Next 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 send 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 Technical University of Munich (TUM) joint forces within eight leading universities of science, technology and business to foster the European spirit in a EuroTeQ format to promote innovative engineering education across Europe. Together, we are created the first EuroTeQ Collider in 2022. Now, the journey goes into the second round. The Collider is an innovative learning format with the aim of bringing students together with vocational trainees and professionals to tackle challenges. The theme for the period 2024-2026 is “Enhancing connections for sustainable Futures”. The goal is to connect participants with different profiles and personalities to boost creativity, innovation, shared understanding, enabling participants to imagine new approaches and design disruptive solutions.

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:
- Select and apply appropriate design, engineering and business approaches and tools to create an innovative and science-based solution to a real-life challenge.
- Develop a profound interpretation of a complex, real-life problem and its context using a system-thinking approach, considering multiple perspectives.

- Develop a problem-driven, creative, and integrative design, demonstrated by a concrete prototype that balances desirability, feasibility, and viability.
- Use disciplinary knowledge and expertise in an inter-disciplinary team to develop an innovative and scientifically sound solution in a European context.
- Communicate your ideas, at different levels of elaboration, via several mediums in an international context to a diverse set of stakeholders.
- Define and regularly reflect on personal and team development.

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 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.

SZ0003-11: Intercultural Communication | Interkulturelle Kommunikation

Module Description

SZ1102: EuroTeQ Intercultural Workshop – Intercultural competencies for working in multicultural teams | EuroTeQ Intercultural Workshop – Intercultural competencies for working in multicultural teams

Version of module description: Gültig ab summerterm 2022

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 1	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:
1 written test 90 min. (100%)

Performance, testing the learning outcomes specified in the module description, is examined by a written test. Aids are permitted. Candidates work on tasks that focus on intercultural theories, intercultural models and other content covered in class. As part of the exam, students must prove their intercultural reflection skills by

Repeat Examination:

(Recommended) Prerequisites:
The course is especially intended for students in engineering programs, but is generally open to all TUM students. In particular, students who will be studying at a EuroTeQ partner university in the coming academic year or those, who are from partner universities and are currently studying at TUM and/or are participating in the EuroTeQ program should feel addressed. Students should envision themselves working in a European engineering context.

Content:
The workshops take place on 3-4 days in the specified period. One Workshop on Fridays / Saturdays and one on Mondays / Thursdays.
In addition to their specialist knowledge, future engineers must coordinate cross-disciplinary work and communicate with other disciplines. Accordingly, in a European job market, intercultural competencies and communication skills are required to create successful collaboration.

Intercultural agility, which is essential for studying and working in a multicultural environment, consists of a combination of knowledge about intercultural contexts and an ability to critically analyze one's own thoughts and values from an intercultural perspective After the course, students can apply intercultural models and strategies based on these models for the practical management of complex, interculturally challenging situations in university and professional settings.

Intended Learning Outcomes:
Students can recognize how intercultural factors can play a role when working in multicultural teams and how our ways of thinking, values, attitudes and our personal background influence the way we interact with others. They have acquired tools for analyzing and interpreting interculturally complex situations in a goal-oriented manner and have discourse strategies to implement these in discussions in order to facilitate mutual understanding. Students can expand their own knowledge of divergent cultural values and standards by asking purposeful and appropriate questions and they can present their own perspective.

Teaching and Learning Methods:
The module consists of a course in which the learning content is studied in a communicative and action-oriented manner using self-experience exercises, video material, critical incidents and theoretical input in individual, partner and group work. Additional self-study material is provided (for preparation and follow-up work and for deepening one's own background knowledge) for consolidation and supplementation of the classroom sessions.

Media:
Multimedia-supported teaching and learning material, also online

Reading List:

Responsible for Module:
Christina Thunstedt

Courses (Type of course, Weekly hours per semester), Instructor:
The EuroTeQ Engineer: Cultural Agility for Studying and Working in Multicultural Settings (Workshop, 1 SWS)
Elekes R, Nierhoff-King B
For further information in this module, please click campus.tum.de or here.

Module Description

WZ9470BOK: BOKU: Research Design | BOKU: Research Design

Version of module description: Gültig ab winterterm 2017/18

Module Level:	Language:	Duration:	Frequency:
Credits:* 2	**Total Hours:**	**Self-study Hours:**	**Contact Hours:**

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

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

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

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

TUM Project Weeks (max. 6 ECTS) | TUM Project Weeks (max. 6 ECTS)

Module Description

CIT643002: 1.000+ Project week | 1.000+ Projektwoche

Team project week 1000+
Industrial internship (focus on SMEs)

Version of module description: Gültig ab winterterm 2025/26

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 50	**Contact Hours:** 40

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

Description of Examination Method:
In a 30 min poster presentation in the team in front of SME employees and with involvement of the examiner the students demonstrate their understanding and correct analysis of the SME`s operational processes and the given problem. The students show the development of at least one problem solving strategy and demonstrate their capability to argue for this approach in the discussion. In the discussion the students also reflect their own competences in the context of possible problems in a company.
The final grade is based on the poster presentation at the closing event.
Credits awarded only if students participate in the closing event

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none
Please register here: https://1000plus.cit.tum.de/

Content:
Many TUM Master's students complete their studies without a clear picture of company processes, corporate culture, or the concrete application possibilities of their skills. This is exactly where the 1.000+ format comes in.
As part of a one-week project, interdisciplinary student teams, whose professional composition is matched with the company's interests, are given the opportunity to get to know a real problem

of small and medium-sized enterprises (SMEs) and industry and to develop practical solution concepts together with the partner company.
In an introductory phase in the run-up to the project week, the company and the team get to know each other. During the project week, the teams immerse themselves in operational processes on site, conduct interviews, observe internal procedures, and use role plays to gain a deep understanding of challenges in areas such as resource management, communication, product development, and decision-making.
The results of the project week are documented in the form of a poster and presented to the company partner in a final presentation at the end of the project week. A special highlight is the final change of perspective: the partner company presents its own view of the problem, which provides the students with valuable food for thought.
At the end of the week, all participating teams and partners come together at the mandatory 1.000+ closing event at TUM. There, all posters will be exhibited and the mutual exchange with the corporate partners will be deepened - an inspiring framework for learning from the experiences of other teams.

1.000+ is aimed at Master's students (from second semester) from all TUM Schools, doctoral candidates and young alumni. The project week offers a unique opportunity to combine theory and practice in a meaningful way - directly at the companies, realistically and beyond one's own discipline.

Offering period: twice a year
Registration via https://1000plus.cit.tum.de/
Registration for summer semester: july-nov in the previous semester/ for winter semester: april-june in the previous semester

Intended Learning Outcomes:
After successfully completing the module, participants will be able to understand operational processes and corporate culture.
They will be familiar with internal processes and will be able to apply innovation processes.
Students will be able to develop problem solving strategies for operational issues.
They will be able to work successfully in interdisciplinary student teams.

Teaching and Learning Methods:
o Introduction to business management and processes as part of an in-house internship
o Role play
o Solution development in an interdisciplinary team through interviews and understanding of internal processes

Media:
Whiteboard; Presentation: Poster, A0 portrait format (template will be provided)

Reading List:
Guidelines and preparation material provided by the company

Responsible for Module:
Hayden, Oliver; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
1.000+ Projektwoche (Praktikum, 2 SWS)
Hayden O
For further information in this module, please click campus.tum.de or here.

Module Description

ED120112: Projectweek: Diversity in urban design | Projektwoche: Diversität in der Stadtgestaltung

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** one-time
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 50	**Contact Hours:** 40

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 im Rahmen der Projektwochen und mit einer mündlichen Präsentation am Ende der Projektwoche. Der Umfang der Projektarbeit umfasst die Erstellung eines Objektes in Form einer 1:1 Installation im städtischen Raum. Anhand eines 1:1 Objektes weisen die Studierenden nach, dass sie zielgerichtet Lösungsansätze für Entwurfsaufgaben überschaubarer Größe und Komplexität erarbeiten können. Sie weisen nach, dass sie Konstruktionsprinzipien verstehen und anwenden, die eigene Arbeit nachvollziehbar darstellen und kommunizieren können. Sie zeigen, dass sie den Input geeigneter Fachleute im laufenden Entwurfsprozess verstehen und auf die eigene Arbeit anwenden können.

Repeat Examination:

(Recommended) Prerequisites:
Interesse an Gruppenarbeit, sehr gutes räumliches Vorstellungsvermögen. Grundlegende Erfahrungen und Kenntnisse des Entwerfens und Konstruierens aus dem Bachelorstudium werden vorausgesetzt.

Content:
Inhalt
Ziel der Projektwoche ist es das Thema Diversität auch im Stadtraum sichtbar wie erfahrbar zu machen und die historische Perspektive von Sammlung und Ausstellung um eine Einbettung in den zeitgenössischen Diskurs zu erweitern. Insbesondere Chancengleichheit in Lehre und Praxis der gestaltenden Disziplinen soll dabei im Fokus stehen.
Innerhalb der Projektwoche werden hierfür in einem 1:1 Design Build Workshop gemeinsam Installationen im Stadtraum Münchens konzipiert und umgesetzt. Ziel ist die Projekte und Architektinnen im Stadtraum zu vermitteln und einzuführen und das Projekt mit

zeitgenössischen Fragen in Architektur, und (Stadt-)Gestaltung zu verbinden. Durch das kollektive, fachübergreifende Selbstbauprojekt werden einerseits neue Wege der Lehre beschritten, andererseits tritt das Projekt aus dem universitären Kontext heraus und wird in der Öffentlichkeit präsent. Die Installationen bieten Möglichkeiten der Einbeziehung, der Interaktion und der Partizipation mit der Stadtgesellschaft.

Intended Learning Outcomes:
Nach der Teilnahme am Modul sind die Studierenden in der Lage,

- Darstellungsmethoden von sozial-komplexen Inhalten konkret und öffentlichkeitswirksam zugänglich zu präsentieren
- die architektonische Detaillierung in Bezug auf die Ausführung zu verstehen
- Das präzise und sparsame Einsetzen architektonischer Mittel zu erfassen
- Input geeigneter Expertinnen im laufenden Entwurfsprozess zu verstehen und auf die eigene Arbeit anzuwenden
- Kurzfristige und adäquate Lösungen von Problemen auf der Baustelle auszuführen
- Die Bedeutung von Teamarbeit bei einer 1:1 Umsetzung zu verstehen
- in Teams der eigenen Fachdisziplin, aber auch darüber hinaus in interdisziplinären Teams, die Sprache des jeweils anderen zu verstehen, eigene Entscheidungen zu rechtfertigen und mit Argumenten zu überzeugen

Teaching and Learning Methods:
Dies ist eine Intensiv-Woche in der mithilfe des kollektiven, fachübergreifenden Selbstbauprojekt einerseits neue Wege in der Lehre beschritten werden, andererseits tritt das Projekt aus dem universitären Kontext heraus und wird in der Öffentlichkeit präsent. Während der Projektwoche werden externe Spezialistinnen eingeladen, die sich mit dem Wirken von Frauen als Gestalterinnen und Entscheidungsträgerinnen im urbanen Raum auseinandersetzen. Diese geben Input durch Vorträge und erweitern die Methoden von Design Build. Mit dem kollektiven, fachübergreifenden Selbstbauprojekt lernen die Studierenden Darstellungsmethoden von sozial-komplexen Inhalten.

Media:
Workshop, Deskcrits, Schlusspräsentation

Reading List:
Eine umfangreiche Literaturliste wird den Studierenden zur Verfügung gestellt

Responsible for Module:
Hartmann, Jana; M.A.

Courses (Type of course, Weekly hours per semester), Instructor:
Projektwoche: Diversität in der Stadtgestaltung (Workshop, 2 SWS)
Jacob A, Kaestle A, Syren Z
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

MGT001443: Project Week 2024/25: Conflicts in Mining Critical Materials: Compromising in Sustainability Strategies | Project Week 2024/25: Conflicts in Mining Critical Materials: Compromising in Sustainability Strategies

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** one-time
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 60	**Contact Hours:** 60

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

Description of Examination Method:
To complete the course, students shall form groups representing different stakeholders and play their roles in the game set up in the class; then, make a presentation (50% of the grade) and write a group report (50% of the grade):
- showing their understanding of sustainability with respect to mining;
-their learning on costs, benefits, and challanges faced by a given stakeholder groups;
- conflicts and ways to find a compromise when it comes to mining strategies;
-importance of mining and its fair development.

Repeat Examination:

(Recommended) Prerequisites:
none

Content:
The course will consist of three parts, which allows for a type of experiment in how exposure to mining practices influences decision making. The first set of sessions will serve to introduce the topic and record “unexperience” and “noncollaborative” perspectives and decision choices on the mining problems presented. Next, students will be exposed actual mining practices, examine the conflicts (standing or past) onsite in visits to open-pit mines in Germany or Austria, and shall form their own views and opinions on the real-world challenges associated with sustainability in mining. Finally, the students return to the stakeholder roles to review their sustainability goals and weights assigned to them, negotiation strategies and impact oriented behavior.

Intended Learning Outcomes:
The module targets students of all backgrounds interested in understanding decision-making processes, challenges associated with choices, and divergence in perspectives on the sustainability goals, in particular, in extraction of critical metals and minerals. The course will explain environmental and societal costs of mining, alongside economic benefits, in the context of the increased demand for metals and materials brought about by decarbonisation goals. Participants will learn about different approaches for addressing the intricate challenges faced by German and global mining industries striving to provide critical resources.

Teaching and Learning Methods:
Students will engage in role-playing exercises to learn the perspectives of three major stakeholder groups, (1) affected communities, (2) upstream producers, i.e. mining operators, and (3) downstream industrial consumers, e.g., automotive companies. They will use the interactive multiobjective optimization (iMO) tool, we prototyped, to test their decisions exploring interest alignments and stakeholder conflicts, fostering deeper understanding of the multifaceted issues surrounding the extraction and consumption of critical materials.

Media:

Reading List:
1. Yakovleva, N., & Nickless, E. (Eds.). (2022). Routledge Handbook of the Extractive Industries and Sustainable Development. Abingdon, UK: Routledge.
2. Hatcher, P., & Grégoire, E. R. (2022). Governance of extractive industries. In Handbook on Governance and Development (pp. 294-307). Edward Elgar Publishing.
3. Veiga, M. M., & Marshall, B. (2018). The extractive industries and society.
4. Veraart, F., Smits, J. P., & van der Vleuten, E. Extractive Industries and Society.

Responsible for Module:
Ikonnikova, Svetlana; Prof. Ph.D.

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

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

Module Description

MGT001446: Project week: Circular Economy Perspectives in Research and Practice | Project week: Circular Economy Perspectives in Research and Practice

Version of module description: Gültig ab winterterm 2025/26

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:
The module examination consists of a final group presentation and a project report. The group presentation is 30 minutes long, with 20 minutes dedicated to presenting the project and 10 minutes allocated for a Q&A session and discussion. Additionally, students are required to submit a comprehensive project report, in which individual contributions are clearly highlighted. The grade for the presentation will make up 40% and the report 60% of the final grade.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
none

Content:
The module provides students with an interdisciplinary introduction to the concept and practical relevance of the circular economy. It emphasizes the complexity and diversity of circular strategies across engineering, natural sciences, economics, political science, and management.
Throughout the semester, students are introduced to foundational concepts of both circular economy and behavioral economics through lectures, guest talks, and interactive workshops. They learn how human behavior, decision-making, and incentive structures influence sustainable practices and how these insights can be applied to circular solutions.
Participants engage with real-world cases and are coached in interdisciplinary teamwork, stakeholder analysis, and strategic project development. The module prepares students to critically assess circular economy approaches and to develop their own solutions to current sustainability challenges.

A key component is the project week, during which students work in interdisciplinary teams on a challenge posed by an external practice partner. They apply their acquired knowledge and skills to analyze the problem, develop actionable solution strategies, and present their outcomes in both a written report and a final presentation.
The course fosters academic-practice collaboration, encourages creativity, and equips students with the tools to act as change agents for sustainability within academic, corporate, and policy settings.

Intended Learning Outcomes:
At the end of the module, students will have developed a deep and interdisciplinary understanding of the principles and applications of the circular economy, including ecological, economic, and social dimensions.
They will be able to critically reflect on the limitations of linear economic models and formulate strategies to support circular solutions in diverse contexts.
By working in interdisciplinary and international teams, students will strengthen their ability to collaborate across disciplinary boundaries and to integrate different perspectives when addressing complex sustainability challenges.
Through active participation in lectures, workshops, guest talks, and team coaching sessions, students will be equipped to apply theoretical knowledge from circular economy and behavioral economics to real-world problems.
They will gain practical experience in problem-solving and strategic thinking by working on real challenges provided by external partners, developing solution concepts that are realistic, actionable, and well-justified.
This includes identifying stakeholder needs, assessing feasibility, and communicating their ideas convincingly in written and oral form to academic and non-academic audiences.
Students will improve their skills in teamwork, project management, and innovation under real conditions, including the ability to work within tight timeframes and manage complex tasks collaboratively.
By the end of the course, students will be able to transfer their learning to future academic, entrepreneurial, or policy-making settings and contribute meaningfully to advancing circular economy practices in research and professional environments.

Teaching and Learning Methods:
The module combines a variety of interactive and student-centered teaching methods to promote interdisciplinary learning and practical application. Core content is delivered through a series of thematic blocks, each taught by experts from different TUM chairs.
Students engage with theoretical foundations of the circular economy and behavioral economics through lectures, guest talks, and flipped-classroom elements. Interactive workshops and structured peer exchanges encourage critical reflection and help students to apply abstract concepts to real-world contexts.
Throughout the semester, students work collaboratively in diverse teams, supported by coaching and input sessions on project management, communication, and presentation techniques. Regular feedback sessions help refine their approaches and ideas.

In the final project week, students tackle a real-world challenge posed by an external partner, working intensively in teams to develop practical solutions. They apply interdisciplinary methods such as stakeholder analysis, systems thinking, and strategic planning. The project week concludes with final presentations and a written report, which demonstrate both the outcome and the collaborative process of the student teams.

Media:

Reading List:
Behavioral Economics:

"Thinking, Fast and Slow" by Daniel Kahneman
A comprehensive overview of the dual-process theory of the mind, heuristics, and biases.

"Nudge: Improving Decisions About Health, Wealth, and Happiness" by Richard H. Thaler and Cass R. Sunstein
Explains the concept of "nudging" and how small interventions can significantly influence decision-making.

"Misbehaving: The Making of Behavioral Economics" by Richard H. Thaler
A memoir-style book that chronicles the development of behavioral economics.

"Predictably Irrational: The Hidden Forces That Shape Our Decisions" by Dan Ariely
Explores how and why people make irrational decisions and how to understand these patterns.

"The Undoing Project: A Friendship That Changed Our Minds" by Michael Lewis
A story of the collaboration between Daniel Kahneman and Amos Tversky, highlighting their contributions to behavioral economics.

Circular Economy:

"Cradle to Cradle: Remaking the Way We Make Things" by William McDonough and Michael Braungart
Introduces the concept of designing products and systems in a regenerative manner.

"Waste to Wealth: The Circular Economy Advantage" by Peter Lacy and Jakob Rutqvist
Discusses the business advantages of adopting circular economy principles.

"The Circular Economy: A Wealth of Flows" by Ken Webster
Provides an in-depth look at the circular economy, its principles, and implications.

"Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist" by Kate Raworth

Challenges traditional economic thinking and introduces a model balancing essential human needs and planetary boundaries.

"The Upcycle: Beyond Sustainability--Designing for Abundance" by William McDonough and Michael Braungart
A follow-up to "Cradle to Cradle," focusing on improving systems and products to create more positive impacts.

Responsible for Module:
Mohnen, Alwine; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Project week: Circular Economy Perspectives in Research and Practice (MGT001446, englisch) (Seminar, 4 SWS)
Burkhardt R, Heinrich V, Kessler A, Kober K
For further information in this module, please click campus.tum.de or here.

Master's Thesis | Master's Thesis

Module Description

CS0115: Master's Thesis | Master's Thesis

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 30	**Total Hours:** 900	**Self-study Hours:** 850	**Contact Hours:** 50

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

Description of Examination Method:
The module examination consists of the preparation and positive evaluation of the Master's Thesis (approximately 25 to 100 pages, depending on the topic). The overall grade is determined by the grade of the Master's Thesis.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
70 credits including all compulsory modules of the Master's program

Content:
Deepening the knowledge of current academic literature on a specific topic, which can be freely chosen from the program in consultation with the supervisor. Deepening the knowledge of appropriate research methods, as well as gaining experience in their application.

Intended Learning Outcomes:
After completing the module, students are able to derive complex scientific questions and to work on them independently using adequate scientific methods. In doing so, they demonstrate their ability to think analytically on their own. They are able to present their results conclusively, discuss them, and draw final conclusions.

Teaching and Learning Methods:
First, together with the supervisor, the topic is
the topic is narrowed down and a research question is developed. Within the framework of the Master's Thesis, the students work on this scientific question. Among other things, literature

research, theoretical models and/or empirical methods are applied. The actual teaching and learning methods depend on the respective research question and are decided jointly with the supervisor in each individual case.

Media:
Academic literature, software, etc.

Reading List:
in consultation with the supervisor

Responsible for Module:
Alle prüfungsberechtigten Dozenten/innen des Studienganges

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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