TECHNISCHE HOCHSCHULE NÜRNBERG
GEORG SIMON OHM

Catalogue of courses offered in English - SoSe 2023

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Dear exchange students,

This catalogue contains the descriptions of the elective courses conducted in English at Nuremberg Tech in summer semester 2023. The courses included in this catalogue are open for all exchange students regardless of the degree programme you are enrolled in at our university. You can participate in any course you are interested in as long as you meet the prerequisites.

Attending these courses can develop not only your academic knowledge, but as they are interdisciplinary and many of them are open to all types of students, you will gain experience in a truly diverse environment.

We hope you find some interesting options for this semester in Nuremberg in addition to the courses from our Language Center and the regular courses in your degree programme. Have a look - it's worth your while! If you have any questions about the courses you can take, please contact the coordinator of this catalogue, Rebecca Ehrig, at rebecca.ehrig@th-nuernberg.de

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Bionic Computation in Business

Course name	**Bionic Computation in Business**
Learning objectives	To gain an understanding of the application of bionic computation algorithms for business use cases.
Content	Students work together in project teams to develop applications of bionic computation to solve concrete problems in business. Bionic computational algorithms are based on biological systems in nature, such as: - affective computing (sentiment analysis) - artificial neural networks - evolutionary computation - swarm intelligence (ant colony, particle swarm optimisation).
Other requirements/information	This course is offered by the Faculty of Computer Science as part of the master's degree programmes in Information Systems and Management, Computer Science, and Computer Science and Media. The course is designed for master's students who have broad experience in computer programming and an understanding of statistics.
Course format	Seminar-style lecture
Credits (ECTS)	5
Lecture hours (LVS)	4
Type of assessment	Presentation and paper

Chemistry and the Energy Transition

Course name	**Chemistry and the Energy Transition**
Learning objectives	Students will be introduced to modern methods of electrical and chemical energy generation, conversion, and storage. In the course, the current methods for energy generation, energy conversion, and energy storage are to be presented as practically as possible. These are exclusively sustainable processes and methods from the fields of electrochemistry, process engineering, electrical engineering, and biochemistry. The energy transition that was started can only be successfully continued and completed if the various methods of energy generation, storage, and conversion are optimally coupled and interlinked. Therefore, one of the main goals of the course is to understand the interconnection of the different topics. One way to achieve this goal is the detailed, comparative study of the different methods of energy generation, energy conversion, and energy storage as presented in the current script.

Content	Based on the learning objectives, the contents of the course are as follows: - Gasoline vs. diesel engine: avoidance of harmful exhaust gases - detoxification of harmful exhaust gases, detailed description of the effect of AdBlue - Hydrogen economy - production of green hydrogen, hydrogen as means of energy storage, hydrogen fuel cell (PEMFC) as energy converter and propulsion in vehicles - Methanol economy - synthesis of green methanol, direct methanol fuel cell (DMFC) as drive medium in vehicles, detailed comparison of PEMFC and DMFC - Methane economy - production of green methane: details of the mechanism of anaerobic digestion of agricultural residues in biogas plants - Electrochemical conversions as basis of electromobility - details on the conversions "electrical to chemical" (electrolytic cell) and "chemical to electrical" energy (galvanic cell) in primary and secondary batteries, lithium-ion-cells as the basis of electromobility - Renewable resources - first- and second-generation biofuels, sustainable biodiesel, bioethanol, e-fuels as a group of XtL fuels - Use of solar energy: solar thermal and photovoltaic - presentation of the most important methods of solar thermal and coupling with other heating systems - Photovoltaic: functioning of silicon solar cells in the framework of the photoelectric effect - Use of wind energy for electricity generation - physics of wind energy and efficiency of wind turbines, comparison of the different ways of storing wind energy
Other requirements/information	A basic understanding of simple redox reactions is required to understand the subject matter.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Written examination (60 minutes)

Climate and Climate Change

Course name	**Climate and Climate Change**
Learning objectives	The aim of this course is to give you an understanding of the different components of the climate system, the processes that govern their variability, the interactions between them, and which drivers and factors lead to climatic changes. The course will familiarise you with key scientific concepts that are necessary for understanding climate and climate changes. At the end of the course you will be able to explain how drivers like the concentration of greenhouse gases are changing and which impacts this has on the climate, also in the context of historic climatic changes. The course will give you a foundation for evaluating statements about climate change that you might hear in the media or from friends and relatives and discuss them critically based on our solid scientific knowledge of the climate system.
Content	The course will cover: Components of the climate system: what are the key climate features of the atmosphere, the oceans, the land surface, and the biosphere? Drivers, forcings, feedbacks, and mechanisms in the climate system: what drives the internal variability of the climate and which external forcings, like anthropogenic greenhouse gases, influence it? Measuring and monitoring the climate: how do we quantify climate and how do we create comprehensive data sets from measurements? Past climatic changes: what can we learn about the past from important climate proxies like ice cores or tree ring data? Climate modelling: How do climate models work, and how do we make sure that they indeed work? Attribution of past and present climatic changes: how do we find out what caused those past and present climatic changes that we have observed? Future climate projections and their implications: what are the assumptions and different scenarios that are used for future climate projections?
Other requirements/information	The course is suitable for students from all subject areas and does not require any specific prior knowledge beyond basic school science.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Written examination (90 minutes)

Computer-Aided Music Production for Electronic Music Genres

Course name	**Computer-Aided Music Production for Electronic Music Genres**
Learning objectives	- Knowledge of genre determining songs - Knowledge of different synthesis technologies and their typical sound characteristics - Knowledge of sonic impact of digital effects, dynamic processors, equalizers and their different parameters - Ability to work with Digital Audio Workstations (DAWs)
Content	- History of electronic music genres - Electronic sound synthesis (subtractive synthesis, additive synthesis, FM-synthesis) - Structure and functionality of Digital Audio Workstations (DAWs) - Digital effects (chorus, phaser, flanger, distortion, tremolo) - Dynamic processors (compressor, limiter) - Equalizers - Beatmaking - Song arrangement
Other requirements/information	The course is being offered by the Faculty of Electrical Engineering, Precision Engineering, Information Technology. No specific prerequisites are necessary.
Course format	Workshop
Credits (ECTS)	2.5
Lecture hours (LVS)	2
Type of assessment	Practical course assignment/s

Constructive Conflict Transformation

Course name	**Constructive Conflict Transformation**
Learning objectives	In this seminar we will analyse models of constructive conflict transformation (i.e., mediation, power-model, value-based models, etc.), to discuss challenges in approaching conflicts constructively. After completing the module, you will be able to critically evaluate and develop conflict transformation models by applying social and psychological perspectives. During the seminar you will acquire an understanding of the elements of conflicts (e.g. personal patterns, values, culture, structural aspects). In addition, you will be able to critically evaluate what constitutes a successful conflict transformation model. Finally, you will acquire the skills to apply the

	discussed models in your professional and personal environment.
Content	The character of the seminar is based on intensive interaction between participants through interactive dialogue and critical discussions. The content of the seminar will be the analysis of social and psychological oriented conflict models, mediation, patterns based on needs and fears, value-based conflicts, and structural aspects of organizational challenges. The seminar is structured in two aspects: (1) Interactive introduction to the analysis of conflict models, (2) Analysis of personal and structural conflicts by the students
Other requirements/information	The methodological emphasis of the course is on practical exercises and interactive dialogue. Therefore, the successful completion of the course requires active participation in all sessions.
Course format	Seminar-style lecture
Credits (ECTS)	3
Lecture hours (LVS)	3
Type of assessment	Paper

CPU Design

Course name	**CPU Design**
Learning objectives	In this course, students are expected to achieve the following objectives: - Gain an overview of modern CPU architectures - Be able to understand and design CPUs at the transistor level - Work with hardware design patterns - Use different simulation tools - Find and debug errors in hardware design
Content	Based on the learning objectives, students will: - Build a 4-bit CPU with TTL chips - Learn how to build a 2-bit CPU at the transistor level - Understand what micro-code is, - Design their own assembly language - Learn about modern RISC CPU architectures such as ARM7 and RISC-V - Get an introduction to compiler and virtual machine design This is a hands-on course, meaning that students will actually build a working 4-bit CPU.

Other requirements/information	The course is being offered by the Faculty of Electrical Engineering, Precision Engineering, Information Technology. Familiarity with C, Java, or a similar programming language and experience with electronics and digital logic (FET transistors, multivibrators, flip-flops) are necessary. Participants in the course must pay about 50 euros for electronic components.
Course format	Lecture + labs
Credits (ECTS)	2.5
Lecture hours (LVS)	2
Type of assessment	Oral presentation, written assignments

Digital Control

Course name	**Digital Control**
Learning objectives	This course provides an introduction to the fundamental concepts of digital control of dynamic systems. We should become familiar with the z-transform and the sampling process. The students should be able to design digital controllers using root locus methods (classical design). The design of digital controllers and observers by pole placement for SISO and MIMO systems is an important part of these studies. The influence of computational time delays is taken into consideration in the design process. The students should also be able to design an optimal controller with a Kalman filter. We will perform these tasks using modern control software.
Content	The course is divided into six sections. The first chapter describes the principal components of a digital feedback control loop, considering some existing examples like electromechanical servomechanisms and aircraft autopilots. The second chapter is about the definition and application of the z-transform. The third chapter deals with controller synthesis. In this part, both transform and state-space methods are described and applied to an example. The fourth chapter shows different observers like full state observer, reduced order observer, and disturbance observer. The fifth chapter describes the control of constant reference and disturbance inputs. The final chapter focuses on the optimal control.

	In this course, students will design a LQ-controller and a Kalman filter, using modern control software.
Other requirements/information	The course is a part of the Electrical Engineering and Information Technology bachelor's programme. It is appropriate for undergraduate and graduate students. The prerequisites are an introductory course in classical control in line with elementary knowledge of matrices and linear algebra.
Course format	Seminar-style lecture
Credits (ECTS)	2.5
Lecture hours (LVS)	2
Type of assessment	Written examination (90 minutes)

Diversity, Equity, and Inclusion

Course name	**Diversity, Equity, and Inclusion**
Learning objectives	Employers around the world are increasing their efforts to respond to the diversity of their workforce. Diversity, Equity, and Inclusion (DEI) approaches all forms of social difference in a strategic way. DEI not only wants to ensure representation and overcome discrimination, but also shape the workplace and transform organisations towards an inclusive culture. In this course, participants are introduced to the principles of DEI. We will not limit the scope to just one category but approach diversity comprehensively by including a broad spectrum of diversity categories such as age, culture, disability, gender, religion, or sexual orientation/identity. A particular focus will be on the cross-cultural comparison of DEI in which we look at how the topic is approached in various countries around the world. This will lead to a reflection on the relationship between language, culture, and diversity. Often, language is the starting point for discrimination. We will therefore look into the challenges of inclusive language as well as unintended patterns of communication that can have discriminatory effects. By tackling with these, the course is also a communication training for all those who want to increase their sensitivity in dealing with their diverse environments.
Content	- Introduction to DEI - Benefits of diversity - Categories of diversity: age, culture, disability, gender, religion, sexual orientation/identity - Intersectionality - DEI around the world – a cross-cultural comparison - Diversity and language

	- Language and discrimination - Avoiding microaggressions - Equity: why social justice matters in the workplace - Inclusion and the transformation of organizational culture - Concepts for inclusive leadership
Other requirements/information	The course is suitable for students from all subject areas.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Presentation

Economics of Global Environmental Challenges

Course name	**Economics of Global Environmental Challenges**
Learning objectives	Students are able to take an economic perspective on global environmental problems like global warming, the loss of biodiversity, marine pollution, and others. They know and can reflect on the current empirical state of such issues. They can apply fundamental economic tools and models to analyse environmental issues. Students can use economic tools to assess important environmental regulatory policies. They can compare different institutional approaches to environmental policy (regulation, market based, taxes, etc.). They are able to critically reflect on methods of estimating the social value of environmental resources. They are aware of the particularities of global environmental challenges and the specific problems of responding to them. Students gain a comprehensive knowledge about correct application of subject-specific terminologies and vocabulary in English.
Content	The course starts with an assessment of the empirical status quo with respect to biodiversity and global warming. An introduction into economic analysis will be provided and the conditions under which markets fail to generate socially benevolent results will be identified. The problems of public goods and common pool resources will be highlighted and it will be discussed how different economic policy tools (taxes, emission trading, emission ceilings) can or can not deal with them. Different cases of global environmental challenges will regularly be discussed. Finally the issue of global climate change and biodiversity loss will be tackled. The structure of integrated assessment models will be discussed and the question of why policy recommendations based on those come up with such varying results will be analysed.
Other requirements/information	The course is offered by the Faculty of Business Administration. It is designed for bachelor students ideally in

	business and economics, however, will also be digestable for students of other subjects.
Course format	Seminar-style lecture
Credits (ECTS)	5
Lecture hours (LVS)	4
Type of assessment	Written examination (90 minutes)

Generative Design, Additive Manufacturing, and Artificial Intelligence

Course name	**Generative Design, Additive Manufacturing, and Artificial Intelligence**
Learning objectives	In this course, students are expected to achieve the following objectives: - Explore different design options for a defined design task using algorithmic and data-driven design approaches - Explore artificial intelligence as an area of research with experimental application in the design process - Develop a design system and a connected building design, which will be presented in a workbook, poster presentation, and 3D-printed architectural model
Content	Based on the learning objectives, students will: - Learn how to use parametric design as a tool for design explorations - Learn the theoretical and philosophical background for the argumentation and application of digital design technology and artificial intelligence - Gain hands-on experience in design and use of advanced algorithms for design tasks
Other requirements/information	The course is designed for students in the programmes in Architecture, Civil Engineering, Design, Media Engineering and other fields of study with keen interest in digital technologies. Experience with computer-aided design is strongly recommended. Knowledge and experience in use of digital design techniques such as 3D-modeling, building information modelling, and parametric design are advantageous. Participants in the course must pay about 50 € for material for the 3D printer.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Oral presentation

Health Information Technology Innovation

Course name	**Health Information Technology Innovation**
Learning objectives	In this course, students are expected to achieve the following objectives: - Acquire in-depth knowledge about health information technology innovation based on the needs of the patient, family caregivers, and healthcare professionals. - Design a technology-based solution in the environment of health care (optimise an existing system, create a new solution, or advance a purchased vendor solution). - Experience the key factors for leading a successful implementation.
Content	The course is divided into four parts. It starts with an introduction to information technology application in health care. In this part, all phases of the patient journey are outlined from the perspective of health technology adaptation and process digitalization. In the second part of course selected problem-solving techniques and methods applicable to a health care environment are conveyed based on real scenarios. The third part includes methods for planning, running, and managing the implementation of desired solutions. The final part addresses challenges across computerised systems and health information exchange towards digital health transformation. At the end of the course, students will present their designed solution(s) in groups.
Other requirements/information	The course is open for students of all disciplines. No prior knowledge is necessary.
Course format	Seminar-style lecture
Credits (ECTS)	5
Lecture hours (LVS)	4
Type of assessment	Practical course assignment/s, presentation

Hydrogen Technology

Course name	**Hydrogen Technology**
Learning objectives	- Describe the role of hydrogen in an energy system, - Describe the physical and chemical properties of hydrogen, - Provide technical descriptions of the various methods of hydrogen production, storage, transport, and utilisation and describe their advantages and disadvantages, - Establish balance equations of hydrogen energy apparatuses and plants and perform energetic assessments, - Conceptualise a hydrogen-based energy system, - Meaningfully participate in the discussion for the development of hydrogen infrastructure.

Content	- Hydrogen in the past, current, and future energy system
	- Physical and chemical properties of hydrogen
	- Hydrogen production
	  o Electrolysis (PEM, alkaline, solid oxide)
	  o Biogenic hydrogen from biomass
	  o Fossil hydrogen from natural gas
	  o New hydrogen production technologies
	- Hydrogen storage and transport
	  o Pressurised hydrogen storage (tanks and underground cavern storage)
	  o Liquid hydrogen
	  o Chemical hydrogen storage and transport
	  o Pipelines (mixing in natural gas and pure H2 pipelines)
	- Hydrogen utilisation
	  o Fuel cells
	  o Hydrogen combustion (hydrogen combustion, gas turbines)
	  o Hydrogen in the chemical, petrochemical, and steel industries
	- Hydrogen technology in comparison and in synergy with other energy storage and energy transportation technologies

Other requirements/information	This course is offered as part of the master's programme in Chemical Process Engineering and Process Technology. It is suitable for master's students in engineering or natural science disciplines. Suitable backgrounds are e.g. in chemical process engineering, (technical) chemistry, physics, mechanical engineering, biotechnology, electrical engineering, or industrial engineering. Previous knowledge or extended interest in energy technology, technical and

	(in)organic chemistry, and thermodynamics are required for a successful participation.
Course format	Seminar
Credits (ECTS)	5
Lecture hours (LVS)	4
Type of assessment	Written examination (90 minutes)

Intercultural Competence & Leadership

Course name	**Intercultural Competence & Leadership**
Learning objectives	In this course, students are expected to achieve the following objectives: - Learn how to negotiate cultural differences successfully - Explore their own culture and how their values influence their behaviour - Consider unconscious bias and the way they can avoid stereotyping and prejudice - Get acquainted with other cultures to gain a better understanding of the cultural preferences in different countries - Be able to approach intercultural encounters with more sensitivity and understanding, thereby avoiding cultural misunderstandings and potential conflicts - Learn how to build trust across cultures - Learn about culture shock and how to deal effectively with it - Gain multiple perspectives on intercultural topics
Content	- What is culture? - How do values influence behaviour? - Development of intercultural sensitivity - Dimensions of culture - Building trust across cultures - Communicating across cultures - Leadership across cultures - Unconscious bias - The phases of culture shock
Other requirements/information	The course is a part of the 'Master Industrial Engineering and Management' programme. It is open for master's students of all disciplines. No prior knowledge is necessary.
Course format	Seminar-style lecture
Credits (ECTS)	5
Lecture hours (LVS)	4
Type of assessment	Course assignment/s, written examination (90 minutes)

Introduction to R: Statistical Data Analysis with R for Beginners

Course name	**Introduction to R: Statistical Data Analysis with R for Beginners**
Learning objectives	In this course, students are expected to carry out univariate, bivariate, and multivariate statistical analysis using the R program and R-Studio. The cycle is focused on the implementation of the regression and variance analysis in line with graphical representations for cross-sectional studies.
Content	- Working with R: functions ("q", "sum", "c" etc.), objects and object types (definition and connection of objects, vectors, factors, data frames, saving and loading of objects) as well as arguments (e.g. "digits" etc.) - Working with data sets: data entry, import of data sets, joining data sets, selecting, labeling, recoding, calculating new variables ("dplyr" package) - Univariate statistics: frequency tables, indicators (mean values, variance etc.) - Bivariate and multivariate statistics: contingency measures, correlation coefficients, bivariate and multiple regression, one-way analysis of variance, tests and confidence intervals for cross-sectional studies - Graphics: charts ("ggplot2" package), plot functions, editing of graphics - Brief introduction to "Markdowns" The content is conveyed in an application-oriented manner using exercises. Students will create their own script in R based on the processing of the tasks. At the end of the course they will be able to carry out regression and variance analysis with R independently.
Other requirements/information	The course is designed for students of all disciplines who are interested in statistical evaluations. Basic statistical knowledge is necessary. The course is conducted online.
Course format	Seminar-style lecture (online)
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Written assignments

Introduction to Excel and VBA in Science and Engineering

Course name	**Introduction to Excel and VBA in Science and Engineering**
Learning objectives	In this course, students will be enabled to phrase mathematic formulations from scientific or technical problems, define an approach for a solution as an algorithm, and solve the algorithm with help of Excel and the VBA programming language. After successful completion of the course, students are expected to achieve the following objectives: - use Excel spreadsheets efficiently to solve scientific and engineering problems - use VBA to extend the features of Excel according the requirements of typical scientific and engineering tasks - use VBA to improve efficiency and re-usability of spreadsheets for solutions in their own fields of study - analyse quantitative measurement data with appropriate numerical methods, find appropriate mathematic models, and evaluate the models - solve non-linear equations numerically with help of Excel and/or VBA
Content	- Spreadsheet calculation with Excel - Relative and absolute cell references - Scientific diagrams - General mathematic and statistic Excel functions - User-defined functions in VBA - Linear regression - Non-linear regression - Modifying Excel spreadsheets with VBA - Solving non-linear equations with numerical methods in Excel and/or VBA
Other requirements/information	The course is designed for students in natural science and engineering fields.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Written examination (60 minutes)

Introduction to SAP ERP

Course name	**Introduction to SAP ERP**
Learning objectives	In this course, students learn the basic technical-organisational concepts of an integrated enterprise resource planning system (ERP system) using the example of SAP ERP based on SAP HANA. This will enable them to understand and evaluate the possible uses and development of such systems in a business context. After completing this course, students will be able to name and explain the basic principles and significance of the in-memory database SAP HANA for companies.
Content	- SAP history - Introduction to SAP ERP - SOA technology and SAP NetWeaver - SAP business suite - SAP user interface - SAP NetWeaver application server with ABAP and Java - SAP components - SAP system administration - SAP workflow and document management - ABAP/4 programming environment - SAP HANA as an in-memory database platform - SAP S/4 HANA based on the SAP HANA platform as a next-generation real-time ERP business suite (digital transformation) Based on the learning objectives, students will: - Learn the basic technology and architecture of the SAP ERP system. - Learn the functionality of SAP HANA. - Understand the technical-organisational relationships between the basic system and the subject-specific application modules. - Plan and implement practical tasks within the scope of system administration. - Be able to demonstrate current development of SAP ERP systems
Other requirements/information	The course is designed for students of all disciplines interested in the use of enterprise software SAP ERP. No prior knowledge is necessary.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2

Type of assessment	Oral examination

Introduction to Systemic Design - How to Navigate and Handle Complex Socio-technical Challenges

Course name	**Introduction to Systemic Design – How to Navigate and Handle Complex Socio-technical Challenges**
Learning objectives	Climate crisis, pandemics, international military conflicts, hunger catastrophes - what at first glance seem like isolated issues, are quickly recognised as interrelated expressions of so called “wicked problems”. There are hundreds of opinions on where to start, who to blame, and how to act - our ways of thinking and understanding do not seem suited to navigate and act within those complex challenges. But a school of thought was developed - systems thinking - which creates ways to overcome those inabilities and offers methods and frameworks to think and act in such ambiguous environments. In this course, students will gain familiarity with the following: - Ambiguity competence - Transformative competencies - Understanding complex problems - Systemic design methods and tools - Systems thinking - Designerly approaches of research and learning

Content	- Introduction to thinking in systems
	  o Basic theories and history
	  o Habits of a systems thinker
	  o Dynamic vs. linear thinking approaches
	- Falling in love with a problem
	  o Systems boundaries exploration
	  o Abstraction levels of a system
	  o Research questions and goals definition
	- Methods, frameworks, tools
	  o Dynamics, feedback loops, archetypes
	  o Modelling and mapping
	  o Analysis and implications
	  o Strategies and interventions building
	- Working on custom use case scenario in groups
	- Literature studies
	- Deliverable: group case study, integration of course deliverables

Other requirements/information	The course is designed for students of all disciplines.
Course format	Seminar-style lecture
Credits (ECTS)	3
Lecture hours (LVS)	3
Type of assessment	Written group elaborations, oral presentation

Mathematics II

Course name	**Mathematics II**
Learning objectives	Demonstrate knowledge and understanding of multivariable calculus, ordinary differential equations, and Fourier series. - Explain and choose as well as apply fundamental mathematical techniques to solve problems related to economics and natural science. - Recognise (or relate) the power of mathematical modelling, analysis, and numerics to application problems. - Make appropriate assumptions to simplify and thus model economical and engineering problems. - Analyse models using mathematical techniques including basic numerical techniques. - Interpret mathematical results and their implications in their economical and engineering context. - Getting comprehensive knowledge about correct application of subject-specific terminologies and vocabulary in English.
Content	- Multivariable functions - Partial derivatives (for functions with more than one independent variable) - Multiple integrals (double and triple integrals) - Differential equations (including method using the Laplace transform) - Fourier series
Other requirements/information	The course is a part of the International Business and Technology bachelor's programme and designed for students who want to study in the following fields: mechanical engineering, electrical engineering, and natural sciences. Understanding the basics of secondary school mathematics is necessary.
Course format	Lecture
Credits (ECTS)	7

Lecture hours (LVS)	6 (+2)
Type of assessment	Written examination (90 minutes)

Nuclear and (Elementary) Particle Physics

Course name	**Nuclear and (Elementary) Particle Physics**
Learning objectives	In this course, students are expected to achieve the following objectives: - Obtain an overview of historical experimental findings in the characterisation of the structure of microscopic matter and the corresponding theories and models - Be able to recapitulate the path from classic atomic physics to modern physics (i.e., quantum mechanical description of microscopic matter) - Gain an overview of the theoretical tools involved in the description of atoms, nuclei, and their substructures and be able to apply these tools for qualitative interpretation and quantitative estimates - Gain an overview on the experimental tools involved in the disclosure of atomic and nuclear substructures and elementary particles - Obtain understanding of nuclear (in)stability and (simple) nuclear models - Obtain understanding of elementary particles and their interaction - Be able to transfer the knowledge from basic research (i.e., above items 1 to 6) to technical applications
Content	Based on the learning objectives, the contents of the course are as follows: - Concepts from Greek philosophers, studies in the course of the alchemy period, findings from chemistry, thermodynamics, and their statistical interpretation, Planck's theory of black body radiation and Einstein's theoretical explanation of the photo effect, Curie's discovery of radioactivity, Thomson's discovery of the electron and his plum pudding atomic model, Rutherford's ground-breaking scattering experiment - Contradictions of Rutherford's atomic model with experimental results, Bohr's quantisation of angular momentum, de Broglie's matter waves, inclusion of the measurement process in atomic theory - Basic ideas and formulations of Schrödinger's and Heissenberg's Quantum Mechanics, Einstein's Special Relativity Theory, introduction of the cross section to describe reactions of microscopic structures

	- Production of high energy particle beams by means of accelerators and detection of particles from microscopic reactions by means of detectors - Nuclear stability diagram, types and nature of nuclear decays, mass deficiency, nuclear droplet model and Bethe-Weizsäcker mass formula, Fermi gas model and extension to more refined nuclear potentials, the nucleon-nucleon-model, and Yukawa's model for the strong nuclear force - Discovery of the "zoo of elementary particles", Salam's and Weinberg's quark-parton-model, the Standard Model of elementary particles and their basic interactions - Introduction to technical applications such as reactors and power plants for nuclear energy production, medical radiation therapy, or radioactive age determination
Other requirements/information	Understanding the basics of classical mechanics, thermodynamics, electromagnetic waves, and atomic physics is necessary.
Course format	Seminar-style lecture
Credits (ECTS)	4
Lecture hours (LVS)	3
Type of assessment	Oral and written examination (presentation + paper)

Photojournalism

Course name	**Photojournalism**
Learning objectives	In this course, students will learn the basics of manual photography.
Content	In this course, the basics of manual photography in line with the basics of design theory are explained and practiced. The results are discussed together on a weekly basis. The conclusion of this seminar will be a thematic work in which a series on a given topic will be developed. The final photo series will reflect the contents presented in the course. In addition, an excursion to a design museum/photo exhibition is planned.
Other requirements/information	The course is designed for students who are interested in photography. No prior knowledge is necessary.

	It would make sense to have a camera that can be adjusted manually. A smartphone is not adequate equipment for the course. Note: Cameras can be borrowed from the university.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Photographic compositions, final submission of a photo series

Scientific Presentation

Course name	**Scientific Presentation**
Learning objectives	In this course, students are expected to achieve the following objectives: - Learn how to design and present scientific posters - Learn how to create and give oral presentations on scientific topics in English
Content	Students will learn about the structure of scientific presentations. The lecture series includes lots of exercises on listening to scientific presentations and analysing these presentations. Furthermore, students will discuss advantages and disadvantages of various presentation methods, their strength and weaknesses. The course also covers a wide range of exercises on creating and presenting scientific posters. A Poster, as a final work, can be created as part of the exercises during the lecture series. Poster presentations will be graded at the end of the course.
Other requirements/information	The course is a part of the Applied Chemistry master's programme and open for all master's students of natural sciences. The lectures are presented only in English. Therefore, English level B2 proficiency is necessary.
Course format	Seminar-style lecture + practical exercises
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Oral examination, poster

Simulations in Molecular Physics

Course name	**Simulations in Molecular Physics**
Learning objectives	In this course (including a strong focus on practical calculations with commercial software) we will learn and understand how the application of quantum chemical calculations can be an alternative way to gain knowledge in chemistry and any molecule-based natural science e.g. biology, pharmacy, etc.
Content	We will learn about the current orbital-based atomic theory. Based on this atomic model we will understand the periodic table of the elements and the nature of the different chemical bonds. Forming and breaking of these bonds will guide us to the energetics of chemical reactions. Based on the intended practical final project we will learn one specialised chemical topic. In the second part of the seminar we will get an overview on computational chemistry and learn on a qualitative level about different quantum chemical methods to calculate molecules. We will learn how we can utilise the calculated data to gain insights in the chemistry and physics of the investigated molecular systems without experiments. Besides the lecture we will do practical exercises in the computer lab to practice for the final project.
Other requirements/information	Participants need no previous knowledge in chemistry or computer science. Interest in natural science and computers is expected. Knowledge in working with spreadsheets is advantageous. The necessary basic knowledge in Linux will be taught.
Course format	Seminar-style lecture
Credits (ECTS)	5
Lecture hours (LVS)	6
Type of assessment	Written assignment

Sustainable Buildings - Designing, Constructing and Living Green

Course name	**Sustainable Buildings - Designing, Constructing, and Living Green**
Learning objectives	The main aim of this course is to create an awareness for the buildings we live in. Almost 40% of all global emissions are produced through the building sector. A large proportion of these through housing. By taking a look at the whole life cycle of a building, students will gain an insight into the impact that can be made through designing, planning, constructing, operating, and removing buildings in a green and more environmentally friendly way. There will be a focus on how small decisions regarding the design, materials, or the energy

	concept can influence the carbon footprint of a building. The overall aim is to develop an awareness for the way we live and to understand how individuals can contribute towards a more sustainable built environment.
Content	After taking a look at the historical development of housing and different ways of living around the world, we are going to study the different disciplines of construction and understand how a more sustainable approach can contribute towards saving resources and reducing our energy consumption. We will not only be looking at individual buildings but different housing concepts and their impact on society. Based on case studies and good practices, both the structural and technical elements of buildings will be examined. The whole life cycle, from the inception to the completion, including the removal and recycling of the building will be taken into consideration. Moreover, the usefulness of building systems and certificates, such as Passive House, DGNB or LEED, will be examined and discussed.
Other requirements/information	All students interested in our built environment or studying something construction related, i.e. architecture, civil engineering, building services engineering, are welcome.
Course format	Seminar-style lecture
Credits (ECTS)	2
Lecture hours (LVS)	2
Type of assessment	Course assignments, presentation