Technikum International Office

UAS Technikum Wien

COURSE GUIDE SS2025

COURSES OFFERED IN ENGLISH

→

Please note:
Incoming students have the possibility to combine courses from different study programs. The number of places available for Incoming students in each course may vary or be limited to a certain number.
Please be aware, that incoming students are obliged to generate at least 9 ECTS from the Campus International.

At the beginning of each semester an Orientation Week is held for all Incoming students as well as for all Double Degree students.
The Orientation Week takes usually place in the 2nd week of September resp. 2nd week of February.
Please take into consideration that this course guide may be subject to change!
Last update: 22.10.24

OVERVIEW OF COURSES OFFERED ENTIRELY IN ENGLISH

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GLOSSARY AND ABBREVIATIONS

Term	Abbreviation	Description
Laboratory	LAB	Application and practical exercises in small groups.
Seminar	SE	High extent of interactivity in teaching and by a sequence of theoretical inputs, case studies, exercises and discussions in small groups.
Integrated Teaching	ILV	Instruction is given by a sequence of theoretical teaching and practical exercises in (small) groups.
Distance Learning	FUV/FL/DL	The courses are devided into the on-campus phase and distance/online learning. During the on-campus phase the presence of the students is obligatory. During these phase the students have the introduction courses, attend the examinations or give their presentations in front of the class. During the online-phase the students have to work on the course contents via moodle courses, where they have to hand in assignments, take part in forum discussions and/or read study letters and literature. During the online-phase the students do not have to be presence at the university.
Lecture	VO	Mediation of new knowledge by the means of frontal teaching.
Exercise	UE	Reduced transfer of new knowledge and practical strengthening in (small) groups.

Study Program	Abbreviation (in German)
Bachelor	
Biomedical Engineering	BBE
Renewable Energies	BEE
Sustainable Environmental and Bioprocess Engineering	BUB
Electronic Engineering	BEL
Electronics and Business	BEW
Information and Communication Systems and Services	BIC
Hydrogen Engineering	BHE
Computer Science	BIF
International Business & Engineering	BIW
Mechanical Engineering	BMB

Mechatronics/Robotics	BMR
Smart Homes and Assistive Technologies	BSA
Sports Engineering & Ergonomics	BHF
Business Informatics	BWI
Master	
Medical Engineering & eHealth	MME
Data Science	MDS
AI Engineering	MAI
Climate-Responsive Building Technologies	MGT
Renewable Urban Energy Systems	MEE
Embedded Systems	MES
Health Care and Rehabilitation Technology	MGR
IT Security	MCS
Power Electronics	MLE
Industrial Engineering & Business	MIB
Mechanical Engineering	MMB
Robotics Engineering	MRE
Software Engineering	MSE
Quantum Engineering	MQE
Sports Equipment Technology	MST
Tissues Engineering and Regenerative Medicine	MTE
Internet of Things and Smart Systems	MIO
Innovation and Technology Management	MTM
Environmental Management and Ecotoxicology	MUT
Information Systems Management	MWI

CAMPUS INTERNATIONAL

Campus International (ECI)

CI_Traffic Safety Culture and Mobility

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	This integrated course provides insights to theoretical background and practical issues of national, regional and local aspects of traffic safety culture and mobility in the Vienna region as well as human factors in transportation and mobility.
Teaching methods	Mandatory readings, individual investigation, presentations and group discussions in plenum and breakout sessions. Some frontal teaching.
Learning outcome	After passing this course successfully students are able to ... - explain the concept of traffic safety culture and practically apply it to plan their mobility, safely and efficiently travel to all relevant points of interest - understand local particularities and consider them for a safe movement during their stay in Vienna and beyond - gain basic understanding of important psychological concepts relevant for research of human factors in mobility (technology acceptance, emotions & aggression, perception). Those concepts can be operationalized and measured, thus considered for the students' own research
Course contents	- Applied: The concept of traffic safety culture and its application to any place in the world, in particular to the Vienna region. Planning trips using all modes from the most individual (bicycle, e-scooter) to the to the most public means of transport (bus, underground, train). Practical aspects from buying tickets to some of the strangest traffic rules in Austria. Acquisition of a driving license as well as use of shared vehicles. Points of interest from administration to sports.

	Theory and Research: •Elaboration of different concepts of traffic safety culture and their application in different professional contexts. Operationalization and measurement of traffic safety culture as well as intervention strategies on different levels (example of local road safety culture). •Human factors in the context of increasing vehicle automation: cooperation between driver and vehicle, new 'driving' skills (monitoring, vigilance), driver training of the future, ethical dilemmas •Acceptance of new technology: different types of adoptions, influencing factors and how to measure acceptance •Aggression in traffic: why can traffic be so hostile? Genesis, contributing and mitigating factors
Prerequisites	None
Assessment Methods	- Reports on mandatory readings (30%) - active participation (30%) - Exam
Recommended Reading and Material	- Ward, N. J., Watson, B., & Fleming-Vogl, K. (Eds.). (2019). Traffic Safety Culture: Definition, Foundation, and Application. Emerald Group Publishing. - Shinar, D. (Ed.). (2017). Traffic safety and human behavior. Emerald Group Publishing. - Journal Transportation Research Part F - Journal of Transportation and Health
Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case you miss more than 20% of the class you lose the first try in the exam.
Comments	

CI_German Language & Austrian Culture B1

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This integrated course provides the linguistic skills to deal with most situations likely to arise whilst you are staying in Austria. You will be

	prepared to enter into conversation on topics that are familiar, of personal interest or pertinent to everyday life (e.g. family, hobbies, work, travel and current events).
Teaching methods	Group work, role plays, text production, excursion, audio- and video files, authentic texts
Learning outcome	After passing this course successfully students are able to ... - understand the main points of clear standard speech on familiar matters regularly encountered in work, school, leisure, etc - understand the main point of many radio or TV programmes on current affairs or topics of personal or professional interest when the delivery is relatively slow and clear. - understand texts that consist mainly of high frequency everyday or job-related language. - understand the description of events, feelings and wishes in personal letters.
Course contents	- Topics: Family life, contacts, men and women today, work environment, travelling and traffic, nature and environment - Grammar: Subordinate clauses, adjective+article, infinitive construction, Tenses, reflexive pronouns, subjunctive I +II, passive voice
Prerequisites	German A2 level
Assessment Methods	- Tests (mid-term and final test,) performance in class, homework
Recommended Reading and Material	
Attendance	80%
Comments	

CI_Building Climate Engineering

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Theoretical and practical basics of Building Energy Design: energy

	efficient constructions, building physics, heating, ventilation and air conditioning of energy efficient buildings in Austria and internationally.
Teaching methods	Lectures combined with practical teaching on the construction site of an energy efficient building.
Learning outcome	After passing this course successfully students are able to ... - analyze different building construction components, facades and window concerning their energy efficiency, comfort and building physics, - design preliminary concepts of energy efficient projects, - overview possibilities of ventilation, heating and cooling, - compare different construction techniques concerning energy efficiency, building quality and comfort, especially related to their home country.
Course contents	- Basics of building physics, heat, humidity and sound protection - Building construction components from the view point of building physics and energy efficiency, comparison on international basis - Heating, cooling and ventilation possibilities, - Energy benchmark levels, calculating of the energy demand of buildings
Prerequisites	Basic knowledge at least in one or two of the following topics: - Building construction- Building physics - Heating, ventilation and air conditioning - Energy planning of buildings
Assessment Methods	- Combined written and oral exam, written exam in 2-3 examples 40% Cooperation, attendance 20% - Project including energy layout and a short planning example of heating, ventilation and/or cooling 40%
Recommended Reading and Material	- Gerhard Hausladen, Saldanha, Liedl, 2013: Climate Skin Building Skin Concepts that can do more with less energy, ISBN978-3-0346-0727-8, Birkhäuser Verlag Basel
Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case you miss more than 20% of the class you lose the first try in the exam.
Comments	

CI_Audio Engineering

Degree programme	ECI
Semester	2

Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This integrated course provides students the opportunity to familiarise themselves with the basics of acoustics and audio engineering, including perception of sound, microphones, amplifiers, loudspeakers, audio processing, etc.
Teaching methods	The Lecturer will explain some basic concepts. The students will compete tasks in the computer using Matlab.
Learning outcome	After passing this course successfully students are able to ... - Understand the signal chain in a typical audio application, and be able to recognise and avoid distortions in all stages - understand how humans perceive sound, - record sounds using the appropriate equipment, - measure different attributes of sound and understand how they correlate to human perception, - analyse and interpret recorded sounds - synthesise sounds with specific attributes - perform audio processing on recordings - understand how audio compression works
Course contents	- Sound and sound attributes - Human perception of sound - Signal chain in audio engineering - Microphones and amplifiers - Analog vs digital signals - Fourier Analysis, Spectrum, Spectrogram - Synthesis of sounds - Filters - Audio compression - Lourspeakers09
Prerequisites	Basic programming skills. Matlab knowledge advantageous.
Assessment Methods	- The students will be assessed according to how far they completed the task at hand
Recommended Reading and Material	- Script provided by the lecturer
Attendance	Attendance is mandatory in this course, only 20% of absence is

	tolerated. In case you miss more than 20% of the class you lose the first try in the exam.
Comments	

CI_German Language & Austrian Culture A1

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Basics in German grammar and conversation. The course should prepare you to get along in everyday situations. To get and to give simple personal information, information about your life and your work. Basic grammar:the article tenses, pronouns, word order, question and negation, modal verbstopics: me and the others, people and things, student's life, living,shopping
Teaching methods	group work, role plays, text production, excursion
Learning outcome	After passing this course successfully students are able to ... - master everyday situations in German
Course contents	- Basic Grammar: Verb Konjugation, the article, Nouns in Singular and Plural, Modal Verbs - Topics: Living together, Looking for an apartment, Furniture, clothes, Sights, Arts, Basic information about Austrian culture
Prerequisites	None
Assessment Methods	- mid-term test; Final-Test (written and oral), Attendance, performance in class
Recommended Reading and Material	- 1.)Panorama; Deutsch als Zweitsprache Kursbuch A1.1 ISBN 978-3-06-120472-3; 2.)voluntarily: Übungsbuch A1.1. ISBN 978-3-06-120602-4
Attendance	minimum attendance of 75 % required
Comments	Try to have the book for the first lesson. It is available at "THALIA" bookshops

CI_German Language & Austrian Culture B2

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Repetition, perfection and exercises of relevant grammatical structures • Vocabulary and useful phrases for B2 • Economy / career / work • New technology • Modern life / society
Teaching methods	Normal class with presence (15 UE): Discussions, work in large and small groups and presentation of your results you have prepared in form of a short text. AND E-learning with Moodle (15 UE): Single work with deadline for interim reports, exercises on reading, grammatical issues and vocabulary, writing 3 short texts (400 words each) and revision of the 3 texts.
Learning outcome	After passing this course successfully students are able to ... - understand grammatically complex texts which are rich in vocabulary on the level B2 - write a summary and comment the main topics of a text. Furthermore you have developed and enlarged your knowledge of German for the purpose of your studies - You have improved and clarified your writing skills as well as you can refer to phrases of argumentation. - describe and comment graphics and you can take a critical point of view in the context of a text. - write a request, a letter of complaint with the appropriate register
Course contents	- Reading of press articles and exercises in global and close reading as well as training of vocabulary and grammar - Writing summaries and expressing your point of view with the right expressions - Expressing advantages or disadvantages - Writing a letter of complaint or a request with the right expressions - Reporting about texts, describing and commenting graphics in the context of an article - Making an interview in the context of your studies and writing about your learning outcome
Prerequisites	Only for students with a good knowledge of German who are

	interested in improving their writing skills
Assessment Methods	- 1) 3 texts Option A Writing a summary and a comment on 3 long newspaper articles (1 with graphics) in the amount of about 400 words. OR Option B: Writing a summary and comment on 2 long newspaper articles (1 with graphics) in the amount of about 400 words and make a study-specific interview with a person of your interest, write a transcription/summary and reflect about your learning outcome. (50 points) - 2) Exercises on Moodle (25 points) - 3) Active participation (25 points)
Recommended Reading and Material	- Texts and exercises on Moodle and handouts of the regular class.
Attendance	Compulsary
Comments	

CI_Scientific Writing

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This hands-on-course dives deep into the praxis of scientific writing. Theory and basics of scientific writing are subjects of online learning, while the meetings are used to practice, analyse und discuss your own scientific writing.
Teaching methods	Exercises, peer-learning, talks, discussions, online-tasks
Learning outcome	After passing this course successfully students are able to ... - Define, describe, identify and evaluate academic resources - Describe and apply the common structure of a scientific paper - Discuss the different kinds of research questions and apply them to their field or research - Describe and discuss the common structure of a Bachelor’s Thesis or Master’s thesis - Write text according to common standards of academic writing

Course contents	- How is academic writing done? Where to find resources and references? What kind of scientific writing is adequate for which purpose? How are scientific papers structured? How to cite correctly? Which style of language is adequate?
Prerequisites	Basic knowledge of scientific keyterms and principles.
Assessment Methods	- Course immanent assessment method and end exam
Recommended Reading and Material	- Leedy, Ormrod: Practical Research. Planning and Design. Pearson - Skern: Writing Scientific English. Facultas wuv UTB
Attendance	Attendance is partly mandatory in this course. You can attend every class, and should at least participate in two sessions (50%) after the Kick-off.
Comments	

CI_German Language & Austrian Culture A2

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Based on the A1 course we train frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment).The course will teach frequently used expressions related to very basic personal and family information, shopping, local geography, employment.indefinite pronouns
Teaching methods	group work, role play, text production,homework
Learning outcome	After passing this course successfully students are able to ... - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment). Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Can describe in simple terms aspects of his/her background, immediate environment and matters in areas of immediate need

Course contents	- Grammar:regular and irregular verbs in Perfect, prepositions with Akkusativ+Dativ, separable verbs - Topics: Living together, Looking for an apartment, Furniture, clothes, Sights, Arts, Basic information about Austrian culture
Prerequisites	A1
Assessment Methods	
Recommended Reading and Material	- Panorama Deutsch Als Fremdsprache ; Kursbuch A2.1 Cornelsen Verlag ISBN 978-3-06-120488-4(also available as E-Book)/voluntarily: Übungsbuch A2.1 ISBN 978-3-06-120604-8
Attendance	Intermediate TestFinal Test (written and oral)Attendance and performance in Class
Comments	Try to have the book for the first lesson. It is available at "THALIA" bookshops

CI_Renewable Energy Laboratory

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Experimental setup of different means of measuring methods to evaluate the performance of renewable energy technologies and systems.
Teaching methods	Laboratory exercises in small groups of typically 8-12 students
Learning outcome	After passing this course successfully students are able to ... - measure and analyze the energetic performance of components of energy conversion systems and measure and interpret the power quality of energy networks - measure and analyze the energetic performance of heat pumps, - measure and analyze the energetic performance of thermal solar plants and photovoltaic plants, - measure certain parameters of ventilation and hydraulic systems and interpret it.
Course contents	- Measurements and analysis of the energetic performance of energy

	conversion systems, - analysis of the power quality of electrical networks, - measurement and analysis of the efficiency of heat pump systems, - measurements and performance tests of solar thermal and photovoltaic plants, - performance tests of ventilation and hydraulic systems
Prerequisites	Basics in: - Electrical machines - Mechanical engineering - Thermodynamics - Instrumentation
Assessment Methods	- Laboratory notes - Laboratory reports - Grading of practical session - Laboratory reports
Recommended Reading and Material	- Scripts of the lecturers
Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case you miss more than 20% of the class you lose the first try in the exam.
Comments	

CI_Electronic Laboratory

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This integrated course provides students the opportunity to calculate and build electronic circuits, as well as measuring their characteristics with modern measuring devices.
Teaching methods	The Lecturer will explain briefly the basic concepts students need to know to perform the experiment at hand. The students will work in groups to perform the experiment. The Lecturer will be available to assist the students in building and measuring their experiment, as well as to clarify any questions and solve any problems that may arise in the process.
Learning outcome	After passing this course successfully students are able to ...

	- measure voltages and currents with a DMM and oscilloscope correctly - produce signals with the Function Generator - calculate electronic circuits, build them and measure their outputs and characteristics - measure the output of circuits involving resistors, capacitors, diodes and OpAmps with the oscilloscope
Course contents	- Oscilloscope and Function Generator - Kirchhoff laws - Diode and Zener Diode - DC Power supply design and implementation - OpAmp circuits - RC Circuit: DC and AC analysis - Transistor Amplifiers - Project: Audio Equaliser
Prerequisites	Students should have basic knowledge of electronics and electronic circuits.
Assessment Methods	- The students will be assessed according to how far they completed the experiment at hand.
Recommended Reading and Material	- Maxfield et al., “Electrical Engineering know it all”, Newnes & Elsevier, 2008. - Scripts and materials provided by the lecturer.
Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case you miss more than 20% of the class you lose the first try in the exam.
Comments	

ASSIST HEIDI Designing and implementing Assistive Tools for people with disabilities

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	This course brings students and people with disabilities (HEIDI –

	Human being with disability) together, in order to design and prototype an individual assistive technology solution for them. Students will learn the basics about disability, existing assistive tools, rapid prototyping and microcontrollers and will have access to materials, tools and equipment (e.g. 3D printer etc.). The Smart Living Lab of the UAS Technikum Wien (https://www.youtube.com/watch?v=qv6cvPn4fNU) provide the perfect environment for the participants. This is the best opportunity to get to know people with disabilities, to contribute, develop and implement your own ideas. The course methodology and contents will be similar to the ASSIST HEIDI summer school 2022 (https://www.youtube.com/watch?v=oN9UciVc-2I).
Teaching methods	Co-Design, Problem-based learning
Learning outcome	After passing this course successfully students are able to ... - understand daily challenges of people with disabilities - understand and apply the principles of co-design - understand types and causes of disabilities - know the current technical aids to support people with disabilities and to be able to select suitable technologies for certain applications - design and imlement assistive prototypes using rapid prototyping, microcontrollers or computer vision / ML
Course contents	- At the beginning of the course the students will be introduced to UAS Technikum Wien English Course Guide 11 of 162 people with disabilities and will interview them in order to understand their daily challenges and find inspiration for project work. After the project selection the students will form groups of 4-6 persons and collaboratively design and implement a project idea supervised by the lecturers. Finally, the project results must be presented and will be evaluated by the HEIDIs and lecturers. - In parallel, several topics will be covered including small exercises: - Physiological basics, Types and causes of disabilities - Assistive tools - Rapid Prototyping - Computer vision + ML with python - Arduino microcontroller - The classes will be held weekly approx. 16:10-17:40. In parallel, regular online sessions are provided on-demand for project supervision approx. 16:10-17:40.
Prerequisites	Programming, English
Assessment Methods	- 2 x Assignments á 10% = 20%

	- 1 x Project work (graded as group work) 80%
Recommended Reading and Material	- Author: Dr. Wolfgang L. Zagler, Title: Rehabilitationstechnik, Date: March 1, 2008, Location: Vienna, Austria, Book URL: https://studyathome.technikum-wien.at:8092/
Attendance	Attendance is mandatory in classes on campus.
Comments	

International Marketing

Degree programme	ECI
Semester	2
Course methods	SO
Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	The decision whether to internationalize: Understanding internationalization motives, barriers and risks; value net analysis of international competitiveness; Deciding which markets to enter: Global market research; market selection process; environmental analysis; Market entry strategy: transaction cost approach; export, intermediate, hierarchical entry modes; international buyer-seller relation; Designing of the global Marketing program: Green marketing strategies; cross boarder pricing challenges, channels decisions, international advertising strategies; Global Brand Management: customer based brand equity, brand association map, brand extension and diversification in a global context brand elements;
Teaching methods	Self-study, lecture, distance learning, case studies, group projects
Learning outcome	After passing this course successfully students are able to ... - discuss motives and triggers why firms go international - evaluate the factors influencing a firm's international competitiveness - define international market selection and identify the problems related with it - evaluate the factors to consider when choosing a market entry strategy - design global marketing programs

	- contribute to strategic marketing decisions - understand and contribute to marketing mix decisions
Course contents	- Internationalization process - Market segmentation - Creating competitive advantage - Global marketing communication - Market selection process - Brand building - Marketing Mix decisions
Prerequisites	none
Assessment Methods	- Written examination (70%) - Group Assingment (30%)
Recommended Reading and Material	- Global Marketing, Hollensen, 2016 - International Marketing, Czinkota , Ronkainen 2012 - Strategic Brand Management, Keller 2013
Attendance	Attendance is compulsory.
Comments	Detailed information regarding the course is provided via Moodle.

Building and Solar Energy

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	Design of a solar system for a housing complex including technical parameter, contribution to the local electricity system including heating and mobility needs; economic calculation, ecologic impact.
Teaching methods	Project-Based Learning method. Combined with lectures and practical teaching on the remote laboratories. Supported by virtual learning environment and simulation.
Learning outcome	After passing this course successfully students are able to ... - Design preliminary concepts and design of energy efficient building supported by solar energy - Simulation of a solar energy system

	- Possibilities of building integrated photovoltaics and construction design - Overview of the market, drivers, stakeholders for integration of affordable renewable energy systems
Course contents	- Energy characterization and energy planning of solar building - Designing a building-integrated photovoltaic installation by software tools - Measurement and analysis of solar systems in the lab - Best practice of solar design (Excursion) - Overview of the market, legislative and drivers for solar energy and buildings
Prerequisites	Basic knowledge at least in one or two of the following topics: - Building construction - Solar energy system - Energy planning of buildings
Assessment Methods	- Lecture notes - Grading of practical session - Project reports
Recommended Reading and Material	- Cost Optimal and Nearly Zero-Energy Buildings (nZEB) Definitions, Calculation Principles and Case Studies, Editors: Kurnitski, Jarek (Ed.) - Designing with Solar Power: Source book for Building Integrated Photovoltaics. D. Prassad, M. Snow Routledge - Modeling, Design, and Optimization of Net-Zero Energy Buildings Athienitis (Ed.), W.O'Brien (Ed.), ISBN: 978-3-433-03083-7, February 2015 - Building integrated photovoltaics: A handbook S. Roberts and N. Guariento, Editors: Springer
Attendance	Attendance is mandatory in this course, only 20% of absence is accepted.
Comments	Mixed: Incoming students in collaboration with FHTW Master students - Project-based learning on real city development project from city of Vienna (MA20) or the city of Korneuburg - Integration in the curricula of the Master program of renewable energy

Mobile Robotics

Degree programme	ECI
Semester	2
Course methods	ILV

Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	The course provides an introduction to the basics in mobile robotics with regard to the main components of mobile robots. The students achieve a basic understanding of methods to control mobile robots and implement behaviours as well as methods for direct sensor-actor coupling.The knowledge learned is first applied in a simulation environment and finally tested on a real robot.
Teaching methods	The learning content is explained using PDF slides and Jupyter notebooks. Afterwards, the students are divided into groups and carry out a project independently with the help of the lecturer.
Learning outcome	After passing this course successfully students are able to ... - explain components and operating modes of robots - define and differentiate between navigation with plans, localisation and trajectory planning - control mobile robots by applying behaviour methods for direct sensor-actor coupling - apply basic knowledge ROS
Course contents	- Introduction to Mobile Robotics - Develop ROS nodes for robot applications
Prerequisites	Mandatory: Programming in C++ and/or Python; Basic Linux Skills (there are warm-up slides) | Recommended: Computer Vision Basics
Assessment Methods	- Homework: 20% - Moodle Quizzes: 20% - Moodle Forum: 5% - Projekt: 55%
Recommended Reading and Material	- O'Kane: A Gentle Introduction To ROS, 2.1.6, 2018, https://www.cse.sc.edu/~jokane/agitr/ - http://wiki.ros.org/
Attendance	
Comments	This course requires a (reasonably) powerful computer:- min i5 (7th gen.)- 8GB RAM (Ubuntu) | 16GB RAM (Windows)

Data Ethics and Open Data

Degree programme	ECI

Semester	2
Course methods	ILV
Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	Open data is accessible public data that people, companies and organisations can use and process. The benefit of Open Data is not only the publication itself, but especially its duplication and reuse as new applications and solutions can increase transparency, promote innovation and encourage community engagement. The extensive use of increasingly more data in general also requires the consideration of complex moral and ethical subjects related to data to support good solutions and responsible handling. The course will be divided into two subject areas: Lectures on Data Ethics will provide the opportunity to learn about the ethical impacts of data and related topics (privacy, transparency, surveillance etc.). In lectures on Open Data students will learn about Open Data from a technical viewpoint and work on an Open Data application.
Teaching methods	The course consists of - lectures combined with discussions - project work and exercises
Learning outcome	After passing this course successfully students are able to ... - analyse and work with Open Data - determine different fields of Open Data applications - assess the quality of different Open Data sources - valuate the importance of responsible handling of data in different areas of application - discuss domain-related data ethics - analyse and describe the challenges and risks of an intelligent machine learning system (AI)
Course contents	- Open Data applications in different fields: Healthcare, finance, Smart Cities etc. - Open Data formats - Open Data policies - Project: analysing and processing open data - Data Ethics - Data Privacy, Transparency
Prerequisites	Basic Knowledge in Web Technologies, Database Systems, and Data Management

Assessment Methods	- Participation in discussions and presentation (Data Ethics) - Project results and project presentation (Open Data)
Recommended Reading and Material	- Ethics Advisory Group (2018): Ethics Advisory Group Report 2018 - European Union (2017): Open Data Maturity in Europe 2017 - Specific papers related to domains - Open data Web sites and catalogues (e.g. https://open.wien.gv.at)
Attendance	Attendance is mandatory
Comments	Course Details will be provided in Moodle.

Service and object-oriented Algorithms in Robotics

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	6.00
Incoming places	Limited

Course description	The course discusses important concepts regarding robot control in the context of modern data-driven robotics. Thus, different methodologies from robotics and data-science are are taught and applied using Python and the robot operating system (ROS).
Teaching methods	This course is based on theory and practical exercises/projects using simulation of mobile robots. The first classes are supported by a theory lecture (theory, methods, mathematics and algorithms) before students solve project tasks in small groups (solving various problems arising in robot control in simulation/on real robots).
Learning outcome	After passing this course successfully students are able to ... - explain components and operating modes of robots, - define and differentiate between navigation with plans, localisation and trajectory planning, - identify required robot system components based on the system's desired use case and level of autonomy, - create ROS launchfiles and interface with ROS using Python and Jupyter notebooks, - implement pipelines for sensor data processing and - explain and desvisualise various data types/structures required in robotics applications.

Course contents	- Introduction to important concepts in robotics and ROS - Sensor-based robot control - Mobile robot simulation - Programming and software documentation (Python and Jupyter notebooks)
Prerequisites	Mandatory: Sensor technology and basic understanding of programming, in particular in Python or C
Assessment Methods	- 70% Group project with presentation - 30% Exercises
Recommended Reading and Material	- http://wiki.ros.org/ROS/Tutorials - C. M. Bishop, Machine Learning and Pattern Recognition, 2006 - S. Russell and P. Norvig, Artificial intelligence: a modern approach, 1995
Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case you miss more than 20% of the class you lose the first try in the semester project.
Comments	

Empowering Intercultural Teams for Success: Theory - Tactics – Solutions

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	Simply, the purpose of this course is to help you enhance your employability and further the development of your career prospects. In an increasingly inter-cultural and dynamic world what will be the skills that stand out to attract employers? Intercultural awareness, the ability to work in multi-cultural teams, the ability to demonstrate awareness and agility and the ability to work in an English environment would be some of the important ones that might occur to you. And it is exactly these skills that this interactive and compelling course will help you develop. The course will mix intercultural theory (such as Hofstede's dimensions) and that of building resilient and functional teams (Bruce Tuckman) with a highly

	interactive practical project where course participants work together to solve a flash business challenge. The course will also enable you to meet many international students from a great variety of nationalities!Some testimonials from students who took the course in the Winter Semester:'In this course you get the perfect combination of theoretical inputs and practical work in the topic of Business in different cultures and countries. At the same time you get to meet students from around the world.''The ECI Course gave me an insight into the world of intercultural team work that is very valuable, also for general management. The culturally diverse team itself and the lecturers created a good working environment.''As a student in the ECI Course, I've been able to gain valuable insights into intercultural team dynamics and expand my management skills while working with a diverse team and learning from expert instructors.'
Teaching methods	Theoretical input, group workshops, teamwork, group discussions, independent research, participant preparation of written documents.
Learning outcome	After passing this course successfully students are able to ... - question their culturally formed stereotypes and prejudices; - reflect on different strategies for dealing successfully with cultural differences; - apply strategies to overcome problems related to intercultural differences; - work successfully in an English as a Lingua Franca environment; - cooperate effectively in intercultural teams to overcome and solve cultural problems and issues.
Course contents	- Attributes of a successful intercultural team participant/leader; - Hofstede's cultural dimensions; - Techniques for efficient communication in English as a Lingua Franca; - Strategies for working successfully in an intercultural team; - Problem based intercultural workshop
Prerequisites	B2 English level
Assessment Methods	- 25% student presentation - 50% successful completion of workshop - 25% final written task
Recommended Reading and Material	- Script
Attendance	75% mandatory
Comments	

Experience Erasmus+: Preparation and Awareness for a Profitable Semester Abroad

Degree programme	ECI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

BACHELOR DEGREE PROGRAMS

Electronic Engineering (BEL)

Business English

Degree programme	BEL
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description

In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary in English.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...
- use a wide range of business vocabulary in English,
- hold a PechaKucha presentation in English, presenting either a marketing analysis of, a CSR (Corporate Social Responsibility) strategy for, or a financial analysis on a company of their choice, understand and deconstruct a business plan in English,
- understand how products can be marketed using the English language,
- understand how products can be marketed using English,
- use a wide variety of techniques to aid communication in international teams and meetings using the English language,
- effectively present data and trends using the English language,
- understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) using the English language

	- and apply them to different companies.
Course contents	- Business topics (marketing, finance, business plan …) in English - Meetings in English - ELF ("English as a lingua franca") communication - CSR (Corporate Social Responsibility) and Business Ethics in English - Business presentations in English
Prerequisites	Course "Technical English"
Assessment Methods	- Vocabulary test, self-studies, class preparation and discussion, PechaKucha presentation and assessed presentation plan
Recommended Reading and Material	- R. Murphy, English Grammar in Use, 5th Edition, 2019, Klett Verlag - University of Minnesota, Business Communication for Success, 2015, ISBN 13-9781946135056
Attendance	Obligatory
Comments	

Microelectronic Design

Degree programme	BEL
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	The course provides introductory know-how on the design methodology, implementation and verification of digital microelectronic circuits and systems using contemporary hardware description languages and programmable logic devices (FPGAs) as target technology
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - explain the importance and history of microelectronics by means of application examples, - describe simple digital microelectronic circuits and systems consisting of combinatorial and sequential logic, based on a contemporary hardware description language such as VHDL,

	- verify the functional correctness of the developed designs by using an industrial digital logic simulator, - synthesize and implement these designs on a contemporary target technology (FPGA) - and apply the acquired knowledge to a final project.
Course contents	- Overview on the importance and history of microelectronics - Introduction to a contemporary hardware description language like VHDL - Design of combinational logic (simple gates, decoders, multiplexers, adders, subtractors ...) with a contemporary hardware description language - Description of sequential logic (different types of flip-flops and registers, counters, state machines ...) using a contemporary hardware description language - Verification of digital microelectronic circuits and systems by using an industrial digital simulator - Synthesis and implementation of digital circuits and systems using industrial EDA tools and modern microelectronic target technologies (FPGAs) - Final project
Prerequisites	Fundamentals of digital systems, basic programming skills
Assessment Methods	- course-immanent performance assessment
Recommended Reading and Material	- P. Ashenden, The Designer's Guide to VHDL, 2008, Morgan Kaufmann, ISBN 0120887851 - C. Unsalan, B. Tar, Digital System Design with FPGA: Implementation Using Verilog and VHDL, 2017, McGraw Hill
Attendance	mandatory
Comments	

Sustainable Environmental and Bioprocess Engineering (BUB)

Business English

Degree programme	BUB
Semester	2
Course methods	UE
Language	English

ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag

	- Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory
Comments	none

Hydrogen Engineering (BHE)

Business English

Degree programme	BHE
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed

	- use a wide variety of techniques to aid communication in international teams and meetings effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory
Comments	none

Information and Communication Systems and Services (BIC)

Business English

Degree programme	BIC
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding

	what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings - effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Selbststudium und Vorbereitung und Diskussion in der Klasse - 60% Business PechaKucha Präsentation und bewerteter Präsentationsplan.
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory
Comments	None

IT Security Basics

Degree programme	BIC
Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description

The course offers an overview of the fundamentals of IT security and deals with cryptographic methods, authenticity, key management, access control and secure communication.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...
- to name the protection goals of IT security and to show threats as well as methods to guarantee the goals
- know cryptographic methods and can name their respective strengths and weaknesses and thus possible application scenarios
- Encrypt and sign emails and any documents
- List methods for access control and monitoring at network, system and application levels and explain their function and application scenarios
- Can explain basic technologies for secure communication
- Explain basic procedures for evaluating the importance of systems or for risk analysis

Course contents

- Basics of Information Security
- Threat to IT security and sources of danger (internal and external threats)
- Basics of cryptography
- HMAC
- Public key infrastructures (PKI)
- Signatures
- Certificates
- access control
- Identification/Authentication/Authorization
- Password security/entropy
- DMZ, Firewall & IDS/IPS
- IPSec

- Transport Layer Security
- Secure communication mechanisms

Prerequisites

Assessment Methods

Recommended Reading and Material

Attendance

Comments

Software Security

Degree programme	BIC
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description

Software security is the umbrella term for software designed to continue to function properly in the face of malicious attacks. Security as part of the software development process is an ongoing process involving people and processes that ensures the confidentiality, integrity and availability of the application. Secure software is the result of security conscious software development processes where security is built in and therefore software is developed with security in mind

Teaching methods

Learning outcome

After passing this course successfully students are able to ...
- Establish identity & access management in (web) applications
- Recognize the 10 most common security vulnerabilities in software
- Use established authentication methods (HTTP Digest, Single Sign On/SAML/OAuth2)
- Development of secure applications and assessment of current security risks
- Evaluate software projects using a Secure Software Lifecycle
- Assessment of threats to applications using a risk matrix
- Basics for conducting a security assessment / pentest

	- Software development: Secure by design, secure by default
Course contents	- Application Security - Secure by design principles - Secure authentication in SW - Web Application Security - Identity & Access Management - Risikobewertung in SW / Threat Modeling - DB Security
Prerequisites	Knowledge of common web languages (HTML, JS, CSS, PHP, AJAX)Knowledge of object-oriented languages (Java || C#. / .net)Knowledge of handling databases (mySQL or Oracle)Basic knowledge of using LinuxKnowledge of network protocols: Ethernet, IP/ARP, TCP/UDP, DNS, Application Layer protocols, Transport Layer Security or http/s, s/ftp, ssh,...
Assessment Methods	
Recommended Reading and Material	- SAML Specifications 2.1 - OAuth 2.0 Autorization Framework - RFC6749 - OWASP 10 2021++/-- - NIST Secure Software Development Framework - OWASP Secure Coding Guideline
Attendance	
Comments	

Embedded Systems

Degree programme	BIC
Semester	4
Course methods	LAB
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This module deals with the development and implementation of sophisticated software projects, based on Embedded Systems and corresponding communication modules.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ...

	- Implement sophisticated communication modules of Embedded Systems (Bluetooth, Wifi, ZigBee, Ethernet, USB, …) - Utilize existing communication module stacks/software libraries - Record and analyze communication protocols - Implement assignments either based on stand-alone firmware or based on pre-configured Embedded OSs (e.g. Embedded Linux)
Course contents	- Description of basic concepts for embedded operating systems (e.g. Embedded Linux) - Implementation and description of various sophisticated embedded communication interfaces (e.g. USB, Bluetooth, Wifi, Ethernet, ZigBee, …) - Implementation of one or more assignments based on embedded hardware platforms (utilizing existing embedded libraries) - Recording and analyzation of data transfers of the embedded communication interfaces, in order to understand the dataflow and the debugger - Implementation of a project based on the course contents
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

International Business Engineering (BIW)

Business English

Degree programme	BIW
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding

	what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings - effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory
Comments	None

Applied Computer Science

Degree programme	BIW
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	Software has become part of all areas of industrial engineering. Therefore, a basic education in applied computer science and the development of software are standard components of the graduates' toolbox. During the teaching, special emphasis is given to the abstraction of requirements and, subsequently, the realisation of corresponding software systems. In the first part of the course you will learn about the fundamentals of computer architecture, operating systems and virtualizations and you will work hands-on with file systems and bootable USB-Drives. In further classes and self-studies you will get insights into programming with python and the creation of algorithms using flowcharts in the first place and subsequently by using Python as a programming language. Python is a high-level programming language with use-cases in mechanic engineering, data aggregation, data analysis and many more. Working hands-on with datatypes and control structures will provide you the basic skills to create programs. Practical weekly moodle tests will keep you on track and will consequently challenge you to gain implementation expertise. Hands-on working with collections and files will expand your options in how to solve problems using your programming skills. In later classes you will expand your skills even further by working with an online simulation of a Raspberry Pi and by processing Open Data using APIs.
Teaching methods	Combination of classes and self-study phases
Learning outcome	After passing this course successfully students are able to ... - understand and explain architectures, operating systems and peripherals of computers - analyze and explain problems/tasks, create algorithmic solutions (using flow charts) and implement them using structured programming techniques

	- understand and apply fundamental tasks of programming languages: reading, processing and output of structured data, basic operations in data structures, regular expressions, control structures (conditional queries, loops, functions). - execute software tests - develop practical applications on a Raspberry Pi simulation - develop practical applications based on open data
Course contents	- Introduction Computer Science: Computer architecture, hardware, operating systems - Software and its characteristics - Programing paradigms, programing languages and their fields of application - Software development, development processes - Basics of computer architectures - Microcontroller vs. Microprocessor - Introduction to programming with python - Data processing: reading, processing, output of data - Contrul structures and loops - Collections - Functions - File-Handling - Regular Expressions - Application Bundeling - Raspberry Pi - M2M-communication - Open Data
Prerequisites	none
Assessment Methods	- Weekly moodle tests - Practical exercises - Moodle exam at the end of the course
Recommended Reading and Material	- Christian Baun, Operating Systems / Betriebssysteme, DOI: 10.1007/978-3-658-29785-5 - Connor P. Milliken, Python Projects for Beginners – A Ten-Week Bootcamp Approach to Python Programming, DOI: 10.1007/978-1-4842-5355-7 - Sunil Kapil, Clean Python – Elegant Coding in Python, DOI: 10.1007/978-1-4842-4878-2 - Python® Notes for Professionals, https://books.goalkicker.com/PythonBook/ (free)
Attendance	

Comments	75%

Engineering Management

Degree programme	BIW
Semester	6
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	This module teaches the knowledge and skills that are required in practice today in the job description of an "industrial engineer". In this module, students will familiarise themselves with selected process models of product development and the transition to production. In some of the focal points presented, in-depth knowledge of the respective technology is consolidated. These will be clearly explained using reference examples and developed in the context of practical tasks.
Teaching methods	Integrative lecture, calculation and group exercises
Learning outcome	After passing this course successfully students are able to ... - to present the technical requirements of the job description of the industrial engineer in practice. - to evaluate and classify problems that predominate in practice. - Applying methodological knowledge in a problem-solving manner in practice. - Explain and apply procedural models for interdisciplinary system development (especially the 3-layer V-model). - Understand the complexity of the interaction between mechanical-electronic software and project management. - to break down, develop and manufacture a complex system into subsystems with the help of the acquired methodological competence.
Course contents	- Basic terms and historical development in industrial engineering - The job description of the industrial engineer - Industrial engineering in the product development process and product life cycle - System and method competence to develop an individual problem-solving competence in IE

	- Digital Twins, Virtual Comissioning - Virtual Engineering - Safety design, risk analysis
Prerequisites	Production Technology, Management Basics 1 und 2
Assessment Methods	- Course-immanent performance assessment
Recommended Reading and Material	- Weilkiens T.: Systems Engineering with SysML/UML., 2006 - Douglas B.P.: Agile Systems Engineering., 2016 - Bokranz, R.; Landau K.: Handbuch Industrial Engineering: Produktivitätsmanagement mit MTM, Schäfer Pöschel, Auflage: 2, 2012 - Sihn, W.; Sunk, A.; Nemeth, T.; Kuhlang, P.; Matyas, K.: Produktion und Qualität –Organisation, Management und Prozesse; Carl Hanser Verlag, 2016
Attendance	Attendence is mandatory according to university standards
Comments	none

Business Informatics (BWI)

Distributed Systems

Degree programme	BWI
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This course introduces the development of component-based (in particular service-oriented) software systems.
Teaching methods	Lectures, homework / project work and self-study with practical examples and supervised project work
Learning outcome	After passing this course successfully students are able to ... - implement component-based systems using a selected programming language - implement service-oriented systems using a selected programming language - analyzing existing monolithic systems and converting them into

	flexible, distributed systems - exchange data asynchronously between (sub)systems using message queues, file transfer, RPC or shared databases - encapsulate data layer functionalities using O/R Mappers and make them available using interfaces - consider and apply design principles in the context of object orientation in the programming process
Course contents	- Component Based System Engineering - Service-oriented System Components - Various principles of system design - SOA related to system components - UML modeling (component/sequence diagrams)
Prerequisites	Basics in software development with a selected programming language. Basic knowledge of software architecture.
Assessment Methods	- Multimodal: - Theoretical assessment (Moodle MC test) - Homework (Coding Hand-Ins) - Project work
Recommended Reading and Material	- see Moodle
Attendance	mandatory
Comments	

Renewable Energies (BEE)

Applied Computer Science

Degree programme	BEE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	Software has become part of all areas of industrial engineering. Therefore, a basic education in applied computer science and the development of software are standard components of the graduates'

	toolbox. During the teaching, special emphasis is given to the abstraction of requirements and, subsequently, the realisation of corresponding software systems. In the first part of the course you will learn about the fundamentals of computer architecture, operating systems and virtualizations and you will work hands-on with file systems and bootable USB-Drives. In further classes and self-studies you will get insights into programming with python and the creation of algorithms using flowcharts in the first place and subsequently by using Python as a programming language. Python is a high-level programming language with use-cases in mechanic engineering, data aggregation, data analysis and many more. Working hands-on with datatypes and control structures will provide you the basic skills to create programs. Practical weekly moodle tests will keep you on track and will consequently challenge you to gain implementation expertise. Hands-on working with collections and files will expand your options in how to solve problems using your programming skills. In later classes you will expand your skills even further by working with an online simulation of a Raspberry Pi and by processing Open Data using APIs.
Teaching methods	Combination of classes and self-study phases
Learning outcome	After passing this course successfully students are able to ... - understand and explain architectures, operating systems and peripherals of computers - analyze and explain problems/tasks, create algorithmic solutions (using flow charts) and implement them using structured programming techniques - understand and apply fundamental tasks of programming languages: reading, processing and output of structured data, basic operations in data structures, regular expressions, control structures (conditional queries, loops, functions). - execute software tests - develop practical applications on a Raspberry Pi simulation - develop practical applications based on open data
Course contents	- Introduction Computer Science: Computer architecture, hardware, operating systems - Software and its characteristics - Programing paradigms, programing languages and their fields of application - Software development, development processes - Basics of computer architectures - Microcontroller vs. Microprocessor

	- Introduction to programming with python - Data processing: reading, processing, output of data - Contrul structures and loops - Collections - Functions - File-Handling - Regular Expressions - Application Bundeling - Raspberry Pi - M2M-communication - Open Data
Prerequisites	none
Assessment Methods	- Weekly moodle tests - Practical exercises - Moodle exam at the end of the course
Recommended Reading and Material	- Christian Baun, Operating Systems / Betriebssysteme, DOI: 10.1007/978-3-658-29785-5 - Connor P. Milliken, Python Projects for Beginners – A Ten-Week Bootcamp Approach to Python Programming, DOI: 10.1007/978-1-4842-5355-7 - Sunil Kapil, Clean Python – Elegant Coding in Python, DOI: 10.1007/978-1-4842-4878-2 - Python® Notes for Professionals, https://books.goalkicker.com/PythonBook/ (free)
Attendance	75 %
Comments	

Biomedical Engineering (BBE)

Business English

Degree programme	BBE
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings - effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan.
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag. - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8

Attendance	75% mandatory
Comments	none

Basics of Prosthetics

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Introduction to the basic principles of protection
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - to name the causes and level of amputation. - Describe different fitting options. - To select materials for prostheses and orthoses. - Orthopaedic products and their specifications for describe.
Course contents	- Causes of amputation - Representation of the supply process - Amputation level - Materials in orthopaedic technology - Mechanics and biomechanics in orthopaedic technology - Supply options related to Amputation level - Shaft connection
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Molecular Genetics

Degree programme	BBE

Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	The lecture Molecular Genetics provides an overview of the structure and functions of prokaryotes and eukaryotic cells. Molecular mechanisms in prokaryotic and eukaryotic cells are presented, focusing on relevant properties of proteins, RNA and DNA, and the fundamental biological processes of replication, transcription and translation, and regulation of gene expression.
Teaching methods	e-learning units on the respective topics with voluntary self-checks, supporting online teaching material (videos, animations simulations), classroom units with discussion of the topics, and group work with subsequent joint discussion of the results.
Learning outcome	After passing this course successfully students are able to ... - general molecular mechanisms in pro- and eukaryotic cells and compare them. - explain the fundamental biological processes of replication, transcription and translation at the molecular genetic level - reflect the different biological properties of proteins, RNA and DNA - explain the molecular interactions that control gene expression
Course contents	- Introduction and basics of molecular genetics - Cell cycle and mitosis/replication - Sexual reproduction and meiosis/recombination - Transcription - Translation - Genetics of bacteria - gene regulation
Prerequisites	ILV Biochemie und Molekularbiologie (BIOMO)
Assessment Methods	- written final exam (80% of final grade), groupworks in class (20% of final grade)
Recommended Reading and Material	- Molekulare Genetik - Rolf Knippers, Thieme Verlag - Genetik - Allgemeine Genetik - Molekulare Genetik - Entwicklungsgenetik - Wilfried Janning; Elisabeth Knust, Thieme Verlag
Attendance	There is a general requirement of 75% attendance. No reasons need

	to be proven or made credible for absenteeism within the remaining 25% (tolerance limit).
Comments	

Computational Bioanalysis

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Fundamentals of computational bioanalysis
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - search literature databases with regard to certain criteria. - perform basic sequence comparisons at DNA and protein level - create protein structures in 3D. - analyze gene expression data sets.
Course contents	- Literature databases - Sequence comparisons (BLAST) on protein and DNA level - Protein Prediction Tools - protein structures - Gene Enrichment Analysis, gene expression data sets
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Telemedicine & eHealth

Degree programme	BBE
Semester	4

Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	The course introduces telemedicine and eHealth. The knowledge acquired helps in particular with the implementation of digitally supported workflows in the entire health care system. A recent example is the contactless prescription of medicines during the COVID-19 epidemic. Such systems improve care by providing complete information in the right place for the people who are entitled to it. Clinical decision support and medical research systems are topics of the course. Graduates of this course are familiar with the application area "medicine" as well as with basic IT knowledge. They can therefore make significant contributions to the overall success, e.g. in the creation of user requirements and system requirements, and also in teams in the implementation of applications.
Teaching methods	Based on introductory lectures, groups of students will explore specific application fields. They will apply the skills from the course to these fields, to gain additional hands-on-experience. A visit to dHealth, the largest yearly scientific eHealth conference in Austria, will complete this intensive round-trip.
Learning outcome	After passing this course successfully students are able to ... - to classify existing systems or systems planned for the future according to different classification systems. - to identify the different types and essential characteristics of data storage, networks and transmission technologies in the health care sector and to analyse their technical properties and performance criteria. - understand the concept and the different levels of interoperability in the health care system and explain which standards can be used at which level. - Relate and balance the benefits and hazards of healthcare ICT applications.
Course contents	- Introduction and definition of terms: eHealth, mHealth, pHealth, telemedicine - Healthcare challenges and eHealth solutions - Basic technologies (networks, mobile and wireless) - Legal and health policy General conditions

	- Interoperability and standards - The Electronic Health Record / ELGA - Patient-centred care (home, health and telemonitoring) - Information and communication technology in the biomedical research - Future aspects and resources for a deepening of the Field of expertise
Prerequisites	Basic knowledge of medical specialties and the structure of the healthcare system
Assessment Methods	- Exam - Interactive presentation and discussion of group projects
Recommended Reading and Material	- Edward H. Shortliffe, James J. Cimino (Editors): Biomedical Informatics - Computer Applications in Health Care and Biomedicine. Springer Science+Business Media New York, 5th Edition, 2021, ISBN 978-3-030-58720-8, https://doi.org/10.1007/978-3-030-58721-5. - Sonali Vyas, Deepshikha Bhargava: Smart Health Systems - Emerging Trends. Springer Nature Singapore Pte Ltd. 2021, ISBN 978-981-16-4200-5, https://doi.org/10.1007/978-981-16-4201-2.
Attendance	
Comments	

Data Management in Medicine

Degree programme	BBE
Semester	4
Course methods	LAB
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Basics of medical data management
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - List and explain common data formats for medical data - Balance the basic data exchange mechanisms - to save sample data sets accordingly

Course contents	- medical data formats - Storage systems in hospitals - Data storage of medical data
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Engineering Heart, Lung and Circulation

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	Introduction to technology and definition of heart, lung and circulation technology
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - select suitable methods for measuring pressure and flow in the lungs and circulation for given issues and justify this selection. - compare different methods for ECG acquisition and detect and eliminate signal interference. - to describe the essential components of pacemakers and to name and justify the settings for different heart diseases. - to describe the sequence of spirometric and oxymetric examinations and to discuss the possibilities and limitations of measurement methods used. - to name the essential aspects for the electrical safety of a given measurement setup and to identify problems. - to perform simple risk analyses of devices for circulatory and pulmonary medicine.
Course contents	- Fundamentals of fluid mechanics with regard to the flows in the

	circulation and lungs - Pressure measuring method: Invasive, non-invasive - Flux measurement method: Invasive, non-invasive - ECG: Conclusion, most important pathophysiological Phenomena, derivations, basic circuits - Spirometry, oximetry - Cardiac pacemakers: basics, components, Operating modes - Safety technology in devices and installation with specific aspects of cardiac safety - Applied risk analysis for cardiovascular devices Lung Medicine
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Medical Data Engineering 1

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Inter-semester project (together with the course "Medical Data Engineering 2
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - to design software for the health care system which could be used by service facilities of the Health Information Network (GIN, Austrian eCard System, electronic insurance card). - to generate structured data from the medical sector and to process them, similar to the CDA findings from the Austrian health file ELGA, and the eCard services - Design database applications for the health care sector and

	perform simple database transactions. - to apply the basic rules of scientific work when writing and analysing texts, distinguishing a scientific approach from a non-scientific (everyday) one
Course contents	- Health Information Network (GIN) - Software development for the health sector - Structured data in the health sector
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Safety & Communications in Medical Data Engineering

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Principles and methods of software development and software testing
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - To apply standardised methods of software development. - to plan and implement basic software testing tasks. - to implement ISO/IEC 62304, ISO 13485, IEEE 829 from theory into practice. - explain the communication chain of the Continua Health Alliance. - implement a client/server connection using the TCP/IP protocol.
Course contents	- fundamental test process - V-model - Standards for medical software development - Standards for medical software development

- Basics of data communication
- IDE Features (Debugging, Unit Tests, ...)

Prerequisites

Assessment Methods

Recommended Reading and Material

Attendance

Comments

Circuit Design & Signal Analysis

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description

This lecture aims to give an introduction to circuit design and to build simple circuits for measuring biosignals. On the other hand the analysis of the self-recorded signals is discussed

Teaching methods

Learning outcome

After passing this course successfully students are able to ...
- analyse passive networks for DC and AC input signals.
- Dimensioning of a simple amplifier for bioelectric signal.
- Design and evaluation of electronic circuits.
- graphical description of analog input stages and active filter.

Course contents

- passive electronic components
- AC and DC analysis of linear network
- Complex signal analysis
- ESD protection in the biomedical field
- Operational amplifier circuits: Amplifier and Filter circuits
- Instrumentation amplifier for bioelectric
- Single and dual voltage supplies for analogue/digital circuits
- Guidelines for verification of electronic Circuits
- Design and evaluation of a biosignal amplifier

Prerequisites

Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Embedded Systems in Medicine

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Introduction and subsequent project work in the field of "Embedded Systems"
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - To name and explain the most important units of embedded systems in medical devices - To define the essential requirements for electronics in medical devices - To name and prototype simple medical devices in their components
Course contents	- project work
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Basics of Circuit Design

Degree programme	BBE
Semester	4

Course methods	LAB
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Introduction to circuit design
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - explain the basics of circuit design - to mention special features of medical devices - Design basic medical device circuits and to realise prototypes
Course contents	- Circuit design - Safety and construction for electronics in medical devices - Circuit design of medically used Electronic Components
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Immunology

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Introduction to Immunology
Teaching methods	Self-study and Team work in class, student-centered learning, presentations of the group works
Learning outcome	After passing this course successfully students are able to ... - explain basic relationships of immunological interactions.

	- classify the innate and adaptive immune system. - theoretically distinguish bacterial and viral infections. - explain basic mechanisms of allergies and autoimmune diseases - explain the principle and challenges of transplantation.
Course contents	- lymphoid organs and their function - innate and adaptive immune system - viral and bacteriel infection - inflammation reactions - allergy, autoimmune diseases, transplantation
Prerequisites	Knowledge from ANAT, CCT and INSTR about cells and antibodies
Assessment Methods	- 10% active in-class participation (questions and presentation), 15% summary of the Mini-Review (has to be positive), 75% final moodle exam (has to be positive)
Recommended Reading and Material	- K. Murphy and C. Weaver, “Janeway´s Immunobiology,” 9th Edition, New York, NY, Garland Science/Taylor & Francis, 2017
Attendance	75% attendance is compulsory.
Comments	

Cancer Drugs & Therapies

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This course deals with the differences between normal and tumor cells, how tumor cells can be targeted, how the body acts on drugs, about the relationship between drug concentration and pharmacological effect, and how patient and tumor factors are taken into account in personalized therapy approaches.
Teaching methods	Self-study phases and class units alternate. In self-study, content is developed using literature and with the help of questionnaires, videos and self-checks; in the presence phase, in-depth content is presented, discussed and worked on in group work.
Learning outcome	After passing this course successfully students are able to ...

	- Outline the development of tumors on a molecular and cellular level and enumerate the characteristics of tumors described by Hanahan and Weinberg. - Propose solutions based on bioassays for questions in the field of tumor biology. - Describe common in vitro and in vivo tumor models and to explain possible applications using examples. - Explain the categories of pharmacokinetics and essential parameters of pharmacodynamics and outline the essential steps to the production of pharmaceuticals. - Perform simple calculations with pharmacokinetic parameters (e.g. bioavailability, volume of distribution, clearance). - Distinguish between acute and chronic toxicity, explain different types of toxic responses and dose-response curves, and give examples of different types of toxins. - Compare traditional chemotherapy, gene therapy and cell-based treatment options in oncology and to explain the underlying molecular mechanisms of action using selected examples.
Course contents	- Tumor assays - Tumor models - Pharmacokinetics and pharmacodynamics - Toxicology - Traditional cancer drugs - Gene- and cell-based therapies
Prerequisites	Biochemie und MolekularbiologieCell Culture Techniques
Assessment Methods	- Entrance tests, Group work, Final Exam
Recommended Reading and Material	- Kleinsmith: Principles of Cancer Biology, 2014, Pearson
Attendance	There is a general requirement of 75% attendance. No reasons need to be proven or made credible for absenteeism within the remaining 25% (tolerance limit).
Comments	

Cell Culture Techniques

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English

ECTS Credits	2.00
Incoming places	Limited
Course description	This course gives an introduction to cell culture techniques.
Teaching methods	Self-study phases and class units alternate. In self-study, content is developed using literature and with the help of questionnaires, videos and self-checks; in the presence phase, in-depth content is presented, discussed and worked on in group work.
Learning outcome	After passing this course successfully students are able to ... - accurately describe the morphology of cells, to explain the origin as well as the advantages and disadvantages of primary and immortalized cells and to compare the requirements of adherent cells and suspension cells. - select suitable media and media additives for the cultivation of mammalian cells, carry out simple calculations to provide the necessary reagents and correctly interpret the course of growth curves. - explain standard techniques of aseptic cultivation of eukaryotic cells in detail, to show possibilities for the detection of contamination and to suggest necessary countermeasures. - determine cell counts and to name bioassays routinely used to record cell viability, apoptosis and proliferation and to describe the principles on which these assays are based. - name possible applications for the use of cells in biotechnology, research and medicine (e.g. virology, drug testing, tissue engineering, gene therapy) and to describe them using specific examples.
Course contents	- Biology of various cell types - Equipment, basic methods and reagents in a cell culture laboratory - Types of contamination and their specific detection - Basic calculations in the cell culture lab - Cell culture methods in various fields of application
Prerequisites	Courses: Biochemie und Molekularbiologie, Biochemielabor, Instrumentelle Analytik in der Labormedizin
Assessment Methods	- Entrance tests, Group work, Handout, Final Exam
Recommended Reading and Material	- Freshney's Culture of Animal Cells, Capes Davis & Freshney, 2021, Wiley Blackwell
Attendance	There is a general requirement of 75% attendance. No reasons need to be proven or made credible for absenteeism within the remaining

	25% (tolerance limit).
Comments	

Human Computer Interaction

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	project work in the field of "human-computer interaction"
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - to name and distinguish between biosignals - biosignals in order to create control systems for users enable - Prototypical applications using to design and experimentally build biosignals
Course contents	- Biosignals, their detection and differentiation - Evaluation of biosignals - project work
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Rapid Prototyping

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English

ECTS Credits	2.00
Incoming places	Limited

Active Assistive Technologies

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Embedded Systems in Medicine

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Introduction and subsequent project work in the field of "Embedded Systems"
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - To name and explain the most important units of embedded systems in medical devices - To define the essential requirements for electronics in medical devices - To name and prototype simple medical devices in their components
Course contents	- project work
Prerequisites	
Assessment Methods	
Recommended Reading and Material	

Attendance	
Comments	

Basics of Circuit Design

Degree programme	BBE
Semester	4
Course methods	LAB
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Introduction to circuit design
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - explain the basics of circuit design - to mention special features of medical devices - Design basic medical device circuits and to realise prototypes
Course contents	- Circuit design - Safety and construction for electronics in medical devices - Circuit design of medically used Electronic Components
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Signal Acquisition and Analysis

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English

ECTS Credits	5.00
Incoming places	Limited
Course description	This course systematically explores biosignals using a mix of theoretical teaching, hands-on lab measurements, and practical implementation of signal processing techniques. The topics are first introduced in self-study units and then deepened during face-to-face sessions. Understanding the material is reinforced and assessed through exercises that cover and combine different aspects of acquiring and analysing biosignals.
Teaching methods	Students begin by studying relevant topics through self-study. The subsequent attendance phases are designed to deepen their understanding of the subjects and assess their knowledge through topic-specific tasks.
Learning outcome	After passing this course successfully students are able to ... - Explain the generation of different biosignals and their properties - Carry out biosignal measurements under safe conditions - Explain selected approaches of digital signal processing (e.g. signal filtering) - Analyse biosignals in the time and frequency domain - Utilize selected machine learning algorithms for biosignal processing - Visualise and interpret signal processing results
Course contents	- Physiologyand Biosignals - Electrodes and Safety Aspects - Basics of Biosignal Processing - Basics of Digital Filters - Neuroscience - Biosignal Acquisition - ECG Processing - Advance Methods of Biosignal Processing
Prerequisites	Anatomy and Physiology, Maths, Electronics, Measurement technology, Matlab basics
Assessment Methods	- Final Exam - Presentation - Laboratory Protocol - Signal Procesing Exercises
Recommended Reading and Material	- Kaniusas, E. (2012): Biomedical Signals and Sensors I, Springer-Verlag Berlin Heidelberg

	- Kaniusas, E. (2015): Biomedical Signals and Sensors II, Springer-Verlag Berlin Heidelberg - Semmlow, J.L. (2004): Biosignal and Biomedical Image Processing: MATLAB Based Applications, Taylor & Francis - S. D. Library (2019) Essential MATLAB for Engineers and Scientists, 7th ed. Cambridge: Elsevier
Attendance	Attendance according to the FHTW statues
Comments	

Rehabilitation Engineering

Degree programme	BBE
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	The course provides interdisciplinary knowledge from neurological rehabilitation, clinical practice, therapy concepts, technical basics of diagnostics and the latest scientific findings. The aim is to anticipate the needs of users on the basis of medical principles and apply them to technical applications, planning, therapeutic processes and environmental design.
Teaching methods	Workshops and practical exercises enable students to apply the knowledge they have acquired in real-life situations. This includes, for example, the application of therapy concepts and the practical implementation of therapeutic procedures.Excursions to a rehabilitation center give participants a direct insight into clinical practice. Here they can experience and deepen their theoretical concepts in a real environment.Analyzing case studies enables students to understand complex situations and develop solutions from different perspectives.Collaborative group work promotes interdisciplinary exchange. Students can bring in different perspectives and learn from each other.
Learning outcome	After passing this course successfully students are able to ... - Understand the technical terms of functional movement therapy. - scientifically measure and process therapeutic measures

	- Recognize and name therapy processes - Anticipate the needs of users on the basis of medical principles - apply therapeutic processes in the design of the environment
Course contents	- neurorehabilitation basics and therapy concepts - rehabilitation - effects of ageing - Cochlear implants: Rehabilitation and aftercare
Prerequisites	non
Assessment Methods	- Moodle test (multiple choice, drag and drop, single choice, assignments)
Recommended Reading and Material	
Attendance	The program-wide (BBE) regulations apply.
Comments	

Biomedical Signals and Medical Sensors 1

Degree programme	BBE
Semester	4
Course methods	LAB
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	project work in the field of "Biomedical Signals and Medical Sensors"
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - to simulate and design electronic circuits for biosignal processing - to build electronic circuits experimentally and to test and characterise them with modern measuring instruments. - to design prototypes with CAD/CAM tools on the basis of concrete tasks.
Course contents	- project work
Prerequisites	
Assessment Methods	
Recommended Reading	

and Material

Attendance

Comments

Mechanical Engineering (BMB)

Business English

Degree programme	BMB
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description

In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary

Teaching methods

Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion

Learning outcome

After passing this course successfully students are able to ...
- use a wide range of business vocabulary in English
- hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice
- understand and deconstruct a business plan
- understand how products can be marketed
- use a wide variety of techniques to aid communication in international teams and meetings

	- effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan.
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory
Comments	none

Computer Science (BIF)

Software Engineering 2 Labor

Degree programme	BIF
Semester	4
Course methods	LAB
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	The course is an introduction to UI development in Java or C# .NET. The main focus is on the separation between the user interface (graphically) and the appropriate code for controlling it. In professional software development environments, it is not sufficient to just write working code. It is important to structure the code in a comprehensible way considering standard patterns and documentation principles. By respecting the concepts of this lecture

	we improve the overall quality, the readability, traceability, expandability and interchangeability.You can choose between C# and Java for the development process during the full course.
Teaching methods	The theory part consists of self-study phases, Moodle Tests and attendance. The practical part is a course project in which all learned content is applied.
Learning outcome	After passing this course successfully students are able to ... - implement a graphical user interface with the help of WPF or JavaFX - use a logging library to document and track runtime behavior of an application - create simple reports with tables and images using a PDF library - design and implement loosely coupled classes and interfaces - plan the deployment of an application and identify possible critical paths - use LINQ or Java Streams to implement functional programming concepts - consider SOLID principles during development of object-oriented software - detect, name and extend design patterns after Erich Gamma in object oriented software - reproduce visual modeling basics that include modeling goals and the concepts of object orientation - model class diagrams to visualize the classes of a software system and their relationships, as well as their behavior and properties - model sequence and communication diagrams to represent communication between classes
Course contents	- Introduction to application analysis and design - Design patterns - S.O.L.I.D. Principles - Basics of visual modeling (UML) - Class diagrams - Sequence and communication diagrams
Prerequisites	Knowledge for object-oriented development, database integration and integration of unit tests in C# or Java is required.
Assessment Methods	- Moodle Tests - Presentations - Semester project
Recommended Reading and Material	- C#: https://docs.microsoft.com/en-us/visualstudio/designers/getting-started-with-wpf

	- C#: http://han.technikum-wien.at/han/ebookcentral/ebookcentral.proquest.com/lib/ftw/detail.action?docID=5327214 - C#: https://www.syncfusion.com/succinctly-free-ebooks/wpf-succinctly - Java: https://openjfx.io/ - Java: https://link-1springer-1com-1000342kv0273.han.technikum-wien.at/book/10.1007/978-3-658-02836-7 - Java: https://link-1springer-1com-1000342we0744.han.technikum-wien.at/book/10.1007/978-3-658-30494-2 - Material (Slides, Videos, selected Articles) via Moodle
Attendance	mandatory
Comments	

Innovation Lab 2

Degree programme	BIF
Semester	4
Course methods	PRJ
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	The course is a project course in which technologies and competencies that have been learned in other courses are combined and applied. Project proposals are made available by the degree program. The duration of the projects is between 1 and 3 semesters. By continuing a project through the entire InnoLab series (InnoLab 1 to 3), students have the opportunity to fully implement larger projects.
Teaching methods	project work
Learning outcome	After passing this course successfully students are able to ... - Implement requirements in a team and transform them into an operational IT system - plan and coordinate a project in small groups - work in teams and to coordinate tasks - to present project results in front of colleagues and to argue possible solutions
Course contents	- Practical deepening of the content of other courses in a project

Prerequisites	All courses of previous semesters
Assessment Methods	- Project results
Recommended Reading and Material	- depending on project
Attendance	partly
Comments	The supervision is done on an individual basis in synchronous or asynchronous settings and is supported by modern communication tools.

Requirements Engineering

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	Requirements define the Needs of customers and stakeholders in a formalized way,so that the Features of a product can be implemented correctly (Needs<-->Requirements<-->Features).Requirements engineering is the process of elicitation, documentation, verification and management of requirements.Insufficient requirements engineering can lead to high follow-up costs(check Berlin Airport, https://www.engineering.com/story/germanys-ghost-airport-berlins-brandenburg).In this course you will learn the basics of requirements engineering in both classic and agile project environments.In doing so, emphasis is placed on both the theoretical basics and the practical application.After successfully completing this course,you will be able to comprehensively collect requirements, document them correctly and follow them up in practice.
Teaching methods	integrated course, flipped classroom principle
Learning outcome	After passing this course successfully students are able to ... - justify the need for requirements engineering - carry out requirements elicitation as appropriate - carry out requirements documentation correctly - correctly document requirements based on models

	- define and manage requirements in agile project settings - develop SW according to the BDD approach (Behavior-Driven-Development)
Course contents	- Requirements Engineering basics - Requirements documentation and modeling - Agile requirements engineering - User Story mapping - Behavior-Driven-Development
Prerequisites	none
Assessment Methods	- Knowledge tests - learning assignments - final exam
Recommended Reading and Material	- Requirements Engineering Fundamentals: A Study Guide for the Certified Professional for Requirements Engineering Exam Foundation Level – IREB compliant, 2nd Edition
Attendance	mandatory
Comments	Flipped Classroom Concept: preparatory literature study - assignments- 3 x 4h class-room units - final exam

Game Content Creation

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Computer Science Seminar

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	In this integrated course the focus is on developing and implementing didactic knowledge and concepts in the field of eLearning and eDidactics. Examples in the courses serve as an introduction to the topic. Feedback loops from other students (peer review – critical friend feedback) and the course supervisors allow a didactically valuable implementation.During the semester a Moodle course is didactically developed - therefore an eCourse concept is elaborated, an introduction "icebreaker" is planned, a teaching video is shot and learning assignments are created. For this purpose, groups are formed to work together on a computer science topic proposed by the degree program. The classes show methods to prepare the content according to the learning outcomes.
Teaching methods	integrated course
Learning outcome	After passing this course successfully students are able to ... - show and reflect the possibilities, range and limits of the application of eLearning. - reproduce the most important terms in eLearning. - describe which eDidactic methods can be used to implement it in an eCourse. - develop problems and feedback in an eLearning context. - use eLearning tools and feedback for content and application development. - design, implement and critically evaluate learning packages. - plan, implement and evaluate video trainings. - familiarize yourself with a new topic in computer science. - establish a connection between the new topics and practice.
Course contents	- Familiarization with a (new) topic and implementing a didactic e-learning concept in Moodle - Introduction eLearning & eDidactics - eLearning Tools & Moodle Basics - Icebreakers & Video Trainings - Video Trainings & Content Management - Learning Assessments - Finalisation Learning Package
Prerequisites	All courses of previous semestersUser knowledge Moodle
Assessment Methods	- 20% eCourse Concept - 50% implementation - 10% CFF - 10% presentation - 10% Lerntagebuch

Recommended Reading and Material	- depending on chosen topic
Attendance	Attendance is required
Comments	-

Android App Development

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	Smartphones, tablets and other mobile devices along with associated apps and services have had a disruptive impact on our society. More and more applications migrate from a classic desktop environment to mobile platforms. This allows for better integration into daily routines and thus enables the support for new use cases. As a consequence, there is a high demand for specialists in the area of mobile computing and mobile app development which are able to implement these use cases.In terms of market share, Android is the largest mobile operating. It powers devices from a large number of different manufactures and different formfactors. Google provides an extensive toolkit for developing Android apps which is constantly evolving and expanding. As a result, knowing and understanding this toolkit, its building blocks and the associated concepts is required if you want to develop native Android applications. Furthermore it helps you to understand the technical possibilities and limitations of such apps and allows for identifying and evaluating innovation potential.
Teaching methods	Theoretical preparation, as well as in-depth exercises in the self-study phases. Group discussions and joint practical examples in the attendance phases.
Learning outcome	After passing this course successfully students are able to ... - develop advanced Android applications using the current development tools and IDEs - name and explain advanced design patterns and best practices for developing Android applications

	- structure and build your own Android application implementations according to these design patterns and best practices
Course contents	- Developing smartphone applications for Android - Design patterns for Android applications - Basics of the Kotlin programming language - Android application design (structuring and developing UI-code, threading, asynchronous web requests, data persistance) - Pitfalls and best practices (memory management, debugging, crash-logs, performance optimization)
Prerequisites	Basics of programming in an object-oriented language
Assessment Methods	- Assignments Part (75 %) 6 Assignments 100 (per assignment) - Theoretical Part (25 %) Theory test 100
Recommended Reading and Material	- see Moodle course for each attendance and self-study phase
Attendance	see program guidelines
Comments	

Data Science und Machine Learning

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	The course offers a comprehensive overview of the fundamental principles and techniques of machine learning. It covers a wide range of topics, including supervised and unsupervised learning methods such as neural networks, decision trees, and clustering. In addition to theoretical foundations, the course places a strong emphasis on practical applications, giving participants the opportunity to analyze real data and develop their own models through projects and exercises.
Teaching methods	integrated course
Learning outcome	After passing this course successfully students are able to ... - prepare, visualize and evaluate structured databases using Excel

	and Tableau. - read a data set into an IPython notebook, processing it in this development environment and exploring it using descriptive statistics and selected statistical methods. - recognize relationships between a dependent and one or more independent variables and use regression methods to develop a prediction model. - classify data points in the multi-dimensional feature space with the help of simple and monitored learning processes (nearest neighbors, decision trees). - evaluate and improve the performance of classification and regression processes. - cluster data points in the multi-dimensional feature space using the kMeans method and to determine the optimal number of clusters.
Course contents	- Data preparation, visualization and evaluation - Use of Python in data science - Regression analysis - Time series regression - classification - Performance evaluation and improvement - Cluster and principal component analysis
Prerequisites	Programming in Python, Probability and Statistics, Linear Algebra and Calculus
Assessment Methods	- Exercises, Project Presentation, Exam
Recommended Reading and Material	
Attendance	obligatory
Comments	

Business English

Degree programme	BIF
Semester	4
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings - effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8

Attendance	75% mandatory
Comments	none

Continuous Integration

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	The integration of Continuous Integration (CI) in general and tooling support through suitable CI servers has meanwhile become standard in the software development industry in many companies. Therefore, knowledge of software development is required and assumed. In addition, the integration of CI solutions in software products has the advantage that software can be delivered faster and with fewer errors. In this course, knowledge in the field of CI is imparted using common CI servers. This includes the presentation of relevant CI servers such as Jenkins, GitHub Actions, GitLab CI, Circle CI, and Azure DevOps as well as the implementation of your own CI pipeline with 2 different CI servers. The architecture and design principles used at the CI Server are learned and applied by implementing a CI Pipeline for a web application.
Teaching methods	Integrated course. Lectures, homework/project work, self-study with practical examples, and supervised project work.
Learning outcome	After passing this course successfully students are able to ... - apply the principles of semantic versioning to your own software projects - to set up a CI server - translate and test existing software on the CI server, build suitable packages and roll them out on the target system - understand the need to merge development and operations - to know the methods and processes of an optimized cooperation between development and operation
Course contents	- Semantic versioning and specialization in Git - Understand the motivation for CI

	- Set up and configure CI server (Jenkins) - Set up build jobs and build pipelines on the CI server - Use build tools (Ant, Maven, Gradle) - Set up and use other tools (Docker, SonarQube, Artifactory) - Application-release automation - Organizational and economic framework of DevOps
Prerequisites	Experience in software development, including project implementation.Basic experience in software testing.Basics of version control with Git.
Assessment Methods	- 2 x Moodle Multiple Choice Test (2 x 25%) - 1 x Semester Project (50%)
Recommended Reading and Material	- Ian Sommerville: Engineering Software Products. An introduction to modern software engineering (Pearson) - Humble, Farley: Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation
Attendance	mandatory
Comments	

Network Security

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	in this course you will learn security aspects in networks (technology classification, OSI security architecture, TCP/IP security challenges, tunneling protocols according OSI layers, mechanisms and applications, WLAN security, security of network services and web applications), firewall technologies, intrusion detection & prevention systems and network segmentation.
Teaching methods	integrated course, flipped classroom principle
Learning outcome	After passing this course successfully students are able to ... - list requirements for secure communication (networks, services, distributed applications) and describe the procedures and protocols

	required for this purpose, - know the different categories of IDS/IPS network devices and explain their advantages and disadvantages, - know the different categories of perimeter security devices and explain the differences, - know methods to secure simple networks, wired as well as wireless.
Course contents	- Physical Security - Secure Network Design - Secure Site Connections - IDS/IPS - Intrusion Detection & Prevention Systems - Secure Protocols (SSH, TLS, IPsec...) - 802.1x and Access Control - Authentication - DDOS mitigation
Prerequisites	Fundamentals of Computer ScienceIT Network fundamentalsOperating Systems Basics (Windows, Linux)
Assessment Methods	- Practical exercises - Final Exam (theory)
Recommended Reading and Material	- Cryptography and Network Security: Principles and Practice, Global Edition – William Stallings (2016) - Network Security Essentials: Applications and Standards, Global Edition – William Stallings (2016) - IT-Sicherheit für TCP/IP- und IoT-Netzwerke: Grundlagen, Konzepte, Protokolle, Härtung – Steffen Wendzel (2021) - IT-Sicherheit Konzepte – Verfahren – Protokolle – Claudia Eckert (2018)
Attendance	Mandatory.
Comments	

System Hardening

Degree programme	BIF
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	In this course you learn security basics of operating systems as well as threats, defense mechanisms and hardening of operating systems (specifics of Windows and Linux).
Teaching methods	integrated course, flipped classroom principle
Learning outcome	After passing this course successfully students are able to ... - explain the need for secure systems, - identify basic methods for securing operating systems, - reflect different tasks of security measures of operating systems.
Course contents	- Identity and Access Management - Administration and Remote Management - Windows Server Security - Windows Client Security - Linux Server Security - Linux Client Security - Secure Active Directory - SELinux - AppArmore
Prerequisites	Basics of computer scienceBasics of IT infrastructureBasics of router and switching configuration
Assessment Methods	- Practical exercises - Final Exam (theory)
Recommended Reading and Material	- Mastering Linux Security and Hardening: Protect your Linux systems from intruders, malware attacks and other cyber threats, 2nd edition – Donald A. Tevault (2020) - Mastering Windows Security and Hardening: Secure and protect your Windows environment from intruders, malware attacks and other cyber threats – Mark Dunkerley and Matt Tumbarello (2020) - Practical Linux Security Cookbook – Tajinder Kalsi (2018)
Attendance	Mandatory.
Comments	

Mechatronics/Robotics (BMR)

Materials Science

Degree programme	BMR
Semester	4

Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Have an insight into the world of materials science! In this course you will get an overview of the most important materials of our everyday life - have an insight into atomic levels, learn what these materials are capable of and what we use them for. Learn to understand why materials behave like they do and establish an understanding about the various material's processing and treatments. We will focus here on metals.
Teaching methods	Integrated course
Learning outcome	After passing this course successfully students are able to ... - have a basic understanding of the properties of materials - distinguish between elastic and plastic deformation - to read phase diagrams - have basic understanding about ferrous and non-ferrous metals - have a basic understanding of steelmaking - have a basic understanding of the heat treatments of steel - have a basic understanding of material selection according to Ashby - have a basic understanding of the different methods of material testing
Course contents	- Classification of Materials - Structures of Materials (Interatomic Bonding, Crystal Structure, Crystal Defects) - Material‘s Properties - Alloying and Casting - Phase Diagrams - Microstructure - Fe-C phase diagram - The Fe-C Phase Diagram - Steelmaking (Blast Furnace, BOP, DRI, Electric Arc furnace,...) - Heat Treatment Process - Designation - Fe-C Categories - Nonferrous Alloys - Materials Testing

	- Material Selection - Difference between Metals, Polymers, Ceramics -
Prerequisites	Basic knowledge according to admission requirements for the bachelor's program
Assessment Methods	- Final Exam - exercises
Recommended Reading and Material	- - Ashby, M.F.; Jones, D.R.H.: Engineering Materials 1: An Introduction to Properties, Applications and Design, Elsevier, 2011
Attendance	75%
Comments	none

Manufacturing Engineering

Degree programme	BMR
Semester	4
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	In this course students acquire basic knowledge in the fields of production engineering according to DIN 8580
Teaching methods	Integrated course
Learning outcome	After passing this course successfully students are able to ... - - to specify essential industrial requirements for manufacturing processes using appropriate technical parameters - - to explain selected manufacturing processes from the main groups mentioned in DIN 8580 with regard to basic physical or chemical principles, typical industrial process steps and devices as well as common industrial applications - - describe a manufacturing process using one or more of these methods by means of the underlying process flow logic (material flow)
Course contents	- - Requirements for industrial manufacturing processes (incl. measured variables) - - Overview of main groups of manufacturing processes (DIN8580)

Prerequisites	Basic knowledge according to admission requirements for the bachelor's program
Assessment Methods	- Participation, Moodle tests and final examination
Recommended Reading and Material	- - Förster, R.; Förster, A.: Einführung in die Fertigungstechnik, Springer Vieweg, 2018
Attendance	75%
Comments	none

Semester Project

Degree programme	BMR
Semester	4
Course methods	PRJ
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	In this module, the elaboration, project planning and breakdown into work packages in self / team organization should take place on the basis of a technical task. In the module, a practical project from task definition to validation / verification of the results should be carried out independently or as a team through self-determined project management.
Teaching methods	Integrative lecture, group exercises
Learning outcome	After passing this course successfully students are able to ... - to successfully conceptualize a practice / research project based on a formulated task and, if necessary, to implement it. - draw up and implement a project / work plan in the dimensions of time, financial requirements and use of resources. - carry out a feasibility study at a suitable time for the project and adapt the project / work plan accordingly as required - to create documentation that also meets scientific and technical requirements
Course contents	- Processing of a subject-specific task, according to the subject area and the level of training - Selection and application of suitable project management methods - Application of the relevant specific technical principles to achieve

	the project goals (independently or in a team) - Presentation, discussion and critical reflection on the results
Prerequisites	Project Management
Assessment Methods	- Course-immanent performance assessment
Recommended Reading and Material	- Timinger H.: Projektmanagement, (aktuelle Auflage)
Attendance	100%
Comments	none

Business English

Degree programme	BMR
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice

	- understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings - effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory
Comments	none

Sports Engineering and Ergonomics

Business English

Degree programme	BHF
Semester	2
Course methods	UE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students will learn some of the key aspects of business communication in English, as well as the key processes

	and activities of starting a business. This will include understanding what kind of organization a business should be, how best to market a product, and what ethical and sustainability related considerations should be built into the process of starting a business. Participants will also discover important communication tools in business environments and learn how to work with and understand reports and business plans and how to use innovative presentation methods to engage an audience as well as expanding their range of business vocabulary
Teaching methods	Short and medium length tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
Learning outcome	After passing this course successfully students are able to ... - use a wide range of business vocabulary in English - hold a Pechakucha presentation, presenting either a marketing analysis of, a CSR strategy for, or a financial analysis on a company of their choice - understand and deconstruct a business plan - understand how products can be marketed - use a wide variety of techniques to aid communication in international teams and meetings - effectively present data and trends - understand the key principles of Business Ethics and Corporate Social Responsibility (CSR) and apply them to different companies.
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Business Presentations
Prerequisites	B2 level English, positive grade in Technical English
Assessment Methods	- 10% Vocabulary Test - 30% Self-studies and class preparation and discussion - 60% Business PechaKucha presentation and assessed presentation plan.
Recommended Reading and Material	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag - Business Communication for Success (2015, University of Montana) Available at: https://open.umn.edu/opentextbooks/textbooks/8
Attendance	75% mandatory

Comments	none

Electronics and Business (BEW)

Advanced Communication

Degree programme	BEW
Semester	6
Course methods	SE
Language	English
ECTS Credits	1.50
Incoming places	Limited
Course description	The students acquire writing and speaking skills necessary to complete their bachelor studies, such as writing abstracts and techniques for successful presentations
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - write abstracts in compliance with given formal and language-related Guidelines - present one of their term papers in english to the exam committee and to defend their paper
Course contents	- Structure of an abstract vs. German summary - Writing process - Building an English presentation from a German paper - Presentation techniques and relevant language
Prerequisites	Common European Framework of Reference for Languages Level B2Completion of previous semester course
Assessment Methods	- Course immanent assessment method, i.e. active participation in class activities and timely completion of assignments
Recommended Reading and Material	- Maderdonner, O. / et al (2014): Abstract Writing, Skriptum - Maderdonner, O. / et al (2014): Presentation Essentials, Skriptum - Additional current handouts and audio-visual support
Attendance	compulsory attendance during on-campus phases
Comments	

Business Law

Degree programme	BEW
Semester	6
Course methods	FUV
Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	Imparting knowledge of selected legal topics regarding the international economic law
Teaching methods	*) Presentations and examples for self assessment *) Case studies as examples and for self study *) Scrips for self study
Learning outcome	After passing this course successfully students are able to ... - specify the legal rules - interpret legal cases - find solutions for legal problems by using these legal rules - utilise selected legal data-banks - evaluate legal decisions concerning defined questions and answer these questions - develop arguments to justify legal decisions
Course contents	- International Economic Law, Introduction, Actors and Rules/Principles - World Trade Organization (WTO) and law of the WTO - United Nations Convention on Contracts for the International sale of goods - Law of the European Union & Case Study - Competition Law - International property rights
Prerequisites	None
Assessment Methods	- Assignments (50%) and Exam (50%), but at least 1% from each part
Recommended Reading and Material	- Scripts and materials (audio-visual presentations, etc.) available in the downloadarea of moodle
Attendance	compulsory attendance during on-campus-phases
Comments	

Change Management

Degree programme	BEW
Semester	6
Course methods	FUV
Language	English
ECTS Credits	1.50
Incoming places	Limited
Course description	The course Change Management prepares the students for contact with change processes from a systemic view.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - identify phases (for example by B. Conner) and dynamics (symptoms, causes) of resistance using simple examples and explain. - name basic models of change management (for example 3-phase-model of Lewin, strategy models of Glasl) and to analyze concrete situations by reference to them. - explain methods of integration of employees (for example kick-off workshop , interview) and to explain consequences of participation / non-participation.
Course contents	- Guidelines and models for change processes - Context clarification - Handling of resistance - Systemic Thinking - Methods of employee participation
Prerequisites	none
Assessment Methods	- Course immanent assessment method (participated sucessfully)
Recommended Reading and Material	- Conner, Daryl R. (2006): Managing at the speed of change, Verlag Randome House, NY - Key Literature of the course: Managing at the Speed of Change: How Resilient Managers Succeed and Prosper Where Others Fail, New York, 2006. - Spencer Johnson, Who moved my Cheese. An Amazing Way to Deal with Change in your Work and in your Life, New York 1998 - Jeannene LaMarsh, Changing the Way We Change. Gaining Control of Major Operational Change, 1995 - Harvey Robbins, Michael Finley, Why Change doesn't Work. Why Initiatives go Wrong and how to Try Again - and Succeed, 199

	- Managing Change and Transition. Practical Strategies to Help You Lead During Turbulent Times (Harvard Business Essential Series), 2003
Attendance	compulsory attendance during on-campus phases
Comments	none

Technology Management

Degree programme	BEW
Semester	6
Course methods	FUV
Language	English
ECTS Credits	6.00
Incoming places	Limited
Course description	Technology Management
Teaching methods	Lecture,Self Studies,Elaborations on set topics, Preparation of a seminar paper on an individually agreed case.
Learning outcome	After passing this course successfully students are able to ... - explain typical challenges in Innovation- and Technology Management. - apply simple tools for organizing Innovation and Technoloy Management projects.
Course contents	- Differentiation: Technology Management - Innovation Management - Importance of Technology and Innovation Management for enterprises and organizations. - Spotting opportunities for Technology and Innovation Management - Designing plans for Technology and Innovation Management activities.
Prerequisites	According to the position of the course in the Program's Curriculum
Assessment Methods	- Assignments - Presentation - Final written exam
Recommended Reading and Material	- The Tao of Innovation: Nine Questions every Innovator must answer. Tan, Teng-Kee et al., 2015, Imperial College Press, ISBN: 978-1-78326-620-3
Attendance	Compulsory

Comments

Master DEGREE PROGRAMS

Robotics Engineering (MRE)

Roboethics

Degree programme	MRE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Basics in ethics and societal impact of technology implementation
Teaching methods	Blended learning – short interactive theoretical inputs, deepening exercises in small groups, discussions, presentations
Learning outcome	After passing this course successfully students are able to ... - to link the acquired knowledge on ethical basics of technology development and application with the area of robotics
Course contents	- Basics, dimensions of responsibility etc, different ethical concepts, application of these notions within the context of sociotechnical systems
Prerequisites	none
Assessment Methods	- E-learning tasks. presentations, participation in discussions
Recommended Reading and Material	
Attendance	75%
Comments	

Probabilistic Robotics Lab

Degree programme	MRE
Semester	2
Course methods	LAB
Language	English

ECTS Credits	2.00
Incoming places	Limited
Course description	In this course, students learn to model and apply modern methods for navigating mobile manipulators and service robots. Students will implement and subsequently analyze the filters and algorithms discussed in the course Probabilistic Robotics ILV in form of a semester project.
Teaching methods	Students will independently implement a predefined mobile robotics application within the Robot Operating System (ROS) framework in C/C++. Probabilistic filters (KF, EKF, particle filters) will be implemented, analyzed and discussed.
Learning outcome	After passing this course successfully students are able to ... - understand and analyze different methods for mobile robot navigation. - independently design and implement localization methods in C/C++
Course contents	- Probabilistic filters (KF, EKF, particle filters) - Localisation with maps - Feature extraction - ROS Framework (C/C++)
Prerequisites	Fundamentals algebra (matrix manipulation), fundamentals statistics (multivariate normal distributions and basic concepts, Bayes' theorem), robot kinematics, sensor technology (laser scanner, IMU and odometry, environment analysis), C/C++ under Linux
Assessment Methods	- 100% semester project
Recommended Reading and Material	- Thrun, S.; Burgard, W.; Fox, D.; Probabilistic Robotics; The MIT Press, 2005
Attendance	100%
Comments	

Probabilistic Robotics

Degree programme	MRE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00

Incoming places	Limited
Course description	You will learn probabilistic robot localization approaches in this course. In the beginning of the lectures, you will learn to understand the fundamental problem of mobile robot localization and uncertainty in the context of motion and sensor noise. Based on these findings and fundamental concepts of statistics, we will derive the Bayes filter. This course discuss several implementations of the Bayes filter. You will learn to select appropriate models for a given problem. Based on the findings in this course, you will implement the algorithms in the laboratory part of this module.
Teaching methods	This course is based on knowledge from the first semester in the master's degree "program robotics engineering" as well as basic knowledge in robotics (e.g.: kinematics). You have to prepare yourself for this course. We assume, that you are able to derive kinematic models for mobile robots. Furthermore, we will not repeat fundamental concepts in linear algebra and statistics. Please recapitulate fundamental concepts before the first lecture. During the semester, you will have to prepare yourself (e.g.: missing knowledge in mathematical formulations) for each class. In the classes, we will discuss the methods and models in detail in order to obtain robust and reliable results.
Learning outcome	After passing this course successfully students are able to ... - formulate the localization problem in mobile robotics - reflect the approaches critically - select appropriate solutions for given localization problems
Course contents	- Fundamental robot localization - Localizing with maps - Modern robot localization
Prerequisites	- Algebra: Matrix manipulation- Statistics: basic concepts and multivariate Gaussian distributions- Bayes Rule: This is the fundamental approach for localization- Kinematics for robots: You must be able to get derive for different robots by yourself- Sensors: You must understand the output of different sensors, namely laser scanners, odometry and IMUs
Assessment Methods	- 100% written exam
Recommended Reading and Material	- Papers and textbooks are used in different chapters. The references are on the slides. - Thrun, S.; Burgard, W.; Fox, D.; Probabilistic Robotics; The MIT

	Press, 2005
Attendance	75% is mandatory
Comments	

Software Engineering (MSE)

Mobile Application Engineering

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Introduction into app development for Android and iOS.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - After successfully completing the course, students are able to - develop Android and iOS Apps, using the latest Development Environment and Toolchain - describe the Liefcycle of Smartphone Applications and explain common concepts in the areas of Testing, Publishing, Marketing & Business Models - estimate the required resources for a feature implementation on Android and iOS
Course contents	- Android and iOS app development and source control management with Git.
Prerequisites	Basic software development experience with Java / C/C++ / Objective C.
Assessment Methods	- Participation, development of the project, delivery dates, clean source code with comments and Git commits.
Recommended Reading and Material	- Joseph Anuzzi Jr, Lauren Dracay, Shane Conder (2014): Advanced Android Application Development, Addison-Wesley ProfessionalNeil Smyth (2015): iOS 8 App Development Essentials - Second Edition: Learn to Develop iOS 8 Apps using Xcode and Swift 1.2,

	CreateSpace Independent Publishing Platform
Attendance	required
Comments	

Selected Topics Software Management

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Graduates of this course receive indepth kowledge about the interfaces between management and IT. The viewpoints of companies, as startups and corporates and their managers and CIOs are being approached with a focus on the business aspect.Business objectives and IT (3 ECTS)Elected chapters of software management (3 ECTS)• International technology exploitation
Teaching methods	Lecture with student participationBest PracticeUse CasesCase studies
Learning outcome	After passing this course successfully students are able to ... - Draw Project portfolio-Management and corporate strategies - Define international technology expoitation - Overview about tools and approaches - Identify international technology expoitation networks - Agile project management
Course contents	- Project management - Project portfolio management - Agile project management - Technology exploitation
Prerequisites	Basics Project Management
Assessment Methods	- Course immanent assessment method and group assignment
Recommended Reading and Material	- Agile Prozesse: Von XP über Scrum bis MAP, Eckhart Hanser
Attendance	requiered

Comments	Hands-on course: Experts from corporates/startups are being invited/visited

User Experience Evaluation

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This course teaches evaluation methods and challenges regarding usability and user experience measurement. Subjective experiences can be quantified and objectively measured using metrics and statistical methods.
Teaching methods	Practical exercises and examples, discussions, group work, lectures
Learning outcome	After passing this course successfully students are able to ... - apply statistical methods correctly to compare various metrics (time on task, task success) - apply these methods in a project environment - name various UX metrics as well as their categories, collect metrics, analyse and interpret them - analyse results (e.g. significance) and present them appropriately
Course contents	- UX metrics - suitable statistical methods - data visualization - reproducibility of tests
Prerequisites	Basics of user centered designs and software usability
Assessment Methods	- Course immanent assessment method and/ or end exam
Recommended Reading and Material	- Tullis, Thomas / Albert, William. (2008) Measuring the User Experience : Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann, ISBN-13: 978-0123735584 - Sauro, Jeff. (2012) Quantifying the User Experience : Practical Statistics for User Research, Morgan Kaufmann, ISBN-13: 978-0123849687 - Bortz, Jürgen / Lienert, Gustav A. (2003) Kurzgefasste Statistik für die klinische Forschung : Leitfaden für die verteilungsfreie Analyse

kleiner Stichproben, Springer, ISBN-13: 978-3540757375

Attendance

Comments

Artificial Intelligence and Visiual Computing

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited

Biologische Intelligenz und Artificial Intelligenz

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	Evolution designed biological systems. Methods to make decisions with limited computational resources have been optimized over millions of years. Many of these methods can potentially open up new and more effective possibilities for AI systems. This course shows examples of some methods. Their possible application in AI systems is discussed.
Teaching methods	Lesson, discussion, students work and presentation.
Learning outcome	After passing this course successfully students are able to ... - describe two principles used in biological systems to improve decision making - explain one possible application of such principles
Course contents	- What is the meaning of the term "Intelligent System”? - The brain and brain structures of different species - Intelligent behavior in the animal kingdom in relation to the term

	"intelligence" - Feed back and feed forward loops and consiounes - Feedback and feed forward loops and the role of the human consciousness. - Object detection and recognition in humans - Comparisons of AI and the biological counterpart - Attention control systems in humans
Prerequisites	Basic knowledge of AI systems
Assessment Methods	- Continuous assessment
Recommended Reading and Material	- see German version
Attendance	not required
Comments	none

Mobility Data Analysis

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	The goal of the course is to introduce the students the main concepts related to mobility data analysis (MDA), using MobilityDB, a mobility database implemented over PostgreSQLand PostGIS.The first (online face-to-face) part of the course will introduce the context for Mobility Data Science. We start with an overview of temporal and spatial databases, and then we introduce the concept of Moving Objects databases. Following the classic Güting-Schneider book, we present an abstract model and then two discrete modelsbased on slicing and sequencing. Then we move into a concrete implementation of the discrete model, MobilityDB (https://mobilitydb.com/). We describe thesystem in detail using three cases studies: maritime navigational data (AIS),flight data (OpenSky) and car tfaffic data (BerlinMOD benchmark). The second part of the course consists in a project to be developed offline.
Teaching methods	Lectures and assignments where theory is applied.

Learning outcome	After passing this course successfully students are able to ... - Create a mobility database - Analyze continuous mobility data - Use techniques to visualize mobility data using Geographic Information Systems
Course contents	- Introduction and motivation. Why do we need mobility databases? Why spatial DBs are not enough? Example cases. - Fundamentals of mobility databases. Basic concepts. The property graph data model. Spatial databases, temporal databases Spatiotemporal databases. - Querying the history of movement: The Abstract Model. The ADT approach. Spatial, temporal and non-temporal data types. Spatio-temporal predicates. - The Discrete Model. Problems of the discrete model. Spatial, temporal and non-temporal types in the discrete model Sliced and sequence representations: pros and cons. Implementation of the discrete model. - Indexing Spatial and spatio-temporal indexes R-trees and R+-trees, Kd-trees, PR-quadtrees - Implementation of MobilityDB Data model. Using MobilityDB for mobility analysis. Applications to different domains: ships, public transport analysis, car movement, etc.
Prerequisites	Good knowledge of relational databases and SQL
Assessment Methods	- Short midterm evaluation at the end of the online part - Course project
Recommended Reading and Material	- Ralf Hartmut Güting, Markus Schneider. Moving Objects Databases. . Morgan Kaufmann 2005, ISBN 0-12-088799-1. - Chiara Renso, Stefano Spaccapietra, Esteban Zim´anyi. Mobility Data: Modeling, Management, and Understanding. Cambridge University Press 2013, ISBN 978-1- 107-02171-6. - Esteban Zimányi, Mahmoud Attia Sakr, Arthur Lesuisse. MobilityDB: A Mobility Database Based on PostgreSQL and PostGIS. In ACM Trans. Database Syst., 45(4): 19:1-19:42, 2020. - Juan Godfrid, Pablo Radnic, Alejandro A. Vaisman, Esteban Zim´anyi. Analyzing public transport in the city of Buenos Aires with MobilityDB. Public Transport., 14(2): 287-321, 2022.
Attendance	Attendance to the online lectures is mandatory, 80% at the minimum.
Comments	We remark that we assume a good knowledge of databases. Students must know how to load data into a database and manipulate and query such data.

Modern Web/Frontend Framework

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	An introduction to web development with a focus on the Svelte Framework.While the focus is on Svelte, many topics covered here will be of use for the wider area of web development and can be used in other frameworks.
Teaching methods	Remote via Zoom
Learning outcome	After passing this course successfully students are able to ... - Build their own websites and web-apps
Course contents	- An overview of the web development ecosystem - The Svelte framework for building User interfaces - The SvelteKit framework for building data-driven web applications - State management and data-driven architecture - HTML Forms - Providing and consuming REST-based APIs - Data Storage options - Deployment options - Authentication - UI Design with CSS and Tailwind - Alternatives to WebApps (PWA, Desktop apps, Mobile apps) using Svelte
Prerequisites	Basic knowledge about HTML, CSS, Javascript, databases and REST APIs.
Assessment Methods	- Students will be creating their own web app to show their learning success
Recommended Reading and Material	- https://svelte.dev - https://kit.svelte.dev
Attendance	
Comments	

Artificial Intelligence

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	
Teaching methods	
Learning outcome	After passing this course successfully students are able to ...
Course contents	
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Application or use cases of various design patterns (software design)

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English
ECTS Credits	3.00
Incoming places	Limited

UX Design in SWE

Degree programme	MSE
Semester	4
Course methods	ILV, FL
Language	English

ECTS Credits	3.00
Incoming places	Limited

Mechanical Engineering (MMB)

Case Study

Degree programme	MMB
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	The course case study is a kind of practical guide for the implementation of projects in the field of machine learning and artificial intelligence. Using a data set from the field of predictive maintenance, a machine learning case study is performed: from structuring the project to rolling out and embedding the model in operational decision making. We learn about common concepts for conducting machine learning case studies, such as CRISP-DM, EDA (Exploratory Data Analysis), Feature Engineering, Cross-Validation and Explainable AI. These concepts can be explored on a data set in greater depth during the project week.
Teaching methods	Lecture with interactive elements and project work
Learning outcome	After passing this course successfully students are able to ... - supervise the practical implementation of a machine learning project as a domain expert/project manager - organize a machine learning project team, i.e. apply project management techniques and tools - understand the practical aspects of creating machine learning models - understand as a domain expert/project manager how to successfully implement projects, i.e. integrate them into operational decision-making processes - develop a machine learning model with a simple data set
Course contents	- 1.1 Definition of the project objective: Implementation of a case study from predictive maintenance

	- 1.2 Organization and structuring of a machine learning use case - 2. Data preparation and data understanding - 3.1 Developing a machine learning model: from feature selection to testing the model - 3.2 Validation of the model and communication of the model results - 4. Integration of the model into operational decisions and maintenance
Prerequisites	MMB-2-VZ - Machine Learning Basics
Assessment Methods	- project presentation
Recommended Reading and Material	- Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly Media. (n.d.). - Müller, A. C., & Guido, S. (2016). Introduction to Machine Learning with Python: A Guide for Data Scientists. O'Reilly Media. (n.d.).
Attendance	
Comments	

Machine Learning Basics

Degree programme	MMB
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	The course gives a practical insight into the basics of machine learning. We are at the beginning of an era where artificial intelligence will influence, if not take over, operational decisions in industrial applications. It is therefore important to develop assessment skills for machine learning applications. The goal is therefore not to rigorously learn the mathematical and programming skills to build machine learning models. Rather, future project managers and domain experts should be able to understand basic principles in order to decide how machine learning models can help improve processes and products. Particular attention is paid to the latest developments in the field of generative AI.
Teaching methods	Lecture with interactive elements (online resources and opportunity

	for self-study)
Learning outcome	After passing this course successfully students are able to ... - Understand basic concepts and principles of machine learning - Understand application scenarios and assess potential use cases (evaluation competence) - Outline a machine learning project process - Apply the basics of supervised and unsupervised learning to own project ideas - Assess the quality of machine learning results
Course contents	- 1.1 Fundamentals: Use Cases, central definition of Machine Learning, distinction from classical programs, differentiation from other areas of artificial intelligence - 1.2 A new era of artificial intelligence with the emergence of Large Language Models? - 1.3 How are ML applications already being used in companies, and what potential does ML have in the future? - 2.1 Understanding key concepts: Supervised Learning vs. Unsupervised Learning vs. Reinforcement Learning. - 2.2 The most crucial ingredient for Machine Learning models: Data - 2.3 Roles in a Machine Learning project and project phases - 3. Getting to know an End-to-End Machine Learning project - 4.1 Fundamental models of Supervised Learning (Regression, Support Vector Machines, Decision Tree methods, Random Forests) - 4.2 Fundamental models of Unsupervised Learning (k-means Clustering, Hierarchical methods, DBSCAN) with a special emphasis on outlier detection - 4.3 Evaluation of machine learning models
Prerequisites	-
Assessment Methods	- written exam
Recommended Reading and Material	- Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly Media. - Müller, A. C., & Guido, S. (2016). Introduction to Machine Learning with Python: A Guide for Data Scientists. O'Reilly Media. - Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. - Matzka, S. (2021). Künstliche Intelligenz in den Ingenieurwissenschaften: Maschinelles Lernen verstehen und bewerten. Wiesbaden: Springer Vieweg.
Attendance	

Comments

Tissue Engineering and Regenerative Medicine (MTE)

Gene Regulation and Signal Transduction

Degree programme	MTE
Semester	2
Course methods	VO
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This course provides necessary information to understand cellular signalling and how genes are regulated. The topics cover aspects of signal transduction in the context of tissue engineering and regenerative medicine.
Teaching methods	Lecture presenting basics and applied examples.
Learning outcome	After passing this course successfully students are able to ... - explain the basic principles of DNA/protein interaction - specify components and regulation of important signaling pathways (e.g. Raf-MEK-ERK, PI3K-AKT-mTOR; apoptosis) and mechanisms of mechanotransduction - interpret and analyze results from typical signaling experiments (Western blots, IPs…) - explicate the relevance of signal transduction in Tissue Engineering - understand the basics of bioinformatics
Course contents	- signaling pathways (RAF-MEK-ERK, mTOR/AKT, Wnt/beta-catenin) - apoptosis - mechanotransduction - aspects of cellular signaling in Tissue Engineering - introduction to bioinformatics
Prerequisites	Molecular Biochemistry and Cell Biology
Assessment Methods	- final written exam, homework for part bioinformatics
Recommended Reading and Material	- current scientific literature suggested by lecturers

Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case more than 20% are missed the first try in the exam is lost.
Comments	

Study Design and Biostatistics

Degree programme	MTE
Semester	2
Course methods	VO
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	The first part of the course provides an overview including details of different study design concepts. Subsequently, some selected parts of biostatistics are discussed. Additionally students present scientific literature in an oral presentation and receive detailed feedback on their presentation skills.
Teaching methods	- Lecture format- Occasional take-home readings- Discussions in classroom
Learning outcome	After passing this course successfully students are able to ... - define general rules/key points of an appropriate study design - identify types of models/study design approaches utilized in various areas of pre- and clinical research - define and critically assess the influence of key advantages and weaknesses of most commonly modeling systems used in pre- and clinical research - define basic rules/definitions used in biomedical descriptive statistics - perform a critical preliminary assessment of (quantitative) data as well as selection of appropriate tests for statistical evaluation of (quantitative) data - define most common do’s and don’t’s in a power point presentation - define/practically apply the optimal tactics for an effective scientific meeting-type talk - apply a “damage control” in the post-talk question/answer period
Course contents	- Study design overview for 1) in vitro, 2) in vivo and 3) clinical study

	sections - Detailed description of study types, their applicability and pro-and cons for each section. - Selected (introductory) study design-related aspects of biostatistics: types of data, distributions/normality, hypothesis testing, data transformation, appropriate approach/selection of statistical tests - Curriculum also includes graded data presentation training (a.k.a. Power Talk Training) by students in a form of a 10min power point (PP) talk/each (followed by a detailed feedback from the lecturer)
Prerequisites	- An open mind and mental flexibility- Positive thinking and eagerness to interact with the lecturer- Knowledge of the basic statistical concepts is useful
Assessment Methods	- Final grade will combine 50% of the test score and 50% of the PP talk.
Recommended Reading and Material	
Attendance	Attendance is mandatory in this course, only 20% of absence is tolerated. In case more than 20% are missed the first try in the exam is lost.
Comments	Students must get approval of the topics to present from the lecturer; titles/topics need to be sent to the lecturer at least 3 days before the scheduled talk. The order of individual talks is to be decided by students.

Ethics in Engineering and Medicine

Degree programme	MTE
Semester	2
Course methods	SE
Language	English
ECTS Credits	1.00
Incoming places	Limited
Course description	The course imparts basic knowledge of bioethics to the students. Ethical questions in bioengeering and biomedicine including their impacts on society and the training of ethical decision-making and argumentation take center stage.
Teaching methods	

Learning outcome	After passing this course successfully students are able to ... - outline selected basic terms and principles of biomedical ethics (for example moral status, allocation ethics, concepts of health and desease/disabilities) by the means of simple examples. - apply ethical standards to latest research developments in selected actual case studies in bioengineering and biotechnology. - describe the steps of ethical decision-making and argumentation and to apply them in selected case studies for ethical assessment of conflicting issues in the field of biomedical research and medicine
Course contents	- Fundamental positions of bioethical decision-making and argumentation - Experiments with human subjects and animals - Ethics issues of resource allocation - Ethical concepts to health-disease/illness-disabilities - Intercultural ethical aspects of bioengineering and biotechnology - Medical information systems (e-health, data security, privacy, confidentiality)
Prerequisites	none
Assessment Methods	- Course immanent assessment method (grade)
Recommended Reading and Material	- Literature at the beginning of the course
Attendance	Attendance is compulsory according to the statutes
Comments	Contentual coordination with the English course in which issues of bioethics are treated as well

Biotechnology

Degree programme	MTE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Design and optimization of recombinant protein production
Teaching methods	Basics and theory are presented within an interactive lecture. Practical examples for application are discussed.

Learning outcome	After passing this course successfully students are able to ... - Bioprocess design for the production of recombinant proteins from gene to purified product applying microbial and/or mammalian systems - Choice of appropriate expression systems and plasmids for recombinant production - Definition of strategies for product development and expression systems - Characterization of concept and principle of bioprocess design (up- and downstream processing) - Design and characterization of various bioreactor types - Application of high-level data exploration and interpretation - Combination of gained knowledge with scientific state of the art - Characterization, interpretation, and application of function and interactivity of complex systems
Course contents	- Recombinant protein production: (1) Basics and expression strategies - Expression hosts: (1) overview: Pro- and eukaryotic expression systems - Upstream Processing (USP): (1) Mass balance and kinetics, (2) Process modes (batch, fed-batch, continuous), (3) Bioreactor types and bioreactor design (mass transfer), (4) Process monitoring and control - Downstream Processing (DSP): (1) DSP design, (2) DSP Unit operations: A) Cell separation (centrifugation, filtration) and cell disintigration, B) Protein Purification (Chromatography) - Continuous manufacturing: (1) USP, DSP and analytics - Multivariate data analysis: (1) Design of Experiments (DoE)
Prerequisites	Basics biology, mathematics, physics
Assessment Methods	- Written exam
Recommended Reading and Material	- Bioprocess Engineering Principles, Pauline M Doran, 2nd edition ISBN 978-0-12-220851-5 - Bioprozesstechnik, Horst Chmiel, ISBN 978-3-8274-2476-1 - Taschenatlas der Biotechnologie und Gentechnik, Rolf D. Schmid ISBN 978-3-527-33514-5
Attendance	
Comments	

Data Science (MDS)

Multivariate Statistics

Degree programme	MDS
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This course covers advanced topics for the exploratory and inferential analysis of multivariate data. Applications are based on R.
Teaching methods	Blended learning.
Learning outcome	After passing this course successfully students are able to ... - preprocess and visualize multivariate data - apply methods to reduce dimensionality (Principal Components Analysis, Multidimensional Scaling) - fit multiple linear models (linear regression, variance and covariance analysis), do diagnostics and apply them for prediction. - fit generalized linear models (logistic regression, regression models for count data), do diagnostics and apply them for prediction. - carry out an hierarchical cluster analysis and assess the quality of the solution
Course contents	- Distances, Covariances and Correlation - Visualization Methods for multivariate data (Trellis, parallel coordiantes, faces ...) - Principal Component Analysis - Multidemensional Scaling - Multiple Linear Regression, Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) - Logistic Regression, Poisson Regression, Negative Binomial Regression - Hierarchical Cluster Analysis
Prerequisites	Probability Calculus; Applied Statistics
Assessment Methods	- Continuous assessment examinations - Project report
Recommended Reading and Material	- Everitt, Hothorn, 2011: An introduction to multivariate data analysis with R. Springer. - Faraway, 2014: Linear Models with R (Second Edition). CRC Press.

	- Faraway, 2016: Extending The Linear Model with R (Second Edition). CRC Press.
Attendance	Mandatory attendance
Comments	

Data Warehouse & BI (Specialisation)

Degree programme	MDS
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This course introduces key concepts, technologies and methods of Data Warehousing and Business Intelligence. Amongst others, an overview of Analytics and Data Warehousing is given (modeling and implementation of a data warehouse). Moreover, the management of BI-related projects as well as basic techniques for data modeling and presentation and selected aspects of data management are addressed in this course. Finally and with respect to practical skills, students learn how to set up an ETL process to populate a data warehouse. An OLAP cube will be created, which will be analyzed in a BI application.
Teaching methods	- Lectures- Interactive Tutorials- Practical group work (on-site and distance)- Group presentations
Learning outcome	After passing this course successfully students are able to ... - give an overview of Business Intelligence and Data Warehousing and develop a BI-related business case and plan a project on a micro-level accordingly - elicit requirements for a BI solution with respect to a business context - create a data model for a BI solution and prepare the data set - handle data sources, asses data quality and retrieve data from database systems - explain fundamental BI operations, select appropriate BI tools and apply them to real-life data - implement a multidimensional analysis model (OLAP) and analyze

	the data - carry out a complete DWH project (planning, implementation, reports) using data from an ERP system
Course contents	- Introduction to Business Intelligence (BI) and Data Warehousing (DW) - Development of business cases and BI projects - Business Architecture and Requirements - Data Modeling for DWHs (Dimensional Fact Modeling, Galaxy Schema) - Data management (data sources, data quality and databases) - Extract-Transform-Load-process - BI operations, tools and methods - Data representation (scorecards, dashboards)
Prerequisites	Knowledge on data modeling, databases, project management and statistical methods
Assessment Methods	- Course immanent assessment method and end exam
Recommended Reading and Material	- Haertzen, D., 2012. The Analytical Puzzle: Profitable Data Warehousing, Business Intelligence and Analytics. 1. Ausgabe. Technics Publications. - Kimball, R., Ross, M., 2013. The Datawarehouse Toolkit (2nd Ed., Chapters 1-6)
Attendance	Required
Comments	

Machine Learning

Degree programme	MDS
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This module provides an introduction to machine learning.
Teaching methods	Presentations, Exercises, Discussion
Learning outcome	After passing this course successfully students are able to ... - select an appropriate Machine Lerning method for a given task

	- explain the most common Machine Learning methods - apply the methods using software, and to interpret the results - evaluate the performance of methods and to compare them.
Course contents	- Fundamentals of Statistical Learning - Supervised Learning (Classification, Regression): k-Nearest Neighbour, Naive Bayes, Trees, Random Forests, Neural Networks, Support Vector Machines, Ensemble Methods (Bagging, Boosting) - Unsupervised Learning (Clustering): k-Means, DBSCAN - Performance Evaluation and Benchmarking of ML Algorithms (Confusion Matrix, Accuracy, Recall/Precision; ROC Curve, Lift Chart) - Experimental Design of Benchmarking Experiments
Prerequisites	Applied Mathematics, Statistics
Assessment Methods	- Exercises - Exam
Recommended Reading and Material	- James/Witten/Hastie/Tibshirani, 2017. An Introduction to Statistical Learning. Springer.
Attendance	Mandatory
Comments	

Sports Technology (MST)

Sports technology project 2

Degree programme	MST
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	In the first semester, students created a project handbook for an industry-based project as part of the *Sports Technology Project 1* course. In this semester, they develop the necessary methodologies for the project and conduct initial measurements.
Teaching methods	- practical work
Learning outcome	After passing this course successfully students are able to …

	- research and select the appropriate methods to answer a research question on an industry-relevant topic from the field of Sports Technology. - plan and conduct a field or laboratory study to answer a research question on an industry-relevant topic in the field of Sports Technology. - scientifically evaluate the measurement data collected to answer a research question on an industry-relevant topic from the field of Sports Technology.
Course contents	- Application of the course contents taught in the 1st and 2nd semester to scientifically work on a research question of an industry-relevant topic from the field of Sports Technology. This includes: Planning of methods; planning and execution of measurements; evaluation of the obtained data.
Prerequisites	Content of the courses of the 1st semester.
Assessment Methods	- Final report (50%) - Poster presentation (50%)
Recommended Reading and Material	- Reference books, articles in journals, etc. depending on the task - Technical books, user manuals, data sheets, etc. depending on the sensor and measurement technology used
Attendance	For preparation purposes, the obligation to attend can be suspended if a predetermined number of meetings with the supervisor are conducted. Laboratory use should primarily occur during the times specified in the schedule. Attendance is mandatory for the poster presentation.
Comments	

Instrumented material testing and testing systems

Degree programme	MST
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	In this course, students learn what to consider when developing a test bench and the pros and cons of standardized tests. Additionally,

	tests are conducted on sports equipment using test benches, and the results are discussed.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - design the requirements for constructing a test bench for testing sports equipment under real-world conditions (outside the standard). - identify the properties, advantages, and disadvantages of various actuators that can be used in the construction of a test bench for sports equipment testing. - discuss the advantages and disadvantages of different testing methods for sports equipment. - conduct tests with sports equipment (e.g. skis, suspension forks, disc brakes) using test benches and determine their properties. - analyse and discuss the results of sports equipment tests on the test bench in relation to their intended use.
Course contents	
Prerequisites	Applied Computer Science in Sports Technology, Applied Measurement Technology in Sports Technology (both courses from the 1st semester)
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Sports practice measurement week - summer

Degree programme	MST
Semester	2
Course methods	SO
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students work in small groups on tasks related to summer sports. The tasks must include field measurements and can be chosen freely by the students.

Teaching methods	- Independent completion of a task - Field measurements at the end of the semester
Learning outcome	After passing this course successfully students are able to ... - estimate and plan the effort and timeline of small projects based on metrologically supported field studies in summer. - understand, solve, and process measurement tasks for collecting representative data sets in metrologically supported field studies in summer. - evaluate, interpret, and present the measurement signals obtained during metrologically supported field studies in summer
Course contents	- Planning and implementation of a field study in summer (additional costs approx. 300€) - Selection of suitable sensor technology - Planning and installation of measurement chains - Testing of selected methods (sensors, measuring chains) in the laboratory - Application of the corresponding measurement technology in the field - Discussion of the achieved measurement results, considering the influences and challenges of conducting a field study in summer
Prerequisites	all courses of the first semester
Assessment Methods	- Final report (50%) - Final presentation (50%)
Recommended Reading and Material	- Reference books, articles in journals, etc., depending on the task - Technical books, user manuals, data sheets, etc., depending on the sensor and measurement technology used
Attendance	Attendance is compulsory for the entire measurement week at the end of the semester. While attendance is not mandatory for the preparation, the laboratory should primarily be used during the times indicated in the course schedule.
Comments	Additional costs for the summer field study are approximately € 300.

FEM in Sports Technology

Degree programme	MST
Semester	2
Course methods	ILV
Language	English

ECTS Credits	5.00
Incoming places	Limited
Course description	The basics of FEM structural mechanics (using the Ansys program) and injection molding simulation (using the Moldflow program) are taught, with examples are calculated together. In the second part of the lecture, small groups work on product development projects. Main topics include: - Requirements specification - 3D CAD component design - FEM structural mechanics simulation - FEM manufacturing simulation (injection molding) - Cost calculation.
Teaching methods	Lecture and joint work on the computer
Learning outcome	After passing this course successfully students are able to: - use the FEM programs Ansys and Moldflow for FEM simulations. - assess the reasonable use of FEM methods. - independently carry out product development.
Course contents	- Basics of FEM - Introduction to ANSYS Workbanch und Moldflow - Carrying out FEM calculation examples - Project work virtual product development in small groups
Prerequisites	- Mechanics in General- Basics of injection moulding
Assessment Methods	- Projects - Participation - Each group presents their project results, and a joint report must be prepared.
Recommended Reading and Material	- S. Tickoo, ANSYS Workbench 2019 R2: A Tutorial Approach, CADCIM Technologies 2019 - C. Gebhardt, Praxisbuch FEM mit ANSYS Workbench, Hanser 2018
Attendance	Attendance is mandatory
Comments	

Statistics and Qualitymanagement

Degree programme	MST
Semester	2

Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description

In this course, students will learn how to analyze quantitative data and how statistical methods are applied in quality management. The key descriptive and inferential statistical methods will be reviewed and practiced using the statistical software R.
A group project will be conducted in parallel, covering the entire process from formulating a quantitative research question to delivering a comprehensive report on the research design.

Teaching methods

- Lectures
- Computer-based exercises
- Project coaching

Learning outcome

After passing this course successfully students are able to ...
- explain the main tasks of statistics and relate them to real-world applications
- plan a quantitative project, including the formulation of a research question, operationalization, data collection, and analysis
- preprocess data in R
- describe and visualize data in R
- determine point and interval estimates for populations and conduct hypothesis tests for categorical and metric variables
- test associations between two categorical variables
- establish and assess linears models (linear regression, analysis of variance) for metric dependent variables
- describe and decompose time series data, and develop models for forecasting
- visualize and cluster multidimensional data
- establish and assess logistic regression models estimate the probabilities of event occurances
- describe, plan, and execute statistical quality control
- summarize findings in a structured research report

Course contents

- Fundamentals of empirical social research (design, sampling)
- Data management in R
- One categorical variable: absolute and relative frequencies, bar charts, binomial test, chi-squared test
- Two categorical variables: contingency tables, grouped bar charts,

	spine plots, chi-squared tests for independence and homogeneity - One metric variable: histogram, indicators for mean and variance, boxplots, t-test - Two metric variables: scatterplot, correlation analysis, regression analysis - Time series analysis: time series plots, time series decomposition, regression models, long-term forecasts - Categorical and metric variables: Parallel boxplots, one-way ANOVA, two-way ANOVA (with and without interactions), effect plots - Binary and metric variables: spinogram, binary logistic regression, binary regression plot - Quality control with R
Prerequisites	no specific prerequisites needed
Assessment Methods	- Projects - Exercises
Recommended Reading and Material	- Meyer/Wurzer: Datenanalyse und Statistische Modellierung (Skriptum) - Hatzinger/Hornik/Nagel: R – Einführung durch angewandte Statistik, Pearson Studium, 2011
Attendance	Not Mandatory
Comments	

Monitoring and feedback

Degree programme	MST
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	In this course, students learn the importance of data visualization after data collection. Due to the requirements of motor learning, immediate feedback is crucial for learning and adapting sports techniques. Therefore, students will develop live feedback systems that send data to a server for later evaluation or for the trainer's assessment.
Teaching methods	

Learning outcome	After passing this course successfully students are able to ... - understand IoT devices and work on simple use cases independently. - grasp the basic function of a web server and create a version using Python. - send, receive, and display data from IoT devices. - connect sensors to an IoT device, and store and transmit data. - create a live feedback system to visualize measurement data for sports practitioners.
Course contents	- Introduction to Web Applications - Introduction to IoT - Understanding the Communication Flow - Python for Web Development - Overview of Flask Framework - Receiving Data from an IoT Device - Creating UDP SERVER - Processing and Storing IoT Data - Displaying IoT Data on a Web Application
Prerequisites	The course builds upon knowledge from *Applied Computer Science in Sports Technology* and *Applied Measurement Technology in Sports Technology*
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Machine Learning

Degree programme	MST
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	In this course, students integrate the concepts learned in the courses *Applied Computer Science in Sports Technology* and *Applied*

	Measurement Technology in Sports Technology to address their own problems. Through applied measurement techniques, students will independently collect and further process sensor data within the scope of this course. Additional insights into the application of machine learning (ML) techniques for various tasks will also be developed.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - prepare sensor data for ML algorithms - create models in different programming environments - evaluate models using various methods.
Course contents	- Applied Computer Science in Sports Technology Applied Measurement Technology in Sports Technology
Prerequisites	*Applied Computer Science in Sports Technology*, *Applied Measurement Technology in Sports Technology*
Assessment Methods	- Course-immanent and infographics
Recommended Reading and Material	- Sturm J., 2013, Approaches to Probabilistic Model Learning for Mobile Manipulation Robots, Springer-Verlag - Hester T., 2013, TEXPLORE: Temporal Difference Reinforcement Learning for Robots and Time-Constrained Domains, Springer-Verlag
Attendance	Attendance is compulsory.
Comments	

Mobile data capturing

Degree programme	MST
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, students have the opportunity to apply and deepen the knowledge gained in the previous course, *Applied Measurement Technology in Sports Technology*. By developing a measurement chain with various components from different manufacturers,

	students will be equipped to tackle numerous tasks independently in the future.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - discuss the advantages and disadvantages of different platforms (e.g., microcontrollers like Arduino, single board computers like Raspberry Pi, measurement applications like LabVIEW) concerning their suitability for mobile data acquisition in the field of Sports Technology. - utilize a mobile data acquisition platform appropriate for a specific measurement task in Sports Technology. - record data from multiple sensors during field measurements.
Course contents	- Presentation of various current platforms, including Arduino, Raspberry Pi, and LabVIEW, that are suitable for mobile data acquisition in Sports Technology - Discussion of the requirements for a platform designed for mobile data acquisition in Sports Technology. - Exercises to create the individual components fora measurement chain. - Extending the measurement chain with a suitable mobile data acquisition platform based on the content from the *Applied Measurement Technology in Sports Technology* course (1st semester), followed by performing measurements on sports equipment and/or participants.
Prerequisites	Content from the *Applied Measurement Technology in Sports Technology* and *Applied Computer Science in Sports Technology*
Assessment Methods	- Course-immanent evaluation - Final exam
Recommended Reading and Material	- Access to current scripts and manuals for the platforms used
Attendance	Attendance is mandatory.
Comments	

Digital Leadership and New World of Work

Degree programme	MST
Semester	4
Course methods	VO

Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	In this course, students gain practical insights into the leadership and transformation challenges faced by international organizations. They develop a fresh perspective on the evolving work environment and the concept of leadership
Teaching methods	Course contents are independently researched, presented, and discussed. Lecturers and students systematically compare their findings with practical experiences, allowing students to relate the acquired knowledge to their own work situations.
Learning outcome	After passing this course successfully students are able to ... - outline the most important trends in the labor market and HR management - evaluate the advantages and disadvantages of different leadership theories and concepts - motivate employees and lead virtual teams in an increasingly digitalized world environment - assess the advantages and disadvantages of traditional and agile organizational structures (e.g., Holacracy) - design digital educational measures for lifelong learning
Course contents	- Economic trends: globalization, digital transformation, Industry 4.0, etc. - Labor market trends: demographic change, diversity, changing values, etc. - Trends in HR management (e.g., talent management, digital HR, new organizations, age management, diversity management) - Traditional theories of leadership: property, behaviour, and situational theories. - Modern leadership concepts (e.g., transformational leadership, agile leadership, servant leadership) - Leadership from a distance - Agile organizational models (e.g., Scrum, Holacracy) - Competence requirements and transfer in the digitalized world of work.
Prerequisites	no special prior knowledge required, practical work experience helpful
Assessment Methods	- Course immanent assessment method and written reflection

	(grade)
Recommended Reading and Material	- Franken, Swetlana (2016): Führen in der Arbeitswelt der Zukunft, SpringerGabler - Petry, Thorsten (2016): Digital Leadership. Erfolgreiches Führen in Zeiten der Digital Economy, Haufe Fachbuch
Attendance	Attendance is compulsory
Comments	

Start-up Management

Degree programme	MST
Semester	4
Course methods	VO
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	This course provides essential methods and knowledge for: - developing and evaluating a business idea using the Business Model Canvas - assessing a given business plan - creating a business plan for a new business idea - presenting a business model with a pitch deck.
Teaching methods	Theory lectures Video tutorials Self-study materials Teamwork Coaching sessions Buzz groups Feedback opportunities
Learning outcome	After passing this course successfully students are able to ... - develop an innovative business model, - evaluate it using the Business Model Canvas - present it with a pitch deck - assess a given business plan - write a strategic business plan - connect with the startup scene
Course contents	- The importnace of a business plan

	- How to write a business plan - Assumptions and estimates for a business plan - Sources for sample business plans and templates - Key components of a business plan - Evaluation of existing business plans - Business Model Canvas - Pitch deck creation - Overview of the Austrian startup scene (incubators, business angels, investors, business plan competitions, etc.) - Team coaching sessions.
Prerequisites	Understanding the principles of business administration.
Assessment Methods	- The students will work in teams and will be graded as follows: - Description of the Austrian start-up scene: 10% - Pitch deck incl. detailed comments in the notes section of the pptx file: 90%
Recommended Reading and Material	- Kailer/Weiß, Gründungsmanagement kompakt, aktuelle Auflage - Genadinik, Alex, Business Plan Template And Example: How To Write A Business Plan: Business Planning Made Simple. Semantic Valley LLC. - Osterwalder, Alexander; Pigneur, Yves. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Wiley
Attendance	Attendance is generally recommended.
Comments	

Power Electronics (MLE)

Intercultural Communications

Degree programme	MLE
Semester	2
Course methods	SE
Language	English
ECTS Credits	1.50
Incoming places	Limited
Course description	We aim at raising intercultural awareness and broadening the

	students' horizons
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - meet the challenges of communicating with members of other cultures - recognize the potential of working in an intercultural team - act flexibly and confidently in an unknown environment
Course contents	- Terms and theories of culture: Johari window, Iceberg theory etc. - Manifestations of culture - Inside and outside perspectives on culture
Prerequisites	Completion of previous semester courses
Assessment Methods	- Grade depends on: - Attendance - Presentation of an intercultural aspect in class - Participation in class discussions
Recommended Reading and Material	- Lewis, R.D. et al (2012) When Cultures Collide 3rd ed., Nicholas Brealey International - Additional current handouts and audio-visual support
Attendance	Attendance is compulsory
Comments	

Medical Engineering & eHealth (MME)

Bioinformatics

Degree programme	MME
Semester	2
Course methods	ILV
Language	English
ECTS Credits	4.00
Incoming places	Limited
Course description	Computer Science provides for modern and essential methods for analyzing and researching biological systems. The course presents computer aided methods in context of biomedical examples.
Teaching methods	Seminar / Workshop, problem based learning

Learning outcome	After passing this course successfully students are able to ... - describe biologial systems - select computer aided methods for successfully investigating biomedical systems and data - apply selected computer-aided methods for analysing biomedical systems and data
Course contents	- Introduction Bioinformatics, Computational Biology and Systems Theory, DNA Sequencing, modelling epidemies - Technologies for analysing biological data and systems (z.B. Python, BLAST, SIR, K-means, Clustering, numerical for differential equations, cellular automata) - practical tasks (adapted to students background)
Prerequisites	Basic computer science backgroundBasic programming skills (Python)Basic biomedical background
Assessment Methods	- Assignments
Recommended Reading and Material	- Provided per topic in course
Attendance	
Comments	

Artificial Intelligence

Degree programme	MME
Semester	2
Course methods	ILV
Language	English
ECTS Credits	4.00
Incoming places	Limited

Course description	For individuals unfamiliar with the intricacies of modern machine learning and AI, the whole domain may appear as a confusing mix. Yet, delving deeper reveals that leading scientists are adopting distinctly different methodologies to advance artificial intelligence, essentially dividing the field into five main strategies.Pedro Domingos, in his seminal book "The Master Algorithm," highlights these distinct methodologies or "tribes" within AI research, a concept echoed across various scientific discussions.The first methodology, known as connectionism, delves into the neural connections

mimicking the human brain's structure and functionality, leveraging backpropagation to derive outcomes, essentially aiming to replicate the brain's workings.Symbolism, the second approach, relies on logic and accumulated knowledge to construct intelligent models, reminiscent of the early days of AI research before the advent of neural networks. This method involves compiling extensive knowledge bases and manipulating them to generate AI, blending traditional and modern techniques.Evolutionism, the third strategy, draws from evolutionary theory, genetics, biophysics, and bioinformatics, applying these disciplines to genetics and distinguishing itself as a unique venture among the AI methodologies.The fourth, the Bayesian school, is one of the more established methods, initially used for tasks like spam detection. It employs heuristic models based on probabilities to refine models for filtering out unwanted outcomes or achieving specific goals, notably utilized in network security to identify potential threats.Lastly, the analogizing approach makes AI more accessible to the general public, with recommendation systems from entities like Facebook and Google serving as prime examples. This method uses algorithms to match concepts or people based on similarity, aiding in personalized recommendations.These diverse approaches collectively contribute to the advancement of AI research, with scientists striving to progress these methodologies collaboratively. However, amidst technological advancements, there's a consensus on the importance of ethical considerations and responsible technology use to mitigate potential societal issues, a principle that applies across all five AI methodologies.

Teaching methods

lecture course / project

Learning outcome

After passing this course successfully students are able to ...
- know the classical approach to AI
- know the 5 schools of AI
- know th eproblems of causality in AI

Course contents

- Basic algorithms of artificial Intelligence
- Agents
- Problem Solving strategie
- Informed Search
- Constrain Satisfactory Problems
- AI and Games

Prerequisites

none

Assessment Methods

- Project 100%

Recommended Reading and Material	- provided by lecturer
Attendance	Attendance not required but recommended!The student needs to be present for the project meetings and final presentation.
Comments	

Electromagnetic Compatibility

Degree programme	MME
Semester	2
Course methods	ILV
Language	English
ECTS Credits	4.00
Incoming places	Limited

Course description	The course is subdivided in two parts:- Part 1 covers physical fundamentals of Electromagnetic Compatibility (EMC) related to electrical appliances including regulatory basics for product conformity- Part 2 focuses on effects of electromagnetic fields (EMF) on the human body, including regulatory basics for limiting personal exposure against EMFs, as well as electromagnetic influences on implants
Teaching methods	Lessons and practical homework (1 assignment, chosen from several proposals)The course will be held in 10 units (6:35 - 9:00 p.m. each)One of these units will be held as an excursion to the EMC labs in Seibersdorf (approx. 35 km southeast of Vienna)For a detailed schedule of the units, please see semester planDetails about the excursion will be negotiated in the course between lecturer and students
Learning outcome	After passing this course successfully students are able to ... - identify potential problems of electromagnetic compatibility during product development - apply the fundamental EMC design rules in practice - name the most important directives, standards and guidelines relevant for EMC comformity assessment of medical equipment and use them to assess the properties of a device in view of the underlying legal requirements - estimate the relevance of exposure situations in practice

	- name the technical possibilities of exposure assessment, their advantages and drawbacks and their limitations - identify potentially harzardous situations regarding electromagnetic interference with electronic implants in practice - name the most important directives, standards and guidelines relevant for limiting personal exposure against electromagnetic fields
Course contents	- Part 1 (Lamedschwandner): - Introduction to Electromagnetic Compatibility (EMC) - EMC conformity assessment - European Union directives and CE marking of products - The EMC directive - EMC standards - EMC test methods - Functional safety and EMC - Development of electrical appliances with respect to EMC - Design basics - Printed circuit board design - Cabling, grounding and shielded cables - EMC filters, ferrites and box shielding - Economic EMC design principle - Part 2 (Schmid): - Biophysical basics - Effects of electromagnetic fields on the human body - Excitation of cells by induced currents (low frequency fields) - Tissue heating by power absorption (radio frequency and microwave fields) - Other reported, but not yet established effects - Safety limits and regulatory basics - Exposure assessment methods - Electromagnetic interference with implants - Malfunction of electronic implants - Concentration of currents by metallic implants - Movement of ferromagnetic implants in strong magnetic fields
Prerequisites	Fundamentals of electrical engineering
Assessment Methods	- Solution and Presentation of homework (50%) - Written exam (50%)
Recommended Reading and Material	- Lamedschwandner K. EMC for MBE – Part 1, Chapter 1-3. Presentation Slides. Available in download section of the course - Paul CR. 2006. Introduction to Electromagnetic Compatibility, 2nd Edition, Wiley, New York, ISBN: 978-0-471-75500-5

	- Schmid G. EMC for MBE. Part 2, EMF Safety. Presentation Slides. Available in download section of the course
Attendance	Attendance is compulsory
Comments	

Scientific Publishing

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	1.50
Incoming places	Limited
Course description	A basic understanding of “scientific life” is given, covering writing rules, strategies for scientific papers publishing, "how to find RELEVANT literature", and how to survive a scientific conference.
Teaching methods	Upfront teaching, group work, students presentation
Learning outcome	After passing this course successfully students are able to ... - Explain the structure of a scientific paper - Write a scientific abstract according to scientific journals rules - Can explain the process from having a first idea to getting a paper accepted - Can prepare a scientfic presentation (oral, poster) for a scientific conference
Course contents	- What to do before a (scientific) paper is written - Structures of scientific papers - Basics of scientific writing - Literature search, Inside PubMed - Critical Comments about today's publication behavior - What else is needed to get a publication accepted - The review - The Scientific Conference - Paper / Poster Presentation
Prerequisites	Basic writing skills
Assessment Methods	- Quality of a self written abstract - Evaluation of other abstrracts

	- Quality of "scientific conference like" presentation - Evaluation of presentations - Written exam
Recommended Reading and Material	- http://www.icmje.org
Attendance	
Comments	

Study Design and Biostatistics

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	A collection of mathmatical methods in the field of non-parametric statistics are presented. These can be used for planning experiments. Obtaining , organizing, summarizing presenting and analysing this data will be followed up by interpreting it and drawing conclusions based on this data sets.
Teaching methods	Lecture & Examples
Learning outcome	After passing this course successfully students are able to ... - justify a research question in the field of non-parametric statistics after identifying the current state of the art with regard to scientific considerations, formulate the question comprehensibly and to define verifiable target criteria - plan the phases of a scientic study, conduct it precisely, document it comprehensibly, and to ensure the comprehensibility, dependability, plausibility and transferability to other problems areas and contexts - relate research questions and results to a medical environment
Course contents	- Testing methods for frequencies - Testing methods for rank-data - Testing methods for cardinal data - Relationship metrics and their tests - Agreement metric

Prerequisites	Parametric Statistics. The only mathematical prerequisite needed for the material found in the outline is arithmetic and some basic algebra.Excel, MatLab/Octave, R
Assessment Methods	- writen exam 50% - moolde examples 50%
Recommended Reading and Material	- Elementary Statistics, Mario F. TriolaPublication Date: January 6, 2011 | ISBN-10: 0321694503 | ISBN-13: 978-0321694508 | Edition: 11 - Nonparametric Statistics for Health Care Research Statistics for Small Samples and Unusual Distributions Second Edition ISBN 978 - 1 - 4522 - 8196 - 4 (pbk.: alk. paper) Medicine ? Statistical methods. Nonparametric statistics.
Attendance	optional
Comments	N/A

Ethics

Degree programme	MME
Semester	2
Course methods	VO
Language	English
ECTS Credits	1.00
Incoming places	Limited
Course description	The course imparts basic knowledge of ethics in medicine to the students. The focus is on raising the awareness of the relevance of ethical questions in engineering and medicine and their ethical impacts on society and the training of ethical decision-making and argumentation.
Teaching methods	Seminar: Theory InputsCase StudiesGroup workEthical arguingDiscussions
Learning outcome	After passing this course successfully students are able to ... - outline selected basic terms and principles of medical ethics (for example moral status, allocation ethics, concepts of health and disease/disabilities) by the means of simple examples. - apply ethical standards to latest research developments in selected actual case studies in medicine and engineering. - describe the steps of ethical decision-making and argumentation

	and to apply them in selected case studies for ethical assessment of conflicting issues in the field of research and medicine.
Course contents	- Fundamental positions of ethical decision-making and argumentation - Experiments with human subjects and animals - Ethics issues of resource allocation - Ethical concepts to health-disease/illness-disabilities - Intercultural ethical aspects of medicine and engineering - Medical information systems (eHealth, data security, privacy, confidentiality)
Prerequisites	
Assessment Methods	- Course with an immanent character (grade): - Introduction into a chosen topic by the student - Hand out - The student is leading a discourse about the chosen in the group
Recommended Reading and Material	- Literature at the beginning of the course
Attendance	Attendance is compulsory
Comments	

Quality and Regulatory Affairs Management

Degree programme	MME
Semester	2
Course methods	ILV
Language	English
ECTS Credits	4.00
Incoming places	Limited
Course description	The course introduces the main processes and steps of implementing quality management systems for design and development and putting to market of medical devices. It provides the necessary steps for addressing regulatory issues in an application oriented perspective.
Teaching methods	Lectures will introduce the topics. Students will extend their knowledge and skills in small assignments.
Learning outcome	After passing this course successfully students are able to ...

	- describe and handle processes to address regulatory issues of medical devices, regarding especially the “Medical Device Directive” - use quality management systems to address regulatory issues in a structured way - describe and perform measures of risk management, generally and in the sense of a "Medical IT-Network Risk Manager" (IEC 80001-1).
Course contents	- Medical Device Directive and Harmonised Standards (ISO 13485, ISO 14971, EN 60601-x, IEC 80001-1, …). Case examples and experiences from the steps of medical device development, from the initial concept to market. Classification, methods for evaluation of conformity). Risk analysis, risk analysis case file. software as medical device, CE mark, accredited and notified bodies. Basic introduction to further regulations (EMC, biocompatibility, RoHS...). Basic of clinical trials. EU- vigilance system. IVD`s, AIMDD. International requirements (FDA, CMDCAS, GxP, UL, ...). - Case studies and experiences from medical device development from the idea to marketability. Classification, methods for conformity testing. Risk analysis, software as medical device, CE marking, accredited and notified bodies. - Further fields of expertise (EMC, Biocompatibility, RoHS...). Clinical evaluation. EU vigilance system. IVDs, AIMDD. International requirements (FDA, CMDCAS, GxP, UL, ...).
Prerequisites	- Basic concepts of device or software development. - Basic concepts of quality.
Assessment Methods	- Final exam and smaller assignements
Recommended Reading and Material	- See learning platform
Attendance	The course includes discussions and assignments, so attendance is necessary to participate in assignments and discussions. In case students miss lectures they must contact the lecturers and agree on measures to handle the situation.
Comments	

eHealth Applications

Degree programme	MME
Semester	2
Course methods	ILV
Language	English

ECTS Credits	4.00
Incoming places	Limited
Course description	We want to understand what "eHealth" actually is, which applications exist, what needs to be done to implement it, on the legal side, in IT systems, in the medical system and economically. How can we evaluate eHealth applications e.g. costs - benefit? We will look at eHealth with the eyes of politicians, patients, economists, industry, medical experts. The course uses a “Problem Based Learning” (PBL) approach. Students will experience the views of different stakeholders in an additional business role playing game.
Teaching methods	The course uses problem based learning, triggered by brief presentations from the lecturer. As a result this students will develop evidence based recommendations to stakeholders. A role playing game will enable us to understand how the stakeholders act, and provoke feedback to the recommendations.
Learning outcome	After passing this course successfully students are able to ... - explain requirements and recent examples of applications of eHealth - critically consider literature and other sources of information for evaluating eHealth applications - consider the views of different stakeholders in designing eHealth applications
Course contents	- requirements and recent examples of applications of eHealth - basic introduction into the socioeconomic environment of eHealth (reimbursement, sustaining resources, legal issues) - engineering concepts for eHealth
Prerequisites	Basic knowledge of software development, familiarity with the medical field
Assessment Methods	- Seminar paper: Evidence based recommendation to stakeholders
Recommended Reading and Material	- eHealth Action Plan 2012-2020 (http://ec.europa.eu/health/ehealth/docs/com_2012_736_en.pdf)
Attendance	The course uses PBL therefore attendance is mandatory.
Comments	Attendance to relevant events (congresses, workshops: eHealth Summit, HL7 Jahrestagung, IHE Day, ...) can be accredited for the course, contact the lecturers.

Advanced Optics

Degree programme	MME
Semester	2
Course methods	ILV
Language	English
ECTS Credits	4.00
Incoming places	Limited
Course description	Geometric Optics, Microscopy Techniques & Spectroscopy (including medical applications)
Teaching methods	Frontal lecture Advanced OpticsLaboratory exercises (spectroscopy + microscope, mechanical eye model)
Learning outcome	After passing this course successfully students are able to ... - explain Maxwell's equations and simple conclusions from them - define basic properties of light and the behavior at interfaces (refraction, (total) reflection, polarization, Fresnel formulas, Brewster law) - represent applications of optical components (lenses, mirrors, prisms, optical fibers, diffraction gratings, classical light sources, LED, laser, polarizers) simple optical systems (light microscope) - represent applications of optical components (lenses, mirrors, prisms, optical fibers, diffraction gratings, classical light sources, LED, laser, polarizers) and of simple optical systems (light microscope) - define spherical aberrations, coma, astigmatism, chromatic aberration, distortions, explain Abbe's diffraction limit, classifying Zernike polynomials with respect to the context - illustrate discussed microscopic techniques and their advantages, represent the functioning of the human eye based on the eye model - present basics of spectroscopy and explain medical application of scattering (Raman, Brillouin)
Course contents	- Motivational introduction to modern optical topics (computer-generated holograms, laser physics, metamaterials) - Meaning of the Maxwell's equations + simple conclusions from them, behavior of light rays in propagation + at interfaces (refraction, (total) reflection, Brewstergesetz, Fresnel formulas) - Overview of optical components (lenses, mirrors, prisms, optical fibers, diffraction gratings, classical light sources, LED, lasers, polarizers), thin & thick lenses, mirrors (image construction, matrix method)

	- Aberrations (characterization, minimization, spherical aberration, coma, astigmatism, distortion, chromatic aberration, Abbe diffraction limit, Zernike polynomials) - Microscopy techniques + mechanical eye Model - Spectroscopy in general with focus on: Raman and Brillouin scattering
Prerequisites	Basics of Analysis and Algebra, Basics of Physics
Assessment Methods	- Written exam - 1 Laboratory protocol
Recommended Reading and Material	- Bergmann & Schäfer. "Lehrbuch der Experimentalphysik". Band 3. Optik. 2004. - Bergmann & Schäfer. "Lehrbuch der Experimentalphysik". Band 3. Optik. 2004. - Born & Wolf. "Principles of Optics". 1999
Attendance	Frontal lectures: 80%Laboratory exercises: 100%
Comments	

Project Management and Leadership Skills

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	1.00
Incoming places	Limited
Course description	This course provides an overview of both the latest practical and the current theoretical leadership theories. One of the course's fundamental components will be the reflection of own behaviour regarding particular issues concerning leadership in project management.
Teaching methods	Theory inputTeamworkRole play
Learning outcome	After passing this course successfully students are able to ... - identify and to explain tasks and instruments of leadership (for example delegation, agreement on objectives). - explain classical management models (for example leading continuum, Maturity Model) and to apply to practical examples.

	- describe different assumptions about human nature (for example McGregor) and to derive the consequences for the leading of co-workers.
Course contents	- Leadership styles and instruments (for example staff appraisal) - Motivation, promotion and development of employees - Leadership functions versus professional tasks - Consequence of “not leading” - Role of the leader in a change process - Dealing with crises, success and failures
Prerequisites	Team Management Skills
Assessment Methods	- An individual reflection paper about the leadership issues encountered in the semester and how the knowledge about leadership was applied.
Recommended Reading and Material	- Daft, R. (2008): New Era of Management, Mason/Ohio:Thomson - Pettinger, R. (2007): Introduction to Management, Houndmills/Hampshire: Palgrave Macmillan - Schermerhorn, J. (2008): Management, Hoboken/New Jersey: John Wiley
Attendance	Attendance is compulsory
Comments	This course may reflect team experiences from elsewhere, e.g from the Project Related Teamwork course.

Writing the Master´s Thesis

Degree programme	MME
Semester	4
Course methods	SO
Language	English
ECTS Credits	28.00
Incoming places	Limited
Course description	Writing the master's thesis according to scientific principles.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - narrow down a complex and practice-relevant topic with the help of scientific questions - work on a complex and practice-relevant topic with the help of

	scientific methods - adequately argue the selection of the scientific method - adequately document, validate and discuss the solution obtained
Course contents	- Creation of a master's thesis - Use of scientific methods - Developing research questions - Scientific work - Scientific writing
Prerequisites	
Assessment Methods	- Assessment of the Master's thesis according to UASTW guidelines
Recommended Reading and Material	
Attendance	
Comments	

Information Systems Management (MWI)

System Integration

Degree programme	MWI
Semester	2
Course methods	ILV, FL
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	All the different applications of a company‘s IT environment need to communicate with other systems. The course Systems Integration focuses on the fundamentals and most important concepts to improve communication between IT systems on each level to help you to plan and develop value-adding integration solutions. The objective is to get to know the most important concepts for Enterprise Application Integration (EAI). Microsoft BizTalk Server serves as an example of how Microsoft implemented these patterns and principles. Practical exercises will give the possibility to gain some experience in developing system integration solutions.
Teaching methods	SATs, practical exercises, preparation and presentation of a related

	topic as part of the group project
Learning outcome	After passing this course successfully students are able to ... - reproduce the context, advantages and disadvantages of basic messaging principles and common data formats (flat files and XML) in terms of connecting IT systems. - reproduce and explain the most important enterprise application integration patterns. - explain the purpose of transactions and their use as atomic or long-running transactions within enterprise application integration solutions. - reproduce and evaluate the advantages and disadvantages of enterprise application integration patterns to develop a suitable integration software design. - analyse and to make use of the different roles and environments needed as part of the software development process. - apply the basic principles of web services to implement a service solution. - develop an enterprise application integration solution by using Microsoft BizTalk Server as messaging middleware.
Course contents	- Message based communication - Web services - Enterprise application integration - Reliability and environments - Message broker - Content-based routing - Business process modeling - Transactions
Prerequisites	
Assessment Methods	- SATs - 10% - Practical exercises - 30% - Group project - 30% - Final Exam - 30%
Recommended Reading and Material	- Course book - VMware image including a complete Microsoft BizTalk Installation
Attendance	
Comments	

Healthcare and Rehabilitation Technology (MGR)

Wahlfach - Introduction to MATLAB for Applications in Life Sciences

Degree programme	MGR
Semester	2
Course methods	SO
Language	English
ECTS Credits	1.50
Incoming places	Limited
Course description	This course freely follows the previous introduction to MATLAB for Applications in Life Sciences (MLS1) and furthermore deepens the foundations of selected chapters from the field of life sciences. At the end of the course, students should be able to use MATLAB in their own work for purposes of processing presented signals/biosignals. The course consists of interactive lectures with students solving sample MATLAB problems ranging in difficulty. Individual topics can be introduced into the course setup.
Teaching methods	Interactive lectures about selected topics from the field of Life Sciences, Practical solution of assignments by students supported by lecturer, Project consultations
Learning outcome	After passing this course successfully students are able to ... - Use MATLAB for data manipulation and visualization - Generate signals and perform basic signal operations in MATLAB - Create and use basic digital filters to process signals in MATLAB - Apply gained knowledge and techniques to analyse specific biomedical signals (ECG/EMG etc.)
Course contents	- Signals classification and properties - Operations with signals and signal generation - Design of digital filters - Biosignal analysis
Prerequisites	Basic programming knowledge, General knowledge from Life Sciences on bachelor level
Assessment Methods	- Activity during lectures
Recommended Reading and Material	- V.K. Ingle and J. G. Proakis, Digital Signal Processing Using MATLAB, 1st ed. Pacific Grove, USA: Brooks/Cole Pub. Co., 1999 - A. B. Biran, What Every Engineer Should Know About Matlab and Simulink. New York: Taylor & Francis Group, 2010.
Attendance	Attendance is mandatory, only 20% of absence is tolerated

Comments

AI Engineering (MAI)

Development Project

Degree programme	MAI
Semester	2
Course methods	PRJ
Language	English
ECTS Credits	5.00
Incoming places	Limited

Scientific Papers in AI

Degree programme	MAI
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	This course prepares the students for writing their AI master thesis and the AI master paper. After a short repetition of the scientific work principles, a large part of the course focuses on journal clubs about AI papers. The latest publications as well as classic important AI papers are read and presented by the students. This is followed by a critical discussion and group evaluation.
Teaching methods	combination of lectures and own presentations
Learning outcome	After passing this course successfully students are able to ... - identify different types of scientific work - use different types of English literature - reason about subject-relevant research question based on the state-of-the-art collected from scientific points of view and to formulate it in a comprehensible manner, and to define verifiable criteria for achieving goals - independently plan the phases of a scientific development or

	investigation using conventional methods, carry them out in a targeted manner, document them in a comprehensible manner, and thereby systematically ensure the traceability, reliability, plausibility and transferability of the findings to comparable problem situations or contexts - to select and apply suitable methods for the respective question, and accordingly to write the structure of a master's thesis, a proposal and then the master's thesis - present own scientific work as well as scientific work of other people
Course contents	- scientific working, writing and methods - finding relevant AI publications - understanding and presenting AI publications
Prerequisites	successfully completed bachelor thesis
Assessment Methods	- contributions during lectures and own presentations
Recommended Reading and Material	- Kornmeier, (2016). Wissenschaftlich schreiben leicht gemacht: Für Bachelor, Master und Dissertation, utb.
Attendance	
Comments	

IT-Security (MCS)

Advanced English Communication

Degree programme	MCS
Semester	2
Course methods	SE
Language	English
ECTS Credits	1.50
Incoming places	Limited

Course description	The theory and examples of different innovative management concepts will be analyzed for the possible implementation in the students' own business environment. Moreover, the course will examine the unique organizational cultures and management concepts that enable innovation. In addition advanced techniques of presentation and academic paper construction will be taught to enable students to effectively and formally express their ideas on this

	subject matter.
Teaching methods	Active participation and discussion .Fulfilment of writing assignments and presentation
Learning outcome	After passing this course successfully students are able to ... - understand the importance of culture to a firm. - explain the characteristics of an innovative culture. - develop concepts for how an organisation can become more innovative. - use of subject specific English vocabulary - write a argumentative, coherent and academically written seminar paper on the subject of corporate culture and innovation
Course contents	- Innovative corporate cultures - New themes in innovation and how they can be applied to businesses - Critical thinking in seminar discussions - Advanced presentation techniques - Schumpeter's concept of creative destruction / Schien's theory of leadership / Cameron and Quinn's model for diagnosing organisational culture - Case studies: Innovative businesses, e.g. Google, Apple, Toyota - Overview and application of key concepts in writing an academic paper
Prerequisites	Common European Framework of Reference for Languages Level B2
Assessment Methods	- Group Presentation; Group Seminar Paper; Participation
Recommended Reading and Material	- Lecturer Handouts
Attendance	Compulsory
Comments	

Scientific Writing

Degree programme	MCS
Semester	4
Course methods	SE
Language	English
ECTS Credits	1.50

Incoming places	Limited
Course description	The focus of the course is an overview of academic language and formal criteria required for writing and presenting a conference paper, and writing an abstract.
Teaching methods	Teaching methods will be used to give the students opportunities to improve and refine their written language skills. Mini- lectures will be used for input on writing techniques and use of language. However, students will also be given in-class activities to actively engage in using the language in order to enhance language awareness and sensitivity. These activities may include pair activities, group activities, etc. Students will be encouraged to approach written language analytically and critically, for example by giving constructive feedback after in-class writing activities, comparing and analyzing texts, etc. Students will be encouraged to use appropriate language when presenting.
Learning outcome	After passing this course successfully students are able to ... - structure a conference paper according to the formal criteria given - write a conference paper according to the language related criteria given - write an abstract according to the formal criteria given - write an abstract according to the language related criteria given - present a conference paper
Course contents	- The role, content, structure, and style of a conference paper - The role, content, style and types of scientific abstracts - Language-related criteria of a conference paper and an abstract - Writing a conference paper and abstract - Presenting a conference paper
Prerequisites	Completion of previous semester courses
Assessment Methods	- Active participation in class activities and timely completion of assignments
Recommended Reading and Material	- Göschka, M. et al (2014) Guidelines for Scientific Writing, Skriptum Additional current handouts
Attendance	Attendance is compulsory at all lessons for this course.
Comments	

Industrial Engineering & Business (MIB)

Int. Marketing and Product Management

Degree programme	MIB
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description

Internationalization, globalization and culturalization are currently known as key success factors of market and brand leadership. According to the current meaning students shall gain an overview of decision fields and peculiarities of international marketing in theory comparison and in the dispute with practice-oriented decision-making situations based on case studies. In particular, students should learn to understand the strategic challenges of market-oriented internationalization strategies and shall name the resulting consequences and requirements on the analysis, Market Selection- and positioning decision and apply. Using practical examples, the students will be sensitized between mainstream marketing and International Marketing with respect to the differences in the marketing mix and should – from the perspective of an acting marketing head - acquire knowledge to build, implement and guide a comprehensive internationalization process from the perspective of marketing communication.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...
- explain the main spheres of activity of nternationalization by Kotler and implement their consequence on the basis of practical cases decisions (Case Studies).
- apply cultural influences on the models of Hofstede, Hall and Thomas as an evaluation basis for environmental analysis and market selection to analyze their influence on the assessment of market attractiveness and to develop appropriate market selection programs.
- assess different brands from the FMCG, IGM and DLM regarding their internationalization and positioning strategies and identify the differences in the respective marketing mix.
- implement the essential decisions of internationalization based on a Case Study in objective, market selection and program design (marketing mix development) and to justify their choices from the

	perspective of marketing managers. - identify the essential model and approach differences in the product, price, distribution and communication policy between mainstream marketing and international marketing, to interpret their impact on the company's success and its market position and to develop plans for an independent marketing mix based on given project tasks in the context of an internationalization strategy at the level of the market leaders.
Course contents	- Introduction to the global product and brand management - Global product strategies and their origins - Management of global brands during the product life cycle - Standardization versus adaption - Analysis of various branding strategies based on familiar examples
Prerequisites	- Basic Knowledge of Mainstream Marketing and Business Administration- English speaking and writing | Level C1
Assessment Methods	- written exam (75%) - exams via Moodle (each 5%, total 25%)
Recommended Reading and Material	- Hollensen (2012): Essentials of Global Marketing, Pearson - Müller/Gelbrich (2004): Interkulturelles Marketing, Vahlens - Usunier/Lee (2012): Marketing Across cultures, Pearson
Attendance	Attendance is compulsory
Comments	

Innovation and Technology Management (MTM)

Agile Software-Development & Lean UX

Degree programme	MTM
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Data Analytics

Degree programme	MTM
Semester	2

Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Start-up-Management & Corporate Venturing

Degree programme	MTM
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Change Management

Degree programme	MTM
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited

Internet of Things and Smart Systems (MIO)

IoT Systems Development

Degree programme	MIO
Semester	2
Course methods	LAB
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	
Teaching methods	
Learning outcome	Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ... - dimension and program sensor nodes. - select the correct sensor nodes and software environment (bare-metal vs. OS-based) for a given application. - design and integrate sensor clusters. - enable efficient communication within sensor clusters.
Course contents	- Design & Development of distributed sensor networks - Integration of local sensor networks to cluster using edge-gateways - Basic concepts o Communication between nodes o Concurrency (multithreading, multiprocessing, distributed systems) o Synchronization of multiple nodes o Data communication in a sensor cluster - Practical implementation of IoT systems - Practical implementation and application of communication structures
Prerequisites	
Assessment Methods	- Ongoing practical projects with final delivery discussion and final theoretical examination
Recommended Reading and Material	- Current manufacturer documentation as well as technical and scientific publications, depending on the used platform and current task
Attendance	Optional
Comments	

Sensor-/Actor Systems & Control Theory

Degree programme	MIO
Semester	2
Course methods	LAB
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description	
Teaching methods	

Learning outcome	Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ... - identify control technology components - describe, simulate and analyze control processes mathematically - plan and simulate simple control systems - apply control technology components in selected examples
Course contents	- Basics of control engineering - Types of sensors and actuators - Fundamentals of control engineering - Mathematical mapping of control loops - Analysis of control processes in MATLAB - Design of controllers in the frequency domain - Difference analog and digital controls - State controller/multivariable controller and state observer - Realization of regulations - Scanning during measurements - Which sensor is suitable for which application (measuring ranges) - Limits of sensors (e.g. humidity, sea level, ...)
Prerequisites	
Assessment Methods	- Ongoing practical examples and final theoretical exam
Recommended Reading and Material	- O. Föllinger, Regelungstechnik: Einführung in die Methoden und ihre Anwendung, VDE Verlag, 12. Auflage, 2016 - N. Große, W. Schorn, Taschenbuch der praktischen Regelungstechnik, Carl Hanser Verlag, 2006 - V. Plenk, Grundlagen der Automatisierungstechnik kompakt, Springer Verlag Vieweg, 2019
Attendance	Mandatory
Comments	

Course description

Teaching methods

Learning outcome	Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ... - write a scientific paper taking into account all scientific and technical conditions - present their master thesis in a scientifically correct manner and explain technical correlations in the subject area of the master thesis
Course contents	- Fundamentals of scientific work with a focus on writing the master's thesis (repetition).

	- Supervision of the master thesis with regard to scientific procedures - Scientific presentation technique - Defense of own work
Prerequisites	
Assessment Methods	- Presentation of the master's thesis and answering technical and scientific questions from the corresponding subject area
Recommended Reading and Material	- Depending on the chosen topic, scientific articles, books and white papers
Attendance	

Iot Technologies

Degree programme	MIO
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	
Teaching methods	
Learning outcome	Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ... - explain IoT specific technologies as well as protocols - verify differences between these and other communication protocols (Internet protocols, e.g.) and to select the correct protocol for a specific application. - specify the requirements for technologies and protocols of an IoT system. - evaluate commercial solutions for IoT systems, to work out the pros and disadvantages as a basis for decision-making.
Course contents	- Introduction to IoT systems and their technologies (wireless technologies such as 5G, WiFi 802.11, 802.15.4: ZigBee, e.g.). - Existing solutions for connecting nodes (LoRa, WAN, ...) - Commercial cloud backends and opensource solutions - The basics of the essential IoT technologies: o IoT specific protocols (MQTT, CoAP, ...). o IIoT specific technologies (Software-Defined Industrial Systems", OPC UA) o Wired technologies

	(Ethernet and extensions in the area of QoS/TSN) - Edge-Computing vs. Cloud-Computing vs. OnPremises - Energy and bandwidth optimization for IoT transmission - Tradeoffs: latency vs. bandwidth vs. energy consumption - Power supply of IoT devices (battery, power grid, energy harvesting, ...)
Prerequisites	
Assessment Methods	- Immanent performance review (active participation/intermediate tests, 40%) - Final exam (theory, practical tasks, 60%)
Recommended Reading and Material	- Prof. Dr. rer. nat. Felix Hüning (2018), Embedded Systems für IoT, Springer Vieweg, © Springer-Verlag GmbH Deutschland. - Martin Sauter (Februar, 2018): Grundkurs Mobile Kommunikationssysteme; LTE-Advanced Pro, UMTS, HSPA, GSM - GPRS, Wireless LAN und Bluetooth, 7. Auflage, Springer Vieweg, © Springer-Verlag GmbH Deutschland
Attendance	

Security

Degree programme	MIO
Semester	2
Course methods	LAB
Language	English
ECTS Credits	5.00
Incoming places	Limited

IT- and Data Protection Law

Degree programme	MIO
Semester	2
Course methods	SE
Language	English
ECTS Credits	5.00

Incoming places	Limited
Teaching methods	
Learning outcome	Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ... - explain the main features of concluding a contract on the Internet - move in online trade in a legally secure way and to know the essential deadlines - design an imprint on the homepage and - use digital content and avoid copyright infringement, for example when using images and setting links - explain the basic concepts of data protection laws - identify which data may be processed in accordance with DSGVO and DSG and which must be deleted - create a data processing register - obtain a GDPR-compliant consent from a person - identify the processing principles of the GDPR and apply them to internal operations.
Course contents	- Conclusion of contract on the Internet - Consumer Protection Directive and Distance and Off-Site Selling (FAGG) - E-Commerce Act (ECG) - Signature Act - Data protection law, Data Protection Regulation (DSGVO) - Basics of copyright - Use of digital content - Telecommunications law (TKG)
Prerequisites	
Assessment Methods	- Final written exam - Oral presentation on a recent judgment.
Recommended Reading and Material	- Jahnel/Mader/Staudegger, IT-Recht, 4. Auflage (2020) - Jahnel/Pallwein-Prettner/Marzi, Datenschutzrecht, 2. Auflage (2020) - Case-by-case recommended literature essays
Attendance	
Comments	

Data Analysis

Degree programme	MIO

Semester	2
Course methods	LAB
Language	English
ECTS Credits	5.00
Incoming places	Limited

Course description

In this lecture students will learn the foundations of the Python programming language as well as data-science foundations. Course contents are data evaluation (explorative data analysis and dashboards), foundations in statistics and machine learning (feature learning, supervised and unsupervised learning). There is also on lecture on time series analysis (highly relevant for IOT) and data preprocessing using Python remains relevant throughout the course.

Teaching methods

The most important tool used in this course is the highly interactive juypter-notebook. There are mainly lectures, small hands-on exercises, 4 homeworks and a case study for applying the learned methods on real data.

Learning outcome

Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ...
- prepare, visualize and evaluate structured datasets with python (jupyter)
- data processing using jupyter-notebooks
- classify data points in multidimensional feature space using simple and supervised learning techniques (nearest neighbors, decision trees)
- evaluate and improve the performance of classification and regression algorithms
- cluster data points in multidimensional feature space using kMeans method and determine the optimal number of clusters.
- select an appropriate learning procedure for a case study with real data to build a predictive model

Course contents

- Data preparation
- Usage of Python in Data Science
- Correlation analysis
- Time series analysis
- Model evaluation
- Model tuning (hyper-parameter-tuning, cross-validation)
- Cluster analysis
- Data visualization
- Machine Learning (Feature Learning)

	- Classification and Regression algorithms - Dashboard-Visualization - Model-performance assessment
Prerequisites	None necessary, fundamental programming skills can help.
Assessment Methods	- 4 exercises 30 % - Case Study supervised learning (20 %) - 1 exam focussing on Python (intermediate exam, 25 %) - 1 exam focussing on Machine Learning (final exam, 25 %)
Recommended Reading and Material	- Aurélien, G. (2nd Ed. 2019). Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed). O'Reilly Media., Sweigert, A (2nd Ed. 2019). Automate the Boring Stuff with Python: Practical Programming for Total Beginners. No Starch Press.
Attendance	Mandatory attendance during exams only.
Comments	The best exercises per group can get additional 2.5 points, the best case studies additional 5 points.

Quantum Engineering (MQE)

Technology Trends in Quantum Engineering

Degree programme	MQE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	Analysis of scientific publications and important publications in the field of quantum technologies. A selection of current issues of quantum engineering is worked on in small groups with experts, using problem-based learning methodology
Teaching methods	– technology trends in quantum engineering analysis of scientific publications in the subject area
Learning outcome	After successful completion of the course the students are able to: – to analyze and discuss current problems of quantum technologies and their broader context in a structured manner – to identify knowledge gaps and based on these to carry out targeted research, to evaluate possible solutions and to develop

their own solutions
- to select, prepare and present their own solutions, and to defend them backed up with scientific arguments
- to analyse, evaluate and select scientific publications based on common quality standards in the subject area
- identify the basic types of scientific publications and differentiate between them, especially original papers, review papers, conference articles, journals and books
- evaluate subject specific literature sources regarding confirmability, dependability, plausibility, and transferability of insights for comparable problems or contexts and use and reference these in their own work
- justify a research question after identifying the current state of the art with regard to scientific considerations, formulate the question comprehensibly and to define verifiable target criteria
- relate research results to industry, society, the economy or the environment.

present own or other scientific publications comprehensibly, evaluate them and formulate suggestions for further development.

Recommended Reading and Material	Research and news articles (differs according to selected topics)
Attendance	Mandatory attendance during exams only.

Advanced Optics

Degree programme	MQE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	The course introduces some concepts of quantum optics. The concept of temporally low and high coherent light sources is introduced. The application of the concept of temporal coherence is demonstrated using the example of different types of interferometers. After introducing the theory of complex-valued dispersive refractive index functions, their technical manipulation is applied using the example of a series of electro-optical modulators. The basics of light sources, interferometers and electro-optical modulators learned are applied to examples from research and medical technology.

Teaching methods	– technology trends in quantum engineering analysis of scientific publications in the subject area
Learning outcome	After successful completion of the course the students are able to: - to explain the setups for deriving spatial and temporal coherence and to derive the characteristic quantities, especially the coherence length - explain the connection between coherence and interference properties - name different light sources of low and high coherence - to assign the characteristic properties of different light sources to low and high coherence and to derive areas of application for the different sources - to record various interferometer setups (Michelson, Mach-Zehnder (macro[reflection & transmission] & micro), Hong Ou Mandel (reflection & transmission), Fabry–Pérot) and explain how they work. - to calculate the mathematical relationship between resonance frequencies and dispersion of the complex refractive index - name different electro-optical modulators and explain their basic functionality list applications of interferometers and electro-optical modulators
Course contents	- Coherence theory (spatial and temporal coherence, definition setups, following interference properties) - Light sources (low temporal coherent: LED and superluminescent light sources, high temporal coherent: lasers of various setups + functional principles of lasers) - Interferometry (introduction of different interferometers: Michelson, Mach-Zehnder (macro[reflection & transmission] & micro), Hong Ou Mandel (reflection & transmission), Fabry–Pérot) - Theory of complex refractive indices including dispersion - Electro-optical modulators (optical Kerr, Pockels, scattering [Brillouin & Raman], Franz-Keldysh) and application of the modulators especially in micro- and nanostructured integrated setups) Applications of various interferometers and electro-optical modulators
Prerequisites	Mathematical calculations with complex quantities (amplitudes, phases) (MAQE) -Wave optics at bachelor level (HOPH) -Knowledge of physics (optics, electronics, quantum theory) at bachelor's level (HOPH) -Engineering knowledge (optical devices, electronics, information theory) at bachelor's level (HOEL,QECE,QEP)
Recommended Reading and Material	- Boyd. Nonlinear Optics. Elsevier Inc. 2020. - Moloney & Newell. Nonlinear Optics. CRC Press, Taylor & Francis Group. 2018. - Feynman, Leighton & Sands. Lectures on Physics. part 1.

Pearson/Addison-Wesley. 2011/2013.
Scripts

Attendance	Mandatory attendance during exams only.

Foundations of Quantum Information

Degree programme	MQE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description

This course delves into the wide field of interpretations surrounding quantum mechanics, providing students with a deep understanding of the philosophical and conceptual foundations of the quantum world. From the measurement problem to entanglement and hidden variables, participants will engage in thought-provoking discussions on the diverse perspectives that shape our comprehension of quantum phenomena. By the end of the course, students will be equipped with the knowledge to critically evaluate and contribute to the ongoing dialogue surrounding the interpretations of quantum mechanics.

Teaching methods

The most important tool used in this course is the highly interactive juypter-notebook. There are mainly lectures, small hands-on exercises, 4 homeworks and a case study for applying the learned methods on real data.

Learning outcome

After successful completion of the course the students are able to ...

- Critically evaluate and articulate the historical and philosophical foundations of quantum mechanics, including key debates and interpretational challenges.
- Analyze the implications of foundational principles on the conceptual framework of quantum mechanics.
- Investigate the measurement problem in quantum mechanics, understanding the intricacies surrounding the role of measurement, observer effects, and the collapse of the wave function.
- discuss the phenomenon of quantum entanglement and its consequences for nonlocal correlations.

- Analyze the challenges posed by nonlocality and investigate its impact on our understanding of the locality principle in classical physics.
- Discuss the debate between realism and the role of hidden variables in the EPR paradox.
- Analyze the development and significance of Bell inequalities in testing the predictions of quantum mechanics.
- Investigate the violation of Bell inequalities as evidence for non-local correlations and the departure from classical physics.
- Engage in the debate between quantum realism and instrumentalism, assessing the ontological commitments and epistemic implications of each perspective.
- Evaluate how different interpretational stances influence one's understanding of the nature of physical reality in quantum mechanics.
- Explore contemporary developments and emerging perspectives in the field of quantum mechanics, with a focus on interpretational challenges.

Discuss open questions, unresolved issues, and potential future directions for research in the context of quantum mechanics interpretations.

Course contents

- Philosophical Foundations of Quantum Mechanics
- Observer Effects and Measurement Problem
- Entanglement and Non-locality
- Quantum Realism vs. Instrumentalism
- Hidden Variables and Bohmian Mechanics

Probabilities in Quantum Information

Prerequisites

None necessary

Recommended Reading and Material

- Jammer M. (1974) The Philosophy of Quantum Mechanics: The Interpretations of Quantum Mechanics in Historical Perspective, Wiley

Freire O. (2022) The Oxford Handbook of the History of Quantum Interpretations

Attendance

Mandatory attendance during exams only.