

UAS Technikum Wien

COURSE GUIDE SS2027 COURSES OFFERED IN ENGLISH

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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.**

Timetable: The timetable will be available approximately one week before the semester starts. Some courses may appear twice, as they are also offered in the evening for part-time students (BB = *berufsbegleitend*, designed for working students).

Possible timetable clashes: Some courses may overlap, so we recommend selecting additional courses as backups. Incoming students can adjust their course selection at the beginning of the semester. The procedure will be explained during **Orientation Week**.

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 place in the 2nd week of February.

Please take into consideration that this course guide may be subject to change!!!!

22.10.2026

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 divided into the on-campus phase and distance/online learning. During the on-campus phase the presence of the students is obligatory. During this 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 present 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
Information and Communication Systems and Services	BIC
Computer Science	BIF
Mechanical Engineering	BMB
Mechatronics/Robotics	BMR
Sports Engineering and Ergonomics	BSE

International Business Engineering	BIW
Business Informatics	BWI
Master	
Medical Engineering & eHealth	MME
Data Science	MDS
Renewable Energies	MEE
Health Care and Rehabilitation Technology	MGR
Industrial Engineering & Business	MIB
Robotics Engineering	MRE
Quantum Engineering	MQE
Sports Technology	MST
Tissues Engineering and Regenerative Medicine	MTE
Internet of Things and Smart Systems	MIO
Innovation and Technology Management	MTM
Information Systems Management	MWI

CAMPUS INTERNATIONAL

Campus International

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+: Intercultural Awareness for a Profitable Semester Abroad

Degree programme

ECI

Semester

2

Course methods

ILV

Language

English

ECTS Credits

2.00

Incoming places

Limited

Course description

Do you want to study abroad and do you want to get the most out of your time studying abroad? Then this course is for you! Here, we will

be examining cultural differences and how to work with them as well as ways in which universities and systems of education can differ across countries and how to negotiate these differences. This will be a highly interactive course: I will be presenting key aspects of intercultural theory and you will be presenting study experiences in specific countries and working through case studies together. There will also be many opportunities to improve your communication skills in English as a medium of communication (by learning suitable strategies) and also many opportunities to work with and get to know other international students. The course has been running successfully for one semester and I have lots of ideas to make it even more useful and absorbing in the coming semester!

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 cultural stereotypes and prejudices in the context of Erasmus+; - reflect on different strategies for dealing successfully with likely cultural differences during their semester abroad; - understand the approaches they can use to prepare for the bureaucratic and technical challenges of their semester abroad; - negotiate a variety of typical challenging situations that they will likely face in an international environment.
Course contents	- Tactics, personal behaviours and qualities to be strengthened for achieving success during the semester abroad; - Bettering intercultural awareness and recognition of stereotyping; - Hofstede's cultural dimensions; - Techniques for efficient communication in English as a Lingua Franca; - Practice in overcoming challenges and problems in an intercultural environment (role plays)
Prerequisites	B2 level English
Assessment Methods	- 50% student presentations - 25% completion of participation tasks - 25% final written task
Recommended Reading and Material	- Script
Attendance	75% mandatory
Comments	

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 - Loudspeakers
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 verbs topics: 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_From Application to Interview

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

Course description	This course provides a comprehensive instruction in the essential aspects of applying to organisations for either courses, internships or full time jobs. In addition to coaching students in writing a letter of application, a CV, completing an online application form as well as successfully interviewing, the instructor will also input ideas regarding the creation of a suitable online presence and, also, critical examples of culturally sensitive behaviour for international applications. The course is very interactive and there will be many opportunities for students to practice and receive direct coaching, feedback and advice on their work.
Teaching methods	Lecture Exercises and group exercises Writing workshop Interview workshop including practice interviews
Learning outcome	After passing this course successfully students are able to ... - This course provides a comprehensive instruction in the essential aspects of applying to organisations for either courses, internships or full time jobs. In addition to coaching students in writing a letter of application, a CV, completing an online application form as well as successfully interviewing, the instructor will also input ideas regarding the creation of a suitable online presence and, also, critical examples of culturally sensitive behaviour for international

applications.

Course contents	- The course will be divided into four sessions: Written applications – input Written applications – workshop session and feedback Interviews – input Interviews – workshop, practice input
Prerequisites	N/A
Assessment Methods	- N/A
Recommended Reading and Material	- Material will be provided by the lecturer via moodle
Attendance	mandatory, only 20% absence can be tolerated
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 Test Final 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

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 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

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 awarded course (Profformance+ Award, Digital Humanism Award, Ars Docendi 2026 Anerkennungspreis) brings students and people with disabilities (co-designer) together, to design and prototype an individual assistive technology solution with them. Students will learn the basics about disability, 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 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 is explained in the ASSIST HEIDI Introduction Video (https://youtu.be/fHXVmwFFdJk). Also have a look at the outcomes of previous courses (https://www.technikum-wien.at/en/course-assist-heidi/#previous-courses) and the ASSIST HEIDI summer school 2025 (https://www.technikum-wien.at/en/assist-heidi-summer-school-2025/) to get an idea about the course. Awards: * https://www.technikum-wien.at/en/news/first-place-for-the-assist-heidi-course-at-the-profformance-teacher-award/ * https://www.technikum-wien.at/en/news/assist-heidi-wins-second-place-at-the-2026-digital-humanism-in-practice-award/ * https://www.technikum-wien.at/en/news/people-with-disabilities-as-active-innovators-ars-docendi-recognition-award-for-a-teaching-format-at-uas-technikum-wien/
Teaching methods	Co-Design, Co-Creation, Problem-based learning, Service Learning, see Course Concept: https://www.technikum-wien.at/en/course-assist-heidi/#course-concept
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 and apply the principles of Design Thinking - understand types 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 implement assistive prototypes using rapid prototyping, microcontrollers, or Software Engineering.

Course contents

- The course is based on the co-creation guide of matchmymaker.de and contains elements of team building and design thinking. People with disabilities will talk about their disability and daily challenges. Afterwards, the students will form groups of 4-5 persons and co-design (see recording of co-design session: <https://www.technikum-wien.at/en/course-assist-heidi/#media>) and implement a project idea supervised by the lecturers. Finally, the project results will be presented and will be evaluated by the co-designers and lecturers. Two assignments at the beginning of the course help to learn the basics of soldering, 3D printing and the co-creation methodology. The classes will be on Wednesday 15:15 – 17:40 on campus in the Smart Living Lab (<https://youtu.be/qv6cvPn4fNU>).

Prerequisites

EnglishSkills in one of biomedical engineering, 3D design/printing, programming or embedded development recommended

Assessment Methods

- Two assignments at the beginning of the course help to learn the basics of soldering, 3D printing and the co-creation methodology.
- 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: Rehabilitationstechnology, Date: March 1, 2008, Location: Vienna, Austria, Book URL: <https://rehatec.studyathome.technikum-wien.at>

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. Prasad, 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 essential mobile robot components. Students achieve a basic understanding of methods to control mobile robots by implementing behaviours as well as methods for direct sensor-actor coupling.

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) and guided exercises 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 basic methods of control theory required for mobile robots,
- visualise and interpret a mobile robot's sensor readings using the robot operating system,
- control mobile robots by applying behaviour methods for direct

sensor-actor coupling,
- apply basic programming knowledge in Python to examine and model behaviour of a mobile robot's control system.

Course contents

- Introduction to important concepts in robotics and ROS
- Coordinate systems and transformations in robotics
- Mobile robot kinematics
- Essential control theory

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

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 - value 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.

BACHELOR DEGREE PROGRAMS

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, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.

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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts.
- Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement.

- Analyse, deconstruct, and critically evaluate business plans, identifying underlying assumptions, strategic choices, and potential risks.
- Explain and critically discuss product marketing strategies, using appropriate business terminology and coherent argumentation.
- Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions.
- Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios.
- Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.

Course contents

- Business topics (marketing, finance, business plan)
- Meetings, ELF communication
- CSR and Business Ethics
- Pecha Kucha Presenting

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 engineering. Therefore, basic education in applied computer science and the development of software are standard components of the graduates' toolkit. During teaching, special emphasis is given to the abstraction of requirements and subsequently the realisation of corresponding software systems. In classroom sessions and self-study, you will gain insights into programming with Python and the creation of algorithms using flowcharts and Python as the programming language. Python is a high-level programming language with a wide range of applications in mechanical engineering, industrial engineering and the field of renewable energies. The implementation of practical tasks based on selected use cases will enable you to acquire basic skills for creating programmes. Five pen and paper tests keep you on track and will consequently challenge you to acquire implementation knowledge. Practical work with collections, files, classes and graphical user interfaces will expand your ability to solve problems using your programming skills. As the course progresses, you will develop code with the support of AI, enabling you to further enhance your implementation skills.

Teaching methods Combination of classes and self-study phases

Learning outcome After passing this course successfully students are able to ...

- analyse simple problems/tasks, - develop algorithmic solutions (using flowcharts) and implement them using structured programming techniques.
- understand and apply the basic functions of programming languages: reading, processing and outputting structured data, basic operations in data structures, control structures (conditional queries, loops, functions).
- use Python Classes.
- perform software tests.
- create and use virtual environments.
- create graphical user interfaces.
- visualize data graphically.
- utilize MQTT and process API requests.
- write code with AI support.
- implement a software project.

Course contents - Introduction to programming with Python

- Data processing: reading, processing, and outputting data
- Control structures, loops, and functions
- Collections & File Handling
- Python Classes
- Software Testing & Unittests
- Virtual Environments & Application Building
- Creating graphical user interfaces
- Data Visualisation
- MQTT & API-Requests
- AI-supported coding (Vibe Coding)
- Software-Project

Prerequisites

none

Assessment Methods

- Pen & Paper Tests
- Project
- 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

Engineering Management

Degree programme

BIW

Semester

6

Course methods

ILV

Language

English

ECTS Credits

5.00

Incoming places

Limited

Course description

In the course of the module, knowledge and skills are imparted that are required in practice today by the professional profile of an

"industrial engineer". In this module, the students will get to know the principles, procedures and methods for the design and development of mechatronic products. These are clearly explained using reference examples and worked out 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).
- 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
- Requirements Specification
- Difference and creation of functional model <-> active model - Systems engineering process models
- Safety design, risk analysis
- Digital Twin Fundamentals

Prerequisites

Production Technology, Management Basics 1 und 2

Assessment Methods

- Course-immanent performance assessment

Recommended Reading and Material

- Bokranz, R.; Landau K.: Handbuch Industrial Engineering: Produktivitätsmanagement mit MTM, Schäfer Pöschel, Auflage: 2, 2012
- Sihn, W.; Sunk, A.; Nemeth, T.; Kuhlmann, P.; Matyas, K.: Produktion und Qualität –Organisation, Management und Prozesse; Carl Hanser Verlag, 2016

Attendance

Attendance is mandatory according to university standards

Comments

none

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, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.
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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts. - Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement. - Analyse, deconstruct, and critically evaluate business plans, identifying underlying assumptions, strategic choices, and potential

risks.

- Explain and critically discuss product marketing strategies, using appropriate business terminology and coherent argumentation.
- Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions.
- Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios.
- Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.

Course contents

- Business topics (marketing, finance, business plan)
- Meetings, ELF communication
- CSR and Business Ethics
- Pecha Kucha 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 - describe principles of molecular cloning. - design a functional cloning strategy.
Course contents	- Literature databases - Sequence comparisons (BLAST) on protein and DNA level - molecular cloning and primer design
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,
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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
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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

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 Molekularbiologie Cell 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	

Cell Culture Laboratory

Degree programme	BBE
Semester	4
Course methods	LAB
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	Learning the most important methods and proper use of the equipment used in cell culture
Teaching methods	Independent development of the basics of cell culture techniques, discussion of the course of the laboratory exercise and the experiments, then independent work in cell culture, writing of a laboratory protocol
Learning outcome	After passing this course successfully students are able to ... - To apply standard techniques of culturing eukaryotic cells under aseptic conditions and to recognize possible contamination in good time in order to take the necessary measures. - to use the equipment required for this, taking into account safety regulations, to recognize possible malfunctions in good time and, if possible, to rectify them yourself. - Prepare reagents and media, label containers adequately and dispose of waste in accordance with legal requirements. - carry out simple tests with cells (e.g. mycoplasma test, cytotoxicity test) according to standard instructions. - to describe and evaluate all the work steps carried out and the microscopic images generated in the process in a comprehensible manner in a written protocol and to critically reflect on the knowledge gained. - to apply the basic rules of scientific work when writing and analyzing texts, and to distinguish a scientific approach from a non-scientific (everyday) approach. - Record work steps and results obtained in a laboratory book.
Course contents	- Introduction to cell culture methods of eukaryotic cells (thawing, medium change, passagers, cell counting, freezing) - Training in handling of cell culture relevant laboratory equipment (incubator, laminar flow workbench, centrifuge, microscope) and reagents - Performance of a mycoplasma test and a cytotoxicity test including evaluation

Prerequisites	Biochemie und Molekularbiologie
Assessment Methods	- Test, Protocol
Recommended Reading and Material	- Freshney's Culture of Animal Cells, Capes Davis & Freshney, 2021, Wiley Blackwell
Attendance	There is a compulsory attendance of 100%.
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	- Physiology and 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 Processing 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 statutes

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

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

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

Rapid Prototyping

Degree programme BBE

Semester 4

Course methods ILV

Language English

ECTS Credits	2.00
Incoming places	Limited
Course description	This course teaches the basics of different rapid prototyping technologies and methods of additive and subtractive manufacturing. In particular, CAD modeling, 3D printing (FDM) and laser cutting are discussed in more detail and deepened by means of practical exercises.
Teaching methods	* Teaching theoretical basics using lecture slides, study letters and literature references* Development of 3D modeling techniques, partly through self-study or distance learning* Use of industry-relevant software for design and 3D modeling* Discussion and coordination of design decisions in the group
Learning outcome	After passing this course successfully students are able to ... - Distinguish and name important methods and tools of rapid prototyping - Select and combine 3D models from freely available libraries - Create 3D models using the online CAD software Onshape - Preparing 3D objects for manufacturing using different 3d-printers (slicing) - Create 2D vector graphics for the use of a laser cutter and prepare them accordingly - Explain how devices for additive and subtractive manufacturing work (in particular FDM printers and laser cutters)
Course contents	- Additive and subtractive rapid prototyping methods - Fused deposition modeling (materials, special features of printing and modeling) - Slicing (with Prusa Slicer and BabuLab Studio) - 3D-Drucker Settings (Support Material, Layer Thickness, etc.) - 3D CAD with Onshape (sketching, 3D design, special connecting elements) - 2D vector graphics with Inkscape and Boxes.py - Use of the available 3D printers and the laser cutter
Prerequisites	No special previous knowledge is required
Assessment Methods	- Work tasks in distance learning (development of an online tutorial, creation of a 3D object)
Recommended Reading and Material	- O. Diegel, A. Nordin, D. Motte: A Practical Guide to Design for Additive Manufacturing: Springer Series in Advanced Manufacturing, 2020

- S. Junk, Onshape – Kurz und Bündig: Einstieg in 3D-Druck und CNC-Biegen. Wiesbaden: Springer Fachmedien Wiesbaden, 2020.
- (both books are available from the FHTW library as eBooks or as pdf downloads)

Attendance attendance is obligatory

Comments

Active Assistive Technologies

Degree programme BBE

Semester 4

Course methods ILV

Language English

ECTS Credits 3.00

Incoming places Limited

Course description Practice-oriented treatise on the subject of Active Assistive Technologies

Teaching methods

Learning outcome After passing this course successfully students are able to ...

- to understand the functions of the human sensory organs and also frequently occurring damage in order to develop suitable technical measures to compensate for failures.
- to know the physiological changes typically associated with the ageing process in order to design suitable technical measures to compensate for such failures.
- to transfer the basic principles of multimodal human-machine interfaces to augmentative and alternative applications for disabled and elderly people.
- to practically apply the most important rules of accessible design and universal design

Course contents

- Definitions and objectives of rehabilitation technology
- What is disability? (based on the WHO definitions, ICIDH and ICF)
- Medical basics (anatomy and physiology with reference to disabilities)
- Augmentative and alternative man-machine Interfaces
- Communication technology for people with disabilities and elderly people

- Tools for orientation and navigation
- Aids for everyday life and work
- Smart Homes, environmental controls and service Robots
- Barrier-free environmental design and universal design

Prerequisites

Assessment Methods

Recommended Reading and Material

Attendance

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

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

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

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, project work and self-study with practical examples and supervised project work

Learning outcome After passing this course successfully students are able to ...

- design and implement component-based systems using appropriate modeling- and implementation-technology
- design and realize service-oriented systems using appropriate modeling- and implementation-technology
- 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)
- Enterprise Message Bus Systems

Prerequisites Basics in software development with a selected programming language. Basic knowledge of software architecture.

Assessment Methods	- Multimodal: - Theoretical assessment (Moodle MC test) - Project work (two Milestones)
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
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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

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, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.

Teaching methods

Learning outcome	After passing this course successfully students are able to ... - use a broad and nuanced range of business and management vocabulary in English with a high degree of accuracy and stylistic appropriateness in professional and academic contexts, - deliver a Pecha Kucha presentation in English, presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement, - analyse, deconstruct, and critically evaluate business plans in English, identifying underlying assumptions, strategic choices, and potential risks, - explain and critically discuss product marketing strategies in English, using appropriate business terminology and coherent argumentation, - present and interpret data, trends, and quantitative information in English clearly and accurately, integrating visual and verbal information to support well-founded conclusions, - demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios, as well as to - communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and to negotiate meaning and clarify misunderstandings.
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	

Business English

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

Course description	In this course, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.
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Teaching methods

Learning outcome	After passing this course successfully students are able to ... - use a broad and nuanced range of business and management vocabulary in English with a high degree of accuracy and stylistic appropriateness in professional and academic contexts, - deliver a Pecha Kucha presentation in English, presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement, - analyse, deconstruct, and critically evaluate business plans in English, identifying underlying assumptions, strategic choices, and potential risks, - explain and critically discuss product marketing strategies in English, using appropriate business terminology and coherent argumentation,
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- present and interpret data, trends, and quantitative information in English clearly and accurately, integrating visual and verbal information to support well-founded conclusions,
- demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios, as well as to
- communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and to negotiate meaning and clarify misunderstandings.

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 (VHDL)
- Design of combinational logic (simple gates, decoders, multiplexers, adders, subtractors ...) with a contemporary hardware description language (VHDL)
- Description of sequential logic (different types of flip-flops and registers, counters, state machines ...) using a contemporary hardware description language (VHDL)
- 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

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, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.

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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts.
- - Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement.
- - Analyse, deconstruct, and critically evaluate business plans,

identifying underlying assumptions, strategic choices, and potential risks.

- - Explain and critically discuss product marketing strategies, using appropriate business terminology and coherent argumentation.
- - Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions.
- - Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios.
- - Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.

Course contents

- Business topics (marketing, finance, business plan)
- Meetings, ELF communication
- CSR and Business Ethics
- Pecha-Kucha 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
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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
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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
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Prerequisites	Knowledge of common web languages (HTML, JS, CSS, PHP, AJAX) Knowledge of object-oriented languages (Java C#. /
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.net) Knowledge of handling databases (MySQL or Oracle) Basic knowledge of using Linux Knowledge 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 Authorization 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 introduces real-time software design on STM32 microcontrollers using FreeRTOS. Students learn how to structure embedded applications into tasks, apply real-time scheduling, and integrate microcontroller peripherals (GPIO, timers, ADC, PWM, UART/SPI/I²C) in a safe and testable way. A sequence of small assignments builds practical skills across the semester.

Teaching methods Hands-on lab sessions with guided exercises on STM32 (STM32CubeIDE + HAL) Short demos and live coding of RTOS patterns (tasks, queues, semaphores, ISRs) Code walkthroughs and lightweight debugging (UART logging, breakpoints, assertions) Multiple small assignments with iterative feedback

Learning outcome After passing this course successfully students are able to ...

- Explain core RTOS concepts (tasks, priorities, context switching, scheduling, tick rate).
- Use FreeRTOS synchronization and communication (queues, semaphores/mutexes, event groups, timers).

- Write ISR-safe embedded code and use the correct FreeRTOS FromISR APIs.
- Integrate STM32 HAL peripherals with RTOS (GPIO, timers, ADC, PWM, UART/SPI/I²C).
- Reason about basic real-time behavior (periods, deadlines, task interactions) and avoid common pitfalls.
- Structure code for readability and maintainability (layered design, documentation, version control).

Course contents

- RTOS foundations: tasks & priorities, preemption, scheduler tick, context switching, timing services.
- Sync & IPC: binary/counting semaphores, mutexes & priority inversion, queues, event groups, software timers.
- ISRs & RTOS: interrupt design, ISR vs. task work split, FromISR APIs, latency considerations.
- STM32 peripheral integration with HAL: GPIO, timers (periodic tasks, capture/compare), PWM, ADC, UART/SPI/I²C under RTOS.
- Assignments: several small RTOS-focused tasks throughout the semester (e.g., periodic sensing, UART command handling, PWM control), each assessed independently.

Prerequisites

Prior course or equivalent experience in microcontroller programming (e.g., Microcontroller Software Design, STM32 + HAL). Solid C programming basics (functions, pointers, structs, ...). Basic embedded concepts (GPIO, timers, PWM, ADC, UART; interrupts; debouncing). Using an IDE and debugger (STM32CubeIDE, breakpoints, stepping, watch variables) and basic UART logging.

Assessment Methods

- 4 Assignments + 1 Short check/Quiz

Recommended Reading and Material

- FreeRTOS Kernel Documentation (concepts and API reference) – freertos.org
- “Mastering the FreeRTOS Real-Time Kernel” (official tutorial book, free PDF) – github.com
- STM32CubeIDE User Guide – UM2609 (project setup, build, debug) – st.com
- STM32 HAL/LL Drivers documentation for the STM32L4 family - UM1884 (peripheral APIs used in labs) – st.com
- Barr Group Embedded C Coding Standard (BARR-C:2018) for readable, robust code
- STM32CubeIDE product page (downloads & docs) – st.com
- FreeRTOS Documentation hub (getting started, API, community) – freertos.org

Attendance

100% mandatory

Comments none

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, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.

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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts.
- Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear

argumentation, effective visual support, and confident audience engagement.

- Analyse, deconstruct, and critically evaluate business plans, identifying underlying assumptions, strategic choices, and potential risks.
- Explain and critically discuss product marketing strategies, using appropriate business terminology and coherent argumentation.
- Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions.
- Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios.
- Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.

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
- •Pecha Kucha Presenting

Prerequisites

Course 'Technical English'

Assessment Methods

- Vocabulary test: 10%
- Self-study tasks: 30%
- Presentation including assessed presentation plan: 60%

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

Mechatronics/Robotics (BMR)

Business English

Degree programme

BMR

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

Course description In this course, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.

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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts.
- Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement.
- Analyse, deconstruct, and critically evaluate business plans, identifying underlying assumptions, strategic choices, and potential risks.
- Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions.
- Explain and critically discuss product marketing strategies, using

appropriate business terminology and coherent argumentation.

- Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios.
- Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.

Course contents

- Business topics (marketing, finance, business plan)
- Meetings, ELF communication
- CSR and Business Ethics
- Pecha Kucha Presenting

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

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
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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

Sports Engineering & Ergonomics (BSE)

Business English

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

Course description	In this course, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.
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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts. - Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement. - Analyse, deconstruct, and critically evaluate business plans, identifying underlying assumptions, strategic choices, and potential risks. - Explain and critically discuss product marketing strategies, using

appropriate business terminology and coherent argumentation.

- Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions.
- Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios.
- Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.

Course contents

- Business topics (marketing, finance, business plan)
- Meetings, ELF communication
- CSR and Business Ethics
- Pecha Kucha 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

Materials and Technology for Performance Apparel

Degree programme

BSE

Semester

4

Course methods

ILV

Language

English

ECTS Credits

5.00

Incoming places

Limited

Course description

Materials are not only important in connection with appliances, but

also for clothing. Due to their structure, functional materials have very specific properties, which are explained to the students in this course. They learn to recognize, test and analyze them.

Teaching methods

The theoretic fundamentals conveyed in impulse lectures of presence units are complemented via preparation, presentation and discussion of specific case studies by the students. The gained competencies are applied within a project work and are ultimately evaluated in a written exam.

Learning outcome

After passing this course successfully students are able to ...

- recognize different functional materials and to derive their production technology.
- describe the connection between structure and functionality of high-tech materials in the sportswear sector.
- analyze requirements for sports garments and to select appropriate materials and production technologies.
- conceive ergonomic designs for specific target groups select appropriate test methods for the evaluation of material properties.
- critically assess sustainability in the life cycle of high-tech materials.

Course contents

- Materials science: Fibers & Membranes
- Manufacturing technologies
- Material testing of fibers & membranes
- Physiology (thermoregulation)

Prerequisites

•Fundamentals of Physics for Engineering Sciences (PHY1)•Fundamentals of Anatomy and Physiology (APHYS)•Fundamentals of Biomechanics and Ergonomics (BIOME)•Materials Testing Plastics (WERKS) Industrial Design (INDUS)•Auswahl von Materialien und Herstellungsverfahren (MATER)

Assessment Methods

- Details see Moodle Course

Recommended Reading and Material

- Hayes, S. G., & Venkatraman, P. (Eds.). (2018). Materials and technology for sportswear and performance apparel. CRC Press
- Shishoo, R. (Ed.). (2015). Textiles for sportswear. Elsevier.
- McLoughlin, J., & Sabir, T. (Eds.). (2018). High-Performance Apparel: Materials, Development, and Applications. Woodhead Publishing.

Attendance

According to FHTW regulations (Satzung § 5)

Comments

Computer Science (BIF)

Digital Accessibility

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

Computer Vision and Natural Language Processing

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

Course description	Computer vision is a field dedicated to providing computers with a high-level understanding of digital images and videos, i.e. it takes a step beyond seeing and tries to recognize and make sense of what it sees. This way Computer vision is tightly interwoven with machine learning and artificial intelligence with typical tasks such as classification, object detection and segmentation. The applications of Computer vision in R&D, IT, various branches of industry, start-ups, public and private companies are sheer countless. Students will be able to apply their knowledge in healthcare, robotics, manufacturing, transport, motion capture, biometrics and many more. Natural language processing (NLP) is a field with a plethora of applications in industry (such as human-device communication, automated text classification, machine translation, AI-based customer service, ...). From a scientific viewpoint human-level NLP is a classical “holy grain” of artificial intelligence that continues to provide challenges and new methods to computer science. The demand for educated professionals in the field can be expected to remain high, given ever-growing amounts of textual data and the respective new tasks, such as hate-speech detection in social media.
Teaching methods	integrated course

Learning outcome	After passing this course successfully students are able to ... - Using python libraries for image processing and analysis - Extracting image features using classical methods and using these for classification and clustering in image data - Describing Convolutional Neural Networks (CNNs) and using CNNs for classification of image data, object detection and segmentation - Giving an overview of NLP methods as well as applying NLP methodologies in a use case - Developing an NLP module using standard python libraries and evaluating the results
Course contents	- Neural networks and deep learning - Computer vision basics - Traditional methods of image data handling and processing - Image processing using convolutional neural networks - Basics and application of Natural Language Processing
Prerequisites	Data Scientist Specialization: Data Science & Machine Learning
Assessment Methods	- Homeworks (individual coding exercises) - Student project Computer Vision - Student project NLP
Recommended Reading and Material	- Programming Computer Vision with Python : tools and algorithms for analyzing images Solem, Jan Erik [VerfasserIn] Sebastol : O`Reilly, [2012] [AnnArbor] : ProQuest eBook Central 2012 (als E-Books in der FHTW-Bibliothek verfügbar)</li> <li>- Practical Natural Language Processing : A Comprehensive Guide to Building Real-World NLP Systems Vajjala, Sowmya Majumder, Bodhisattwa Gupta, Anuj Surana, Harshit Beijing : O`Reilly, [2020] [Ann Arbor] : ProQuest Ebook Central 2020 (als E-Book in der FHTW-Bibliothek verfügbar)
Attendance	mandatory
Comments	

DevOps and Security

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

Incoming places	Limited
Course description	This course is structured into three key parts: DevSecOps, Azure DevOps Deployment, and Secure Coding, providing a well-rounded understanding of security in DevOps environments. DevSecOps Fundamentals: Learn the fundamentals of DevOps and its evolution into DevSecOps, covering risk mitigation strategies, CI/CD pipeline design, and containerization basics. Azure DevOps Deployment: Gain hands-on experience deploying applications using Azure DevOps, YAML, and Bicep templates, while configuring agent pools and understanding pipeline management. Secure Coding: Master secure development principles, threat modeling (STRIDE, CWE), and common security vulnerabilities such as buffer overflows, broken authentication, and improper password storage. By the end of the course, participants will be equipped to build secure DevOps pipelines, assess risks, and implement security best practices in modern cloud environments.
Teaching methods	Integrated course
Learning outcome	After passing this course successfully students are able to ... - explain DevOps and DevSecOps principles - estimate DevOps risks and develop risk mitigation strategies - know about roles and responsibilities in DevOps Operations Teams - deploy a DevOps pipeline in Azure using YAML and Bicep - understand secure coding principles and the secure coding lifecycle - conduct a STRIDE based threat analysis - avoid coding problems and describe common use cases and misuse cases
Course contents	- Part 1: DevOps Fundamentals: DevOps Basics and Evolution to DevSecOps, Design and build CI/CD Pipelines, Containerization Basics, DevOps risks and und risk mitigation, DevOps Operations (Monitoring, Alerting, Profiling) - Part 2: Azure DevOps Deployment: YAML Deployments, Configure Agents Pools and Understanding Pipelines, Deployment using Azure Bicep Templates - Part 3: Secure Coding: Secure Principles, Secure Development Lifecycle, Use Cases and Misuse Cases, Threat Modelling, STRIDE and CWE, Coding Problems (Buffer Overflows, Password Storage, Broken Auth, Encryption, etc)
Prerequisites	Infrastructure Basics, DevOps&Cloud Computing Basics, IT Security Basics

Assessment Methods	- Part 1: 10% Moodle quizzes, 20% self study assignments - Part 2: 30% Azure project - Part 3: 20% exam, 20% 2 practical examples
Recommended Reading and Material	- The DevOps Handbook, 2nd Edition by Gene Kim, Jez Humble, Patrick Debois, John Willis, Nicole Forsgren Released November 2021 Publisher(s): IT Revolution Press - Continuous Integration (CI) and Continuous Delivery (CD): A Practical Guide to Designing and Developing Pipelines 1. Auflage. von Henry van Merode (- Docker Deep Dive - Second Edition[Book] by Nigel Poulton. Released July 2023. - Securing DevOps by Julien Vehent Released August 2018 Publisher(s): Manning Publications - Various Microsoft Azure tutorials - Various OWASP guidelines
Attendance	Attendance required
Comments	

Software Engineering 2 Labor

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

Course description	This course provides a well-founded introduction to the development of modern software applications with Java or C# .NET using a web frontend and server backend architecture. The thematic focus is on the clear separation between the presentation level, implemented using Angular, and the processing level, which includes the control of the business logic as well as the integration of data and communication mechanisms. In professional development projects, simply creating working code is not enough. Rather, the structured and sustainable design of software systems is of central importance. Through the targeted use of established design and architecture principles as well as standardized documentation techniques,
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applications are designed to be understandable, maintainable and extensible. The course deals with central concepts, tools and best practices that contribute significantly to the quality, readability, traceability, extensibility and interchangeability of software components. Students have the opportunity to implement the practical exercises and project work either in Java or C# .NET.

Teaching methods

The theory part consists of self-study phases, homework exercises 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 ...

- critically analyze requirements and derive a structured multi-tier software architecture, enabling the design of a multi-layered application based on a systematic assessment of functional and technical needs
- design and implement a web-based graphical user interface using an appropriate web framework, applying established usability principles during construction
- implement a backend system using middleware technologies, encapsulating business logic and exposing clearly defined interfaces
- implement a backend system using middleware technologies, encapsulating business logic and exposing clearly defined interfaces
- explain and plan the deployment process of a software application while identifying potential critical paths, thereby recognizing operational risks and constraints
- persist application data in a relational database using an Object-Relational Mapper (ORM), including the modeling of consistent data structures
- systematically recognize, classify, apply, and extend classical design patterns as described by Erich Gamma, enabling a critical assessment of architectural decisions
- apply SOLID and Clean Code principles analytically to both existing and newly developed source code, ensuring long-term maintainability and high implementation quality
- record and document runtime behavior by applying appropriate logging libraries, supporting systematic error diagnostics and performance analysis
- provide services through REST-based APIs and integrate external services securely, applying relevant standards and communication protocols

Course contents

- Analysis and design of modern software applications based on functional requirements

- Classical software design patterns: Mediator, Observer, Facade, Decorator, including their architectural application
- Advanced SOLID principles with a focus on Inversion of Control (IoC) and Dependency Injection (DI)
- Software modeling using UML diagrams (e.g., class diagrams, sequence diagrams)
- Development of web-based user interfaces using Angular, including reactive UI concepts
- Implementation of backend systems using middleware frameworks (Spring Boot / ASP.NET Core)
- Comparison and practical application of Clean Architecture versus traditional Layered Architecture
- Data persistence using Object-Relational Mappers (ORM) with JPA and Entity Framework Core
- Provision and integration of REST services, including OpenAPI specifications
- Application containerization and configuration using Docker, including production-oriented best practices
- Advanced data persistence techniques in relational databases (e.g., PostgreSQL) including database migrations
- Utilization of logging mechanisms and systematic configuration management to monitor and control application behavior
- Planning and execution of deployment processes for multi-tier applications, including operational and security considerations

Prerequisites

Knowledge for object-oriented development, database integration and integration of unit tests in C# or Java is required. Furthermore basic knowledge in web-technologies HTML, CSS and JavaScript/TypeScript.

Assessment Methods

- Exercises
- Presentations
- Semester project

Recommended Reading and Material

- C#: <http://han.technikum-wien.at/han/ebookcentral/ebookcentral.proquest.com/lib/ftw/detail.action?docID=5327214>
- Java: Official Spring Boot Documentation [spring.io]: <https://docs.spring.io/spring-boot/documentation.html>
- Java: Learn Spring Boot: <https://www.baeldung.com/spring-boot>
- Java: Spring Boot with IntelliJ [Jetbrains]: <https://www.jetbrains.com/help/idea/spring-boot.html>
- 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. Recognition: InnoLab 2 cannot be recognized. This means that if you are studying in the 4th semester, you must also complete InnoLab 2, regardless of whether you have already completed this

course before (possibly when repeating it).

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$\leftrightarrow$Requirements$\leftrightarrow$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
Course description	Teaching the basics of pre-production and the development of a coherent visual identity (art direction, concept art, animation, VFX, UI)
Teaching methods	Mixture of attendance and self-study phases
Learning outcome	After passing this course successfully students are able to ... - Identify different types of 2D graphics - Reflect on the advantages and disadvantages of using AI models - Analyze video games and other media in terms of the art direction applied - Confident and unafraid to create concept drawings, storyboards and mockups - Apply principles of animation - Evaluate and develop user interfaces that support the gaming experience
Course contents	- Art Direction - Concept Art - Animation

- VFX
- Film Theory
- Storyboards
- UI
- Player Perspective

Prerequisites	none
Assessment Methods	- 30% Individual Assignment - 70% Group Assignments
Recommended Reading and Material	
Attendance	according to the guidelines
Comments	

Game Development Basics

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

Course description	This course gives an overview of topics related to game development as well as its challenges. It takes a look on all the things required to develop and publish a game on game consoles and tries to covers the larger area of technical implementation, game design, cooperation and communication within the team as well as some business and legal aspects.
Teaching methods	integrated course
Learning outcome	After passing this course successfully students are able to ... - To explain the structure of a commercial game production and to describe the process for releasing an indie game - Describe the basic functionality of modern game engines - to use the central functions and modules of Unity and to expand them with scripts - Load assets from external tools into the engine and process them there

	- To explain the basic processes of a Game AI or simple physical facts and to implement them in Unity - to design simple games, to create, implement and test the necessary software architecture - Implement acceleration techniques
Course contents	- Basic structure of a game - Distribution of roles and teamwork - Structure and framework of a commercial game production, economic and legal aspects - Game engine introduction and architecture - Unity basics - Game loop - Data Driven Development and Scripting - AI basics for games - Pathfinding - Collision detection
Prerequisites	Programming knowledge into gaming
Assessment Methods	- Code Reviews - Projects in small groups
Recommended Reading and Material	- Introduction to Game Design, Prototyping, and Development, Gibson Jeremy - ISBN: 0136619940 - The Art of Game Design: A Book of Lenses, Jesse Schell - ISBN: 1138632058 - A Theory of Fun for Game Design, Raph Koster - ISBN: 1932111972
Attendance	Yes
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

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 persistence)
- 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	

Business English

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

Course description	In this course, participants will develop C1-level competence in professional business communication in English, alongside a critical understanding of the processes involved in establishing and developing a business. The course explores organisational models, market positioning, and product communication strategies, while examining how ethical responsibility and sustainability shape contemporary entrepreneurial decision-making. Participants will work with key professional business genres, including reports and business plans, learning to analyse and interpret them. The course also focuses on the effective use of advanced communication tools and Pecha Kucha presenting to persuasively address professional audiences. Throughout the course, participants will expand their business-specific vocabulary and refine their ability to communicate complex ideas confidently and appropriately in high-level professional contexts.
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 broad and nuanced range of business and management vocabulary with a high degree of accuracy and stylistic appropriateness in professional and academic contexts. - - Deliver a Pecha Kucha presentation presenting a marketing analysis, CSR strategy, or financial analysis, demonstrating clear argumentation, effective visual support, and confident audience engagement. - - Analyse, deconstruct, and critically evaluate business plans, identifying underlying assumptions, strategic choices, and potential risks. - - Explain and critically discuss product marketing strategies, using appropriate business terminology and coherent argumentation. - - Present and interpret data, trends, and quantitative information clearly and accurately, integrating visual and verbal information to support well-founded conclusions. - - Demonstrate a critical understanding of business ethics and corporate social responsibility (CSR) and apply these principles analytically to different companies and business scenarios. - - Communicate effectively and flexibly in English as a Lingua Franca (ELF) settings, demonstrating strategic competence, accommodation to diverse linguistic and cultural backgrounds, and the ability to negotiate meaning and clarify misunderstandings.
Course contents	- Business topics (marketing, finance, business plan) - Meetings, ELF communication - CSR and Business Ethics - Pecha-Kucha 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

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

Continuous Integration

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

Course description

This course provides in-depth knowledge in the field of Continuous Integration (CI) and Continuous Delivery/Deployment (CD) as well as the practical application of CI servers. CI has become a standard in modern software development, enabling faster and error-free delivery of software products. Students will become familiar with relevant CI tools such as Jenkins, GitHub Actions, GitLab CI, Circle CI, and Azure DevOps. During the course, students will develop their own CI pipeline using at least two different CI servers, applying architecture and design principles that they will learn.

Teaching methods

The integrated course combines lectures, practical examples, homework assignments, self study, supervised project work, exercises, and tests.

Learning outcome

After passing this course successfully students are able to ...

- apply the principles of semantic versioning to their software projects
- set up and configure a CI server
- compile, test, package, and deploy existing software on a target system
- analyze the importance of integrating development and operations

(DevOps)

- understand and implement methods and processes for optimized collaboration between development and operations

Course contents

- Semantic Versioning
- Advanced Git topics
- Motivation and benefits of CI
- Setting up and configuring a CI server (e.g., Jenkins, GitHub Actions, GitLab CI, Azure DevOps, Circle CI)
- Configuring build jobs and pipelines
- Utilizing build tools
- Using tools such as AWS (infrastructure provisioning), Docker Compose (container management), SonarQube (static code analysis), Posthog (analytics, A/B testing, feature flags), Snyk (code and container security)
- Application release automation
- Organizational and economic aspects of DevOps

Prerequisites

Experience in software development and project implementation
Basic knowledge of software testing
Basic familiarity with version control using Git

Assessment Methods

- Practical part 70% (semester project and exercises)
- Theoretical exam 30% (closed book Moodle multiple-choice test)

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

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
- AppArmor

Prerequisites

Basics of computer science Basics of IT infrastructure Basics 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

Software Engineering 2 Labor

Degree programme

BIF

Semester

4

Course methods

LAB

Language

English

ECTS Credits

5.00

Incoming places	Limited
Course description	This course provides a well-founded introduction to the development of modern software applications with Java or C# .NET using a web frontend and server backend architecture. The thematic focus is on the clear separation between the presentation level, implemented using Angular, and the processing level, which includes the control of the business logic as well as the integration of data and communication mechanisms. In professional development projects, simply creating working code is not enough. Rather, the structured and sustainable design of software systems is of central importance. Through the targeted use of established design and architecture principles as well as standardized documentation techniques, applications are designed to be understandable, maintainable and extensible. The course deals with central concepts, tools and best practices that contribute significantly to the quality, readability, traceability, extensibility and interchangeability of software components. Students have the opportunity to implement the practical exercises and project work either in Java or C# .NET.
Teaching methods	The theory part consists of self-study phases, homework exercises 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 ... - critically analyze requirements and derive a structured multi-tier software architecture, enabling the design of a multi-layered application based on a systematic assessment of functional and technical needs - design and implement a web-based graphical user interface using an appropriate web framework, applying established usability principles during construction - implement a backend system using middleware technologies, encapsulating business logic and exposing clearly defined interfaces - implement a backend system using middleware technologies, encapsulating business logic and exposing clearly defined interfaces - explain and plan the deployment process of a software application while identifying potential critical paths, thereby recognizing operational risks and constraints - persist application data in a relational database using an Object-Relational Mapper (ORM), including the modeling of consistent data structures - systematically recognize, classify, apply, and extend classical

design patterns as described by Erich Gamma, enabling a critical assessment of architectural decisions

- apply SOLID and Clean Code principles analytically to both existing and newly developed source code, ensuring long-term maintainability and high implementation quality
- record and document runtime behavior by applying appropriate logging libraries, supporting systematic error diagnostics and performance analysis
- provide services through REST-based APIs and integrate external services securely, applying relevant standards and communication protocols

Course contents

- Analysis and design of modern software applications based on functional requirements
- Classical software design patterns: Mediator, Observer, Facade, Decorator, including their architectural application
- Advanced SOLID principles with a focus on Inversion of Control (IoC) and Dependency Injection (DI)
- Software modeling using UML diagrams (e.g., class diagrams, sequence diagrams)
- Development of web-based user interfaces using Angular, including reactive UI concepts
- Implementation of backend systems using middleware frameworks (Spring Boot / ASP.NET Core)
- Comparison and practical application of Clean Architecture versus traditional Layered Architecture
- Data persistence using Object-Relational Mappers (ORM) with JPA and Entity Framework Core
- Provision and integration of REST services, including OpenAPI specifications
- Application containerization and configuration using Docker, including production-oriented best practices
- Advanced data persistence techniques in relational databases (e.g., PostgreSQL) including database migrations
- Utilization of logging mechanisms and systematic configuration management to monitor and control application behavior
- Planning and execution of deployment processes for multi-tier applications, including operational and security considerations

Prerequisites

Knowledge for object-oriented development, database integration and integration of unit tests in C# or Java is required. Furthermore basic knowledge in web-technologies HTML, CSS and JavaScript/TypeScript.

Assessment Methods	- Exercises - Presentations - Semester project
Recommended Reading and Material	- C#: http://han.technikum-wien.at/han/ebookcentral/ebookcentral.proquest.com/lib/ftw/detail.action?docID=5327214 - Java: Official Spring Boot Documentation [spring.io]: https://docs.spring.io/spring-boot/documentation.html - Java: Learn Spring Boot: https://www.baeldung.com/spring-boot - Java: Spring Boot with IntelliJ [Jetbrains]: https://www.jetbrains.com/help/idea/spring-boot.html - Material (Slides, Videos, ausgewählte Artikel) via Moodle
Attendance	mandatory
Comments	

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

Master DEGREE PROGRAMS

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

Sustainable Mobility and Transport

Degree programme MMB

Semester 2

Course methods ILV

Language English

ECTS Credits 2.00

Incoming places Limited

Course description The course deals with topics related to the sustainability of mobility and implementation options for ecological transport, such as the minimization of fuel consumption or the use of alternative drive concepts (hydrogen, fuel cells, e-mobility)

Teaching methods

Learning outcome After passing this course successfully students are able to ...

Course contents

Prerequisites

Assessment Methods

Recommended Reading and Material

Attendance

Comments

Circular Economy

Degree programme MMB

Semester 2

Course methods ILV

Language English

ECTS Credits 3.00

Incoming places Limited

Course description Circular economy is not a niche strategy – it is an engineering response to resource scarcity and the overshooting of planetary boundaries. This course introduces the conceptual foundations of circular economy (10R framework, Doughnut Economics, planetary boundaries, design for circularity and circular business models) and develops students' capacity to analyse and reimagine products, material flows, and value creation systems from a systemic perspective. The focus is not on isolated technical solutions, but on systemic impact.

Teaching methods The course is structured as three blocked full-day sessions following a dialogic and interactive teaching approach. Lecture-style input is limited to focused segments; the majority of time is dedicated to collaborative group work, facilitated discussion, and a continuous group project. Between sessions, targeted preparation tasks (readings, videos, podcasts) are assigned and integrated into the subsequent session.

Learning outcome After passing this course successfully students are able to ...

- name and explain the key concepts and strategies of circular economy
- describe the difference between complicated and complex thinking and apply it to real-world problem settings
- analyse products and material flows from a systemic perspective and identify leverage points for circular economy improvements
- develop and present a reasoned circular economy proposal for a self-selected industrial object
- assess and critically reflect on the relevance of circular economy for their own engineering/professional practice

Course contents	- Thermodynamic foundations of circular economy (entropy, material losses, physical limits of recycling) - planetary boundaries and Doughnut Economics - the 10R framework and its hierarchy - systems thinking: complicated vs. complex, wicked problems, causal loop diagrams - circular economy strategies (Design for Disassembly, Product-as-a-Service, Industrial Symbiosis, Urban Mining) - analysis and redesign of an industrial product or company in a group project format
Prerequisites	Basic knowledge of thermodynamics, materials science, and manufacturing engineering at bachelor's level is assumed. No prior knowledge of circular economy or sustainability science is required.
Assessment Methods	- Group assignment (4–6 students): Development and presentation of a circular economy concept for a self-selected industrial product or material. Deliverables: one-page poster/handout (digital or A1 format) and a 15-minute final presentation with discussion (Day 3). Assessment criteria: systemic perspective, correct application of course concepts, creativity; reasoning quality of product selection; and quality of discussion.
Recommended Reading and Material	- Supplementary / Ergänzend: Podcasts: Sustainability Defined; Circular Economy Podcast (Ellen MacArthur Foundation) TED Talk: Kate Raworth – "A Healthy Economy Should Be Designed to Thrive, Not Grow" (2018, TED.com) Video: The Story of Stuff (2007, storyofstuff.org) - Meadows, D. (2008). Thinking in Systems: A Primer. Chelsea Green Publishing. - McDonough, W., & Braungart, M. (2002). Cradle to Cradle: Remaking the Way We Make Things. North Point Press. - Ellen MacArthur Foundation (2013). Towards the Circular Economy Vol. 1: An Economic and Business Rationale for an Accelerated Transition. Ellen MacArthur Foundation. [Open Access: ellenmacarthurfoundation.org] - Potting, J., Hekkert, M., Worrell, E., & Hanemaaijer, A. (2017). Circular Economy: Measuring Innovation in the Product Chain. PBL Netherlands Environmental Assessment Agency, The Hague. - Raworth, K. (2017). Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist. Chelsea Green Publishing.
Attendance	Attendance at all three blocked sessions is expected and is a prerequisite for assessment.

Comments

Computational Fluid Dynamics

Degree programme	MMB
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This course introduces the fundamental concepts of computational fluid dynamics (CFD) and provides hands-on training using ANSYS Fluent. After covering the theoretical basics, typical CFD workflows are presented. Through selected examples, students learn how to set up flow simulations, perform numerical analyses, and interpret the results correctly.
Teaching methods	Lecture on the theoretical fundamentals. Introduction to computational fluid dynamics software (ANSYS Fluent). Independent development of simple flow simulations, including written documentation of the results and oral presentation.
Learning outcome	After passing this course successfully students are able to ... - understand the fundamentals of numerical fluid dynamics - discretize the continua of a given fluid flow - conduct a numerical flow simulation with a commercial software - to analyze and interpret the results of a CFD calculation
Course contents	- equations of conservation - discretization methods - solving methods and algorithms - turbulence modeling - meshing - evaluation and visualization of results - boundary conditions - transient modeling - stability and convergence
Prerequisites	fundamentals in fluid dynamics, thermodynamics and numerical modeling
Assessment Methods	- MOODLE-Exam (25%)

- Final Report (55%) - in english
- Oral Presentation (20%) - in english

Recommended Reading and Material

- Ansys Fluent Theory Guide
- Ansys Fluent User's Guide
- Ansys Fluent Tutorial Guide

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

Information Systems Management (MWI)

System Integration

Degree programme MWI

Semester 2

Course methods	ILV
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, Azure Logic Apps and Service Bus serve as examples 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 Azure Logic Apps and Service Bus as messaging middleware.
Course contents	- Message based communication - Web services

- Enterprise application integration
- Message broker, content-based routing
- Business process modeling
- Transactions
- Environments

Prerequisites

- Assessment Methods**
- Practical exercises - 39%
 - Group project - 25%
 - Final Exam - 36%

- Recommended Reading and Material**
- Course book

Attendance

Comments

Renewable Energies (MEE)

Marketing and Supply

Degree programme MEE

Semester 2

Course methods ILV

Language English

ECTS Credits 5.00

Incoming places Limited

Course description In this sub-module students acquire basic skills in the areas of marketing and sales.

Teaching methods Flipped Classroom

Learning outcome After passing this course successfully students are able to ...

- define the terms “market” and “marketing”
- name the components of a marketing plan
- Differentiate between different types of marketing strategies
- differentiate between different market research methods
- prepare product policy decisions
- prepare price policy decisions
- prepare communication policy decisions
- prepare sales policy decisions

- weigh up between different alternatives regarding the organizational anchoring of marketing in the company
- calculate key figures for effectiveness and efficiency controls in marketing
- name various instruments of online marketing and to describe their mode of operation

Course contents

- Concept and characteristics of marketing
- Marketing planning
- Marketing strategies
- Market research
- Product policy
- Price policy
- Sales policy
- Marketing organization
- Marketing controlling
- Online marketing

Prerequisites

Fundamentals of business administration

Assessment Methods

- Written final exam: 70 points
- Development of a marketing concept (group work): 30 points

Recommended Reading and Material

- Bruhn, Marketing, Springer-Verlag
- Bruhn, Marketingübungen, Springer-Verlag

Attendance

See examinations regulations

Comments

Advanced Modelling and Simulation

Degree programme MEE

Semester 2

Course methods PRJ

Language English

ECTS Credits 5.00

Incoming places Limited

Course description

Modeling, simulation and optimization of specific energy systems: On the basis of project work, technical energy systems such as a PV or wind power system, a building energy system, a district energy network or an energy community are modeled, simulated and optimized. The focus is on the application of the theoretical principles

and methods imparted in MEE1-4 to examples from everyday energy technology. Students can choose from one of four energy technology projects: BIPV, Buildings, Plus Energy Quarter and Energy Community, program a model of the system in appropriate languages and tools such as Matlab, Python, TRNSYS, PowerFactory and use it to carry out simulations and optimizations. The focus is on the application of simulation technology and programming. The content-related consideration and analysis of the exemplary systems will be deepened in the further course of the curriculum.

Teaching methods	Project work with Q&A and presentation of the project progress in face-to-face and distance learning for the independent creation of the models, implementation of the simulation and documentation in the form of a project report
Learning outcome	After passing this course successfully students are able to ... - To model and simulate more complex energy systems - To produce, test and use the necessary code - Perform optimizations for an energy system - Combine several individual models to form a larger overall model - To assess and name the applicability, strengths and challenges of typical energy system models - Explain the code involved and find and fix bugs in it
Course contents	- Students choose a project of a typical energy system: - - Building energy systems (PV simulation, Building thermal model) - - Positive energy Districts (Integrated models, District energy networks) - - Energy community systems (PV, Emobility, Storage) - - Building Integrated PV systems (Electrotechnical Systems)
Prerequisites	MEE1-4 Introduction to Modelling and Simulation
Assessment Methods	- 30% intermediate presentation of the exercises (teamwork) halfway through the course - 70% final presentation of the exercise results at the end of the course (open book) with an integrated examination discussion on understanding and theory. The students present their executable model and answer questions about its function and structure. The focus of the performance assesment is on the handling of the model. Students should be able to explain how the modeling and simulation can be implemented
Recommended Reading and Material	- Nollau, R., 2009. Modellierung und Simulation technischer Systeme: Eine praxisnahe Einführung. Springer-Verlag, Berlin

Heidelberg. <https://doi.org/10.1007/978-3-540-89121-5>

- Crastan, V., 2004. Modellierung und Simulation, in: Crastan, V. (Ed.), Elektrische Energieversorgung 2: Energie- und Elektrizitätswirtschaft, Kraftwerktechnik, alternative Stromerzeugung, Dynamik, Regelung und Stabilität, Betriebsplanung und -führung. Springer, Berlin, Heidelberg, pp. 367–412.
https://doi.org/10.1007/978-3-662-06958-5_10

Attendance

Mix of classroom and distance learning (50-50)

Comments

Applied Topic-Specific Methods

Degree programme MEE

Semester 2

Course methods PRJ

Language English

ECTS Credits 5.00

Incoming places Limited

Course description

Based on the work done in the course 'Specialization Focus Definition and Scientific Methods', students work in small groups to work on energy concepts, e.g. for energy communities, plus-energy districts, or regional/local energy systems, also modeling this (i.e. in Matlab or Python) and carry out a simulation or optimization of selected scenarios in order to acquire topic specific methods for further use in their specialization field

Teaching methods

Independent project work with Q&A and presentation of the project progress in attendance and self-study for the independent development, modeling and simulation/optimization of energy concepts for energy systems; final documentation in the form of a project report, taking into account the formal (e.g. linguistic implementation,...) and content requirements (e.g. quality of own contribution,...)

Learning outcome

After passing this course successfully students are able to ...

- develop and model energy concepts in a sophisticated manner
- develop and simulate or optimize various scenarios
- understand and classify the results of the simulation or optimization and interpret them in a wider context

- write up the results of the project work, taking into account the formal (e.g. linguistic implementation,...) and content-related requirements (e.g. quality of their own contribution,...)
- carry out an interdisciplinary complex project in a group work
- apply project management in complex projects according to the situation

Course contents

- Development of scenarios
- Deepening the content of the selected topic area
- Carrying out a sensitivity analysis
- Definition of key performance indicators
- Modelling, simulation / optimisation of complex systems
- Analysis and interpretation of simulation and optimisation results
- Application of agile project management methods
- Scientific Writing and Presentation

Prerequisites

Introduction into Modeling and Simulation

Assessment Methods

- Interim Report (max 20 pts; min 6 pts)
- Presentation (max 30 pts; min 9 pts)
- Final Report (max 50 pts; min 15 pts)

Recommended Reading and Material

Attendance

Comments

The assessment of the three submissions are made as follows:1. Interim report (max. 20 points, min. 6 points)Assessment Criteria: A 10% allocation is to be assigned to the introduction and problem outline, including references and any presentation of specific project contexts. A 10% allocation is to be assigned to the project objectives and any research questions. A 25% allocation is to be assigned to the presentation of methodology. A 45% allocation is to be assigned to a meaningful presentation of initial results that can be assessed in terms of content and that show that the chosen methodology is appropriate and how it was implemented. 10% of the assessment will be allocated to the presentation of any open issues, together with expected additions and results, to be included in the final submission. A minimum of at least 6 points (30% of 20 points) are necessary, to consider the achieved points for the calculation of the final grade.2. Final presentation (max. 30 points, min. 9 points)Assessment criteria: 10% for Scope, quality and depth of the work 10% for Compliance with formal criteria/ Presentation structure 35% for Comprehensibility of the method and results 35% for Interpretation and presentation of the results, and conclusions 10%

for answered questions A minimum of atleast 9 points (30% of 30 points) are necessary, to consider the achieved points for the calculation of the final grade. 3. Final report (max. 50 points, min. 15 points) Assessment criteria: 15% for Scope, quality and depth of the work 15% for Compliance with formal criteria and scientific writing style 30% for Comprehensibility of the method and results 30% for Interpretation of the results and conclusions 10% for Incorporation of feedback on the interim report and final presentation A minimum of atleast 15 points (30% of 50 points) are necessary, to consider the achieved points for the calculation of the final grade.

Energy Economics

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

Course description	The course provides a clear understanding of the principles of energy economics. Function and Objectives of energy economics on the national, international and global level are discussed, in particular concerning to climate change and energy security. Focus is on the application of economic assessment methods, that will be explained in the course and applied.
Teaching methods	The content will be developed in the lectures and deepened as part of distance learning. The method for economic calculation is trained via group work in distance learning units and exercises and the results of the group work are presented at the end of the semester
Learning outcome	After passing this course successfully students are able to ... - describe and apply economic assessment methods and to compare different energy technologies from an economic perspective - interpret and analyze energy balances - describe and explain the processes on energy markets - name and explain energy policy instruments and analyze their effects - name and analyze the magnitude of energy consumption and volume in Austria, Europe and worldwide and describe the

challenges for energy policy

Course contents

- Foundations of energy economics
- Energy statistics
- Energy prices and energy markets
- Greenhousegas-Emissions and climate change policies
- Instruments of energy policy
- economic assessment methods, e.g. cost-benefit analysis for different energy technologies
- Balancing technically and economically
- Basics of the liberalized energy markets
- Organization of the Austrian energy markets
- Energy consumption and supply, institutional setting

Prerequisites

Assessment Methods - end exam

Recommended Reading and Material

- Georg Erdmann/Peter Zweifel: Energieökonomik - Theorie und Anwendungen
- Kaltschmitt: Regenerative Energien in Österreich

Attendance 75%

Comments

Assessment Methods

Degree programme MEE

Semester 2

Course methods PRJ

Language English

ECTS Credits 3.00

Incoming places Limited

Course description

This project-based course introduces students to a range of qualitative and quantitative assessment methods used to evaluate technologies, systems, and policy options in the context of sustainability and energy transitions. The course aims to strengthen students' ability to think systemically and to critically assess complex socio-technical systems. Students gain insight into different assessment methods, including technology assessment, systems thinking, quantitative and qualitative scenario development, cross-impact analysis, sustainability assessment, material flow analysis,

workshop and participatory method development, and economic evaluation techniques. Each method is first introduced theoretically, focusing on its purpose, scope, assumptions, and limitations. Throughout the semester, students work in small groups on a continuous case study that serves as a guiding thread through the course. This recurring case study enables students to directly apply the learned methods and reflect on their strengths and weaknesses in a real-world context. Emphasis is placed on linking technical, environmental, economic, and societal perspectives. By the end of the course, students synthesize their findings in the form of a concise policy brief, translating analytical results into clear, evidence-based recommendations for decision-makers. In addition, students complete an exam that assesses their understanding of the assessment methods, their appropriate application, and their relevance in renewable energy and sustainability-related decision-making.

Teaching methods

- Brief introductions to convey methodical approaches for technology assessment
- Exercises to deepen the basic knowledge
- Working in small groups to apply the methods using case studies

Learning outcome

After passing this course successfully students are able to ...

- Understand the concepts of qualitative and quantitative assessment methods
- Use systems thinking and scenario approaches to evaluate complex socio-technical challenges in energy and sustainability transitions.
- Apply and compare assessment methods to analyse renewable energy and sustainability-related systems, including their strengths and limitations.
- Discuss systemically and translate analytical findings into policy-relevant recommendations.

Course contents

- The course provides an introduction to qualitative and quantitative assessment methods for analysing renewable energy and sustainability-related systems. Students apply systems thinking, scenario development, sustainability and economic assessment methods to a continuous case study and communicate their results in the form of a policy brief.

Prerequisites

Participants are expected to have a basic understanding of ecology, biodiversity, and climate change. They should be able to critically reflect on the links between historical power structures, social inequality, and their implications in the context of climate change, as

well as demonstrate an awareness of the complex interdependencies between environmental and societal systems

Assessment Methods

- 40 % policy brief
- 10 % economic methods
- 50 % written exam

Recommended Reading and Material

Attendance 75 % Attendance required

Comments

Energy Planning

Degree programme MEE

Semester 2

Course methods ILV

Language English

ECTS Credits 2.00

Incoming places Limited

Course description

The course focuses on the targeted development of energy systems at national, regional, municipal, and neighbourhood levels through energy concepts. Students will gain insights into the hierarchical structure of energy planning (Nomenclature of Territorial Units for Statistics - NUTS), exploring how broader territorial strategies translate into localized applications. The course emphasizes the practical implementation of energy concepts at the municipal level, where students will critically analyse energy consumption patterns, renewable energy potential, and legal frameworks. Through input on the social, technical, and legal aspects of energy concepts, students will discuss and evaluate how these concepts can contribute to climate-neutral development. By the end of the course, students will have developed a comprehensive energy concept for a selected municipality, integrating both demand and supply perspectives.

Teaching methods

- Lecture units to provide the methodological and content-related foundations.
- Workshop to facilitate practical application and reflection.
- Group work to analyse energy systems and develop energy concepts collaboratively.
- Project reports and presentations to summarize and communicate findings in the plenum.

Learning outcome	After passing this course successfully students are able to ... - Define the relevant stakeholders and describe the relationships between actors, their targets, priorities and decision-making processes. - Identify the use of renewable energy technologies in different reference areas, describe the relevant legal frameworks, and explain energy consumption patterns across sectors, including potential measures for reduction. - Discuss, interpret, and illustrate the main components of energy concepts, including the two sides of an energy balance. - Propose actionable recommendations for improvement in a given context.
Course contents	- NUTS system; energy concepts - Renewable energy potentials; land-use requirements - Measures for demand reduction; energy-saving potentials - Legal frameworks; energy and spatial planning - Stakeholder analysis; development of actionable recommendations
Prerequisites	•Understanding of scientific work and methods (Specialization Focus Definition and Scientific Methods MEE-1) •Fundamentals of energy systems and renewable technologies (Introduction to Modelling and Simulation MEE-1)
Assessment Methods	- 45 % Presentation - 45 % Final Report - 10 % Workshop Reflection
Recommended Reading and Material	- Republic of Austria. 2020/2022. Austria's Long-term Strategy 2050 (LTS 2050) - Austria's Integrated National Energy and Climate Plan (NECP) for 2021-2030
Attendance	75 %
Comments	

Digital Systems in Energy Industry

Degree programme	MEE
Semester	2
Course methods	ILV
Language	English
ECTS Credits	5.00

Incoming places Limited

Course description The course "Digital Systems in the Energy Industry" deals with the increasing digitization in the energy industry and offers an overview of relevant digital technologies in this context. The subjects covered are data acquisition and processing, data management and analysis, forecasts, digital processes and business models, automation, self-learning systems, Internet of Energy, digital twins and data protection.

Teaching methods

Learning outcome After passing this course successfully students are able to ...

- demonstrate proficiency in data acquisition and processing techniques
- apply data management and analysis methods to extract meaningful insights from datasets
- develop accurate forecasts based on data analysis and predictive modeling
- understand and implement digital processes and business models in various industries
- implement automation techniques to streamline processes and increase efficiency
- design and implement self-learning systems for continuous improvement and adaptation
- analyze and utilize the Internet of Energy concepts for efficient energy management.
- utilize Digital Twins for virtual representation and analysis of physical assets or systems
- implement data protection measures to ensure the security and privacy of sensitive information

Course contents

- data acquisition and processing
- data management and analysis
- forecasts
- digital processes and business models
- automation
- self-learning systems
- Internet of Energy
- digital twins
- data protection

Prerequisites

Assessment Methods

**Recommended Reading
and Material**

Attendance

Comments

Tissue Engineering and Regenerative Medicine (MTE)

Bioreactors and Biophysical Pathways

Degree programme MTE

Semester 2

Course methods ILV

Language English

ECTS Credits 2.00

Incoming places Limited

Course description The students obtain knowledge about bioreactors in tissue engineering and biophysical therapies in the field of regenerative medicine applications. Furthermore basic concepts regarding design and triggered cellular and tissue effects will be discussed.

Teaching methods VO - Basics and Theory
SE - Discussion of Examples and Modells for Bioreactors
SE - Discussion of Design Concepts and Outcomes

Learning outcome After passing this course successfully students are able to ...

- define the term „Bioreactorsystems in Tissue Engineering“ and differentiate them from bioreactors in biotechnology
- define the common bioreactor types and explain their working principle.
- explain the main idea of the “in vivo bioreactor” concept with examples from the course.
- define the two main rationales to use bioreactors in tissue engineering.
- evaluate advantages and disadvantages of different bioreactor systems in regard to their application for a specific tissue type.
- develop a basic bioreactor system for a certain organ/tissue and simulate elementary processes inside the bioreactor.
- explain common types of sensors for bioreactor systems and apply these sensors on a specific bioreactor application.
- to give an overview of biophysical therapies

- to describe working principles of biophysical therapies
- to explain the choice of laser- as well as light therapies for trauma-related diseases

Course contents

- Mechanics of Bioreactors
- Electronical Control Design of Bioreactors
- Connecting Points to Bioreactors used in Biotechnology
- Feedback Control Basics
- Literature Discussion of Common Bioreactor Types (including critical discussion)
- Discussion of Commercially Available Bioreactor Systems
- Interdisciplinary Approach on the Design of Bioreactors for Tissue Engineering
- Key Parameters involved in Bioreactor Design
- Scaffolds and Constructs for Bioreactor Systems (including adapted Fabrication Techniques)
- Control and Feedback Control in Mechatronics for Mechanical Stimulation
- Basics of Mechanotransduction - Signalling Pathways
- Biosensors and Actuators for Bioreactors
- "Functional Tissue Engineering"
- "in-vivo" Bioreactors - idea and current approaches
- "Lessons learned from research projects of the FHTW"

Prerequisites

Cell Biology; Basic knowledge on Mechanics, Electronics, Biomaterials and Cell Culture

Assessment Methods

- Course immanent assessment method and end exam

Recommended Reading and Material

- Gordana Vunjak-Novakovic, R. Ian Freshney (2006): Culture of Cells for Tissue Engineering, Wiley
- Ulrich Meyer, Thomas Meyer, Jörg Handschel, Hans Peter Wiesmann (2009): Fundamentals of Tissue Engineering and Regenerative Medicine, Springer
- C. Kasper, M. Van Griensven, R. Pörtner (2008): Bioreactor Systems for Tissue Engineering, Springer
- Relevant publications will be provided via moodle course

Attendance

Attendance is mandatory in this course, only 20% of absence is tolerated. In case you miss more than 20% you lose the first try in the exam.

Comments

Biotechnology & Extracellular Vesicles

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

Course description Biotechnology underpins a vast array of applications, ranging from biopharmaceuticals and industrial enzymes to research tools and agricultural innovations, and is a cornerstone in the development of therapeutics such as monoclonal antibodies, vaccines, and other biomolecules. The design and optimization of recombinant protein production are discussed in this lecture series, and basics and theory of biotechnology are presented within interactive lectures, including practical examples for its application. Extracellular Vesicles gained extreme scientific attraction in the last years. They are thought to be relevant for inter-cellular communication, thus being a reasonable way of improving targeted therapies, but also as biomarkers for pathologies. In the course of this lecture series, the biology of EVs, purification and characterization, and possible therapeutical applications of EVs will be discussed.

Teaching methods frontal lecture, Case studies are discussed in seminars.

Learning outcome After passing this course successfully students are able to ...

- design bioprocesses for the production of recombinant proteins from gene to purified product applying microbial and/or mammalian systems
- choose the appropriate expression systems and plasmids for recombinant production
- define strategies for product development and expression systems
- characterize a concept and principle of bioprocess design (up- and downstream processing)
- design and characterize various bioreactor types
- apply high-level data exploration and interpretation
- combine of gained knowledge with scientific state of the art
- characterize, interpret, and apply function and interactivity of complex systems
- understand the biology of EV-genesis, and purification and characterization techniques of EVs
- explain possible therapeutical applications of EVs

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 disintegration, B) Protein Purification (Chromatography) - Continuous manufacturing: (1) USP, DSP and analytics - Multivariate data analysis: (1) Design of Experiments (DoE) - Biology of EVs - Therapeutical applications of EVs - Characterization techniques of EVs
Prerequisites	Molecular and Cellular Biology in Regenerative Medicine, Proteinchemistry
Assessment Methods	- final 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	Attendance is mandatory in this course, only 25% of absence is tolerated. In case you miss more than 25% you lose the first try in the exam.
Comments	

Gene Regulation and Signal Transduction

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

Course description	The course Gene Regulation and Signal Transduction (GRST) covers central aspects of signal transduction in the context of tissue engineering and regenerative medicine. The lectures present basics and applied examples from various signaling pathways (RAF-MEK-ERK, mTOR/AKT, PI3K, Wnt/beta-catenin, BMPs, Smads), DNA Damage und apoptotic signaling cascades, and other aspects of cellular signaling relevant in tissue engineering applications. The role of epigenetics, mechanotransduction, and the nuclear architecture will be discussed in context of regenerative processes.
Teaching methods	frontal lectures
Learning outcome	After passing this course successfully students are able to ... - describe components and regulation of important signaling pathways (e.g. Raf-MEK-ERK, PI3K-AKT-mTOR; BMPs, Smads) and mechanisms of mechanotransduction - explain epigenetic mechanisms in regenerative processes - explain DNA damage signaling pathways and regulation of apoptosis in TE applications - interpret the results of typical experiments in the field of signal transduction (Western blots, IPs...) - explain the importance of signal transduction in tissue engineering
Course contents	- signaling pathways (RAF-MEK-ERK, mTOR/AKT, Wnt/beta-catenin) - apoptosis - DNA damage signaling - machanotransduction - aspects of cellular signaling in Tissue Engineering
Prerequisites	Molecular and Cellular Biology in Regenerative Medicine (MBRM)
Assessment Methods	- written final exam
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	

Healthcare and Rehabilitation Technology (MGR)

Wahlfach - Introduction to MATLAB for Applications in Life Sciences II

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

Wahlfach - Data Analysis

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

Sports Technology (MST)

Novel Data Analysis Approaches in Sports Technology

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

Course description	In this course the learned contents from the lecture "Applied Computer Science in Sports Technology" and "Applied Measurement Technology in Sports Technology" are combined to solve own problems. Through the applied measuring technique, the students are able to record sensor data independently and process it further within the scope of this course. Further inputs for the application of ML techniques in other tasks will be developed.
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Teaching methods

Learning outcome	After passing this course successfully students are able to ...
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- to prepare sensor data for ML algorithms.
- to create models in different programming environments.
- to evaluate models with different methods.

Course contents

Prerequisites	Applied Computer Science in Sports Technology, Applied Measurement Technology in Sports Technology
Assessment Methods	- Course-immanent and infographic
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	

Monitoring and Feedback

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

Course description	In this course, students are prepared not only to collect but also to visualize recorded live data. Due to the requirements of athlete monitoring, transmission time plays a crucial role in analyzing and adjusting sports techniques. Therefore, students learn to use MQTT to realize IoT concepts to transmit data over the internet with minimal delay—either for later analysis or for direct visualization, enabling real-time feedback from the coach.
Teaching methods	The course follows a blended teaching approach, combining lectures on theoretical foundations with hands-on exercises and structured self-study phases that support deeper understanding. Students apply the acquired knowledge in a group project, encouraging collaborative learning as well as the development of problem-solving and analytical skills.

Learning outcome	After passing this course successfully students are able to ... - Students can explain the basic applications of live data in sports and independently analyze and practically implement at least one simple use case. - Students can explain the basic functions of the MQTT protocol and implement their own functional variant using Python and a publicly available broker. - Students can explain selected Networking concepts for transmitting and receiving live data and apply them in their own implementation. - Students can deploy a MicroPython Publisher implementation on an Arduino Nano RP2040 and a matching Subscriber implementation in Python in an IoT setting to collect, store, and transmit data. - Students can analyze live measurement data and create appropriate visualizations to provide live feedback for athletes. - Students can explain the difference between live and batch data processing and practically implement at least one simple use case.
Course contents	- Fundamentals of the data lifecycle and networking concepts. - Monitoring using MQTT, including its applications and role in IoT systems, as well as an introduction to relevant actors and communication protocols. - Publishing data with MQTT, covering relevant concepts, development platforms, and supporting software libraries. - MicroPython-based development on the Arduino Nano RP2040 for IoT monitoring applications. - Publishing and subscribing to data using MQTT with Python. - Subscribing to data with MQTT, covering relevant concepts. - Batch and continuous data processing in Python, including relevant analysis and visualization libraries. - Techniques for preserving live data streams for later batch analysis. - Live data visualization and animated plotting in Python. - Data-driven reactions and feedback mechanisms in IoT applications for professional sports.
Prerequisites	Basic Python, Database & SQL basics
Assessment Methods	- Final Exam: Moodle-based exam covering all lecture topics using various question formats, without coding tasks. - Group Project: Group assessment of the software with individual evaluation via interviews during the live demonstration day.
Recommended Reading and Material	- Sarcar, Vaskaran. Python Bootcamp : A Rapid Crash Course Featuring Q&A Sessions, Exercises, and Projects. 1st ed. 2025., 2025.

Attendance Attendance is mandatory on the written exam day and on one of the two live demonstration days. For all other sessions, attendance is strongly advised but not mandatory.

Comments

Monitoring and Feedback - Exercise

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

Course description This course focuses on the practical application of monitoring and feedback systems in exercise and sports contexts. Students explore the critical role of immediate and meaningful feedback for the acquisition, adaptation, and optimization of movement techniques. Emphasis is placed on data visualization and real-time feedback following data collection. Students will transfer their theoretical knowledge into practice by designing and implementing monitoring and feedback solutions using microcontrollers (Arduino IoT platforms) and various sensors (e.g., inertial, force, or physiological sensors). These systems will be capable of acquiring, processing, and visualizing data in real time, as well as transmitting data to a server for later analysis and trainer assessment.

Teaching methods Through hands-on exercises and project-based learning, students gain experience in sensor integration, data acquisition, real-time feedback generation, and basic system evaluation. By the end of the course, students will be able to develop functional monitoring and feedback systems and critically assess their effectiveness in supporting motor learning and exercise performance.

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

- - Exercise-Based Data Acquisition
- - Real-Time Feedback During Exercise Execution
- - Processing and Synchronization of Exercise Data
- - Visualization of Exercise Performance Data
- - Evaluation and Optimization of Feedback Strategies in Exercise

Prerequisites

The course builds upon knowledge from Applied Computer Science in Sports Technology and Applied Measurement Technology in Sports Technology

Assessment Methods

- Assessment is based on a student project focusing on the development of an exercise-related monitoring and feedback system. Students present their project, demonstrating the practical implementation, functionality, and applicability of their solution during exercise tasks. Evaluation considers the quality of data acquisition, feedback design, visualization, and the ability to critically reflect on the effectiveness of the system in an exercise context.

Recommended Reading and Material

Attendance Attendance is mandatory

Comments

Instrumented Material Testing and Testing Systems

Degree programme MST

Semester 2

Course methods ILV

Language English

ECTS Credits 2.00

Incoming places Limited

Course description

The module “Testing” focuses on testing of sports equipment both indoors and outdoors. The content of the two courses, “Instrumented Material Testing and Testing Systems” (IMT) and “Instrumented Material Testing - Exercise” (IMEX), is aligned. IMT primarily lays the theoretical foundations for implementing the practical tasks in IMEX.

Teaching methods

Classroom sessions take place in the laboratory or computer room

so that theory can be demonstrated and discussed on practical applications.

Learning outcome

After passing this course successfully students are able to ...

- discuss the advantages and disadvantages of different testing methods for sports equipment.
- carry out tests with selected sports equipment using test benches and process and analyse the measured data.
- to develop a mobile measurement setup using LabVIEW and use it to collect measurement data from analog sensors.
- discuss the results of a test of a sports equipment on the test bench in relation to its use.
- to name the most important parameters that must be taken into account when constructing a test bench.

Course contents

- Testing sports equipment on the test bench
- Data analysis and interpretation (using matlab)
- Programming with LabVIEW
- Design of a test bench for testing of sports equipment

Prerequisites

Applied Computer Science in Sports Technology
Applied Computer Science in Sports Technology - Exercise
Applied Measurement Technology in Sports Technology

Assessment Methods

Recommended Reading and Material

Attendance

Comments

Please note that the module "Testing" is an integrative module. This means that you must attend both courses (IMT und IMEX), the assessment covers the content of both courses, and you will receive the same grade for both courses (representing the grade of the module).

FEM in Sports Technology

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

Course description	In this course, students are introduced to the fundamentals of the Finite Element Method (FEM) in structural mechanics and injection molding (flow simulation). Using the software tools ANSYS Workbench and Autodesk Moldflow, students learn how to model, analyze, and interpret simulation results. Through hands-on exercises and case studies, they gain practical insights into the application of numerical methods in product development and sports technology.
Teaching methods	Lectures combined with guided and independent computer-based exercises.
Learning outcome	After passing this course successfully students are able to ... - apply the FEM software tools ANSYS Workbench and Autodesk Moldflow for simulation tasks in structural mechanics and injection molding. - evaluate where FEM methods can be meaningfully applied in product and process development. - independently perform FEM-based analyses to support product design and optimization in sports technology.
Course contents	- Fundamentals of the Finite Element Method (FEM) - Introduction to ANSYS Workbench and Autodesk Moldflow - Practical simulation exercises in structural mechanics and injection molding - Evaluation and interpretation of simulation results
Prerequisites	Basic knowledge of mechanics and fundamentals of injection molding processes.
Assessment Methods	- Project work - Active participation
Recommended Reading and Material	- H. Lee, Finite Element Simulation with Ansys Workbench 2023, SDC Publication 2023 - S. Tickoo, ANSYS Workbench 2019 R2: A Tutorial Approach, CAD/CIM Technologies 2019 - C. Gebhardt, Praxisbuch FEM mit ANSYS Workbench, Hanser 2018
Attendance	Attendance is mandatory.
Comments	

Instrumented Material Testing - Exercise

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

Course description The module “Testing” focuses on testing of sports equipment both indoors and outdoors. The content of the two courses, “Instrumented Material Testing and Testing Systems” (IMT) and “Instrumented Material Testing - Exercise” (IMEX), is aligned. IMT primarily lays the theoretical foundations for implementing the practical tasks in IMEX.

Teaching methods - Working on the test benches in the laboratory.- Evaluating the measurement data in the computer room and in the self-study.- Testing the mobile measurement setup outside the laboratory.- Designing the test bench in the laboratory.

Learning outcome After passing this course successfully students are able to ...

- discuss the advantages and disadvantages of different testing methods for sports equipment.
- carry out tests with selected sports equipment using test benches and process and analyse the measured data.
- to develop a mobile measurement setup using LabVIEW and use it to collect measurement data from analog sensors.
- discuss the results of a test of a sports equipment on the test bench in relation to its use.
- to name the most important parameters that must be taken into account when constructing a test bench.

Course contents

- Testing sports equipment on the test bench
- Data analysis and interpretation (using matlab)
- Programming with LabVIEW
- Design of a test bench for testing of sports equipment

Prerequisites Applied Computer Science in Sports TechnologyApplied Computer Science in Sports Technology - ExerciseApplied Measurement Technology in Sports Technology

Assessment Methods

Recommended Reading and Material

Attendance

Comments

Please note that the module "Testing" is an integrative module. This means that you must attend both courses (IMT und IMEX), the assessment covers the content of both courses, and you will receive the same grade for both courses (representing the grade of the module).

FEM in Sports Technology - Exercise

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

Course description

In this exercise, students work in small groups on practical product development projects. The main focus areas include requirements specification, 3D CAD design, FEM simulations in structural mechanics and injection molding, as well as cost estimation. The objective is to guide students through the entire product development process — from the initial idea to the creation of a virtual prototype. Each group presents its project results and submits a comprehensive written report documenting the development process and simulation outcomes.

Teaching methods

Collaborative and independent project-based work under supervision.

Learning outcome

After passing this course successfully students are able to ...

- apply ANSYS Workbench and Autodesk Moldflow for FEM-based simulations in structural and manufacturing processes.
- identify and assess suitable applications of FEM methods in product development.
- independently plan, execute, and document a complete product development process, including concept design, simulation, and evaluation.

Course contents

- Group project on virtual product development
- Creation of a requirements specification (Lastenheft)
- 3D CAD part design

	- FEM simulation of structural mechanics and injection molding processes - Cost calculation - Presentation of results
Prerequisites	• Basic knowledge of ANSYS Workbench and Autodesk Moldflow • Knowledge of plastic-compatible part design • Basic understanding of mechanics and injection molding processes
Assessment Methods	- Project work (Report and Presentation) - Active participation
Recommended Reading and Material	- H. Lee, Finite Element Simulation with Ansys Workbench 2023, SDC Publication 2023 - 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	

Design

Degree programme	MST
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	In this course, students are introduced to the topic of industrial design/product design and given an overview of the working methods and tasks of a designer using examples (from various fields). The topic is explored in greater depth during the semester through a project in which the entire design process is carried out. Focus is on the use of the rendering software “Keyshot” for visualizing CAD data.
Teaching methods	Working with the visualization software “Keyshot” and project work.
Learning outcome	After passing this course successfully students are able to ... - explain the workflow, tasks and tools a designer uses. - explain the process of a complete designproject.

	- to visualize/render CAD files using ,Keyshot‘ as a Rendersoftware
Course contents	- Rendersoftware "Keyshot" - Design processes
Prerequisites	Content of the course "Computer Aided Design" (1st semester)
Assessment Methods	- Unless otherwise stated in the Moodle course: interim assignments and final presentation
Recommended Reading and Material	
Attendance	Unless otherwise stated in the Moodle course, attendance is compulsory.
Comments	

Material for Sports Equipment

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

Course description	Special clothing has developed in leaps and bounds in recent years. Modern, perfectly coordinated equipment has greatly altered the framework of what is humanly possible. In addition to novel materials, it is above all the material mix, the macro-, micro- and also nanostructure, which are responsible for the sometimes extreme properties. This lecture is intended as an introduction to the complex world of modern materials for sportswear. This course conveys a basic understanding of state-of-the-art running shoes, their different constructions, their creation process (development), their purpose (function) and the link to the human body. (Running biomechanics)
Teaching methods	Interactive lecture. Cooperation is constantly encouraged! Literature examples from current scientific publications Dialogues, discussions and question led interaction.
Learning outcome	After passing this course successfully students are able to ... - detect different fiber types - explain complex material architectures

- explain the basics in running biomechanics
- identify and name parts & pieces of a running shoe
- explain how to create a high performance marathon shoe

Course contents

- natural fibers - origin, processing, properties
- synthetic fibres
- complex material compositions
- Understand and think further about innovative developments

Prerequisites

noneLecture section Mr Schuster: Please bring your current running shoe to the first session. Review the shoe before hand and think about what worked well and what didn't.

Assessment Methods

- written examination

Recommended Reading and Material

- slides will be shared

Attendance

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, the students have the opportunity to apply and deepen the contents of the previous LV "Applied Measurement Technology in Sports Technology". By working out a measuring chain with different components from different manufacturers, many tasks can be independently worked on in the future.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- to discuss the advantages and disadvantages of different platforms (e.g. microcontroller (Arduino), single board computer (Raspberry Pi), measurement applications (LabVIEW)) with regard to their possible use for mobile data acquisition in the field of sports technology.

	- use a mobile data acquisition platform suitable for a measurement task in the field of sports technology. - record data from multiple sensors during field measurements.
Course contents	- Presentation of various current platforms, such as Arduino, Raspberry Pi and LabVIEW, which are suitable for mobile data acquisition in the field of Sports Technology - Discussion of the requirements for a platform for mobile data acquisition in the area of Sports Technology. - Exercises for creating the individual components of a measurement chain. - Based on the contents of the LV Angewandte Messtechnik in Sports Technology (1st semester), the measurement chain will be extended by a suitable platform for mobile data acquisition and measurements will be performed on sports equipment and/or participant.
Prerequisites	Content of the course "Angewandte Messtechnik in Sports Technology" Content of the course "Angewandte Informatik in Sports Technology"
Assessment Methods	- Course immanent - Final exam
Recommended Reading and Material	- Current scripts and manuals for the platforms used
Attendance	Attendance is mandatory.
Comments	

Sports Practice Measurement Week - Summer

Degree programme	MST
Semester	2
Course methods	PRJ
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	In this course, technologies and knowledge from the first and current (second) semesters are combined and applied to work on a task from the field of summer sports in small groups. At the beginning of

the semester, students come together in groups and can select from a list of predefined tasks. Alternatively, they can propose a task of their own (possibly associated with their master's thesis topic). Each task (whether predefined or self-selected) must be related to summer sports and field measurements. Students then have time in the laboratory (and around the UAS Technikum Wien) to develop and test their methods before the sports practice measurement week at the end of the semester. During this week, the final measurements must be carried out regardless of the weather.

Teaching methods

- Independent work on a task related to summer sports.- Regular meetings with the supervisor.- 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 the course of small projects on metrologically supported field studies in summer.
- understand, solve and process measurement tasks for the collection of representative data sets of metrologically supported field studies in summer.
- to evaluate, interpret, analogously represent 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 the suitable sensor technology
- Planning and installation of the measuring chains
- Testing of the selected methods (sensors, measuring chains) in the laboratory
- Application of the corresponding measurement technology in the field
- Discussion of the achieved measurement results under consideration of the influences and problems of a field study in summer

Prerequisites

Content of all courses of the first semester.

Assessment Methods

- Unless otherwise stated in the Moodle course: reports, presentations, individual and group performance.

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

Unless otherwise stated in the Moodle course: Attendance is

compulsory at the presentations, meetings, during the whole sports practice measurement week and the exam.

Comments

Sports Technology Project 2

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

Course description In the first semester, a project manual was created in the course “Sports Technology Project 1”. This semester, the methods for the project are being developed so that first test measurements can be carried out at the end of this semester. The final measurements will be carried out in the third semester in the course “Sports Technology Project 3”.

Teaching methods - Practical work- Regular meetings with the supervisor

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 - Applying the 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 all courses of the first semester.

Assessment Methods - Unless otherwise stated in the Moodle course: reports, presentations, individual and group performance.

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	Unless otherwise stated in the Moodle course: Attendance is compulsory at the presentations, meetings and the exam.
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
Course description	This course introduces students to the interplay between agile project management and user experience design, as well as their efficient and effective integration—known as “Lean UX.” Students will apply the knowledge they gain through hands-on workshops and a project.
Teaching methods	Self-study, workshops, discussions, group work, practical examples, online tutorials, project work
Learning outcome	After passing this course successfully students are able to: - Apply agile product development methods in practice (including Design Thinking and Scrum) - Build and Coordinate Agile Product Teams - Explain the key characteristics of user experience design and to apply the most important methods in practice (including prototyping and discount usability evaluation) - Plan products from an agile perspective (effort estimation, JITRS)
Course contents	Agile Project Management (Scrum, Kanban, etc.) Principles of Flow Minimum Viable Product

User Experience
Prototyping
Usability Testing
Discount Usability

Prerequisites	No
Assessment Methods	In-class performance (20%) + independent study / project work (80%)
Recommended Reading and Material	Gothelf, Lean UX: Applying Lean Principles to Improve User Experience Anderson/Carmichael, Essential Kanban Condensed Schwaber/Sutherland, The Scrum Guide
Attendance	Attendance is required for on-site course sessions (hands-on workshops)
Comments	

Data Analytics

Degree programme	MTM
Semester	2
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	An introduction to the methods, tools, and process models of computer-aided data analysis, based on selected chapters. The course provides an overview of the topic and introduces approaches for deepening individual knowledge as needed.
Teaching methods	Specialized lectures on key topics (25%), self-study and discussion of topic-specific questions (50%), hands-on exercises using Python or Jupyter (25%), and online quizzes to monitor learning progress.
Learning outcome	After passing this course successfully students are able to: • Use Python, Jupyter, and scientific software libraries for data analysis

- Manage, process, statistically analyze, and clearly visualize data
- Apply fundamental data analysis methods to selected problems
- Independently explore and apply advanced topics in data analysis

Course contents

- Introduction to Python, Tools, Software Libraries, and Visualization
- Process Models, Case Studies, and Additional Information
- Regression
- Classification
- Decision Trees
- Time series

Prerequisites

Programming skills and linear algebra are helpful

Assessment Methods

- Collaboration (15%)
- Online tests (55%)
- Group work (30%)

Recommended Reading and Material

- Data Science from Scratch, Second Edition, by Joel Grus (O'Reilly), 2019, ISBN 978-1-492-04113-9
- Code samples: <https://github.com/joelgrus/data-science-from-scratch>
- The Complete Hands-On Machine Learning Crash Course, Marco Peixeiro, Towards Data Science (2019)
- Storytelling with data, Cole Nussbaumer Knaflic (John Wiley & Sons), 2016, ISBN 978-1-19002260

Attendance

Attendance is mandatory

Comments

Additional information and teaching materials will be made available through the accompanying Moodle course in English.

Change Management

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

Course description	In this module, students acquire in-depth knowledge and practical skills in the field of change management. The focus is on the professional design and support of change processes in organizational contexts. The course is based on experiential learning and integrates systemic and solution-focused approaches as well as approaches that focus on perception, attention, and meaning attribution in change processes. Theoretical impulses from organizational sociology and organizational psychology are combined with practical case studies and reflection formats. A particular focus is placed on the social impact of companies, especially in relation to corporate purpose, organizational cultures, health in the workplace, and issues of responsibility and equal opportunities. The aim is to enable students to understand change processes analytically, reflect on them critically, and help shape them professionally.
Teaching methods	Lectures, experience-based exercises, reflection formats, structured exchange of experiences, discussions, case studies, and guided self-study.
Learning outcome	After passing this course successfully students are able to ... - •distinguish different types of organisational change and analyse their dynamics - •identify internal and external influencing and inhibiting factors of change processes - •identify and critically assess key success factors of change processes - •plan change initiatives in a structured manner and derive key steps and measures - •understand resistance in change processes and use it as a potential resource - •apply solution-focused approaches in change processes and reflect on their limitations - •situate organisational change within the context of the societal effects of organisations
Course contents	- •Types of organisational change - •Dynamics and phases of change processes - •Structure and planning of change projects - •Success factors and barriers in change processes - •Resistance in organisations and constructive ways of dealing with it - •Solution-focused approaches in change management - •Organisational culture, corporate purpose, and societal effects of

organisations

- •Systemic perspectives on organisational change

Prerequisites

Basics of business studies

Assessment Methods

- •continuous, semester-based assessment
- •attendance and active participation
- •group-based performance (e.g. case work and presentation)
- •individual performance during the semester
- •NO written final exam

Recommended Reading and Material

Attendance

Regular attendance and active participation are required, as the course is primarily interactive and experience-based.

Comments

Further information, selected scientific texts, and accompanying teaching materials are provided in the corresponding Moodle course.

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 internationalization 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	

Medical Engineering & eHealth (MME)

Biomechanics for Medicine

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

Course description	In this course, students experience the broad spectrum of biomechanics, ranging from fundamental biomechanical principles of human movement to the application of these principles in motion analysis and multibody simulation. The first block Biomechanics of Human Tissue, focuses on the understanding of physiological and biomechanical principles underlying skeletal muscle force production. Furthermore, students learn to differentiate between human tissue such as bone, cartilage, muscle, tendons and ligaments, based on their mechanical properties. In Biomechanical Calculations, the second block, students learn to mathematically solve biomechanical problems of both statics and dynamics such as calculating the joint forces during a lifting task. Block three and four of this course are dedicated to the practical application of the above-mentioned fundamentals. In Motion Analysis in Biomechanics (block three), students will learn to gather and analyze biomechanical data using electromyography, force plates and inertial measurement units. This data will be also used in the fourth block to simulate loading scenarios of the musculoskeletal system using Biomechanical Multibody Simulation.
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Teaching methods

Learning outcome	After passing this course successfully students are able to ... - describe the physiological and biomechanical principles underlying skeletal muscle force production - interpret and compare stress-strain diagrams of various materials
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- describe the mechanical properties of human tissue such as bone, cartilage, muscle, tendons and ligaments
- mathematically solve biomechanical problems of statics and dynamics
- collect and analyze biomechanical data using state-of-the-art motion analysis systems
- use a biomechanical multibody simulation software to perform simulations as well as display and interpret their results
- control the kinematics of a model in a biomechanical multibody simulation using previously recorded IMU data, displaying and determining body angles and muscle forces

Course contents

- Biomechanics of skeletal muscle force production (Rate coding and population coding, muscle fiber composition, force-length and force-velocity relationship, muscle architecture and moment arm)
- Fundamental principles of stress, strain, elasticity and plasticity
- Mechanical properties of bone, cartilage, muscle, tendons and ligaments
- Basic mechanical concepts and calculations
- Calculations of joint loads during static positions using mechanical concepts and calculations
- Basics of calculating joint loads during movements using inverse dynamics
- Collection and analysis of biomechanical data using electromyography, force plates, 2D video and IMUs
- Biomechanical Multibody simulation with the software Opensim
- Analysis of muscle loads during motion
- IMU data driven kinematics and kinetics of biomechanical multibody models

Prerequisites

Assessment Methods

- Moodle quiz on Biomechanics of Human Tissue (40%)
- Written exam on Biomechanical Calculations (40%)
- Mini project/Moodle quiz on Biomechanical Multibody Simulation (20%)

Recommended Reading and Material

Attendance

During the block Motion Analysis in Biomechanics, there is a 100% mandatory attendance.

Comments

Study Design and Biostatistics

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	The course covers mathematical methods in non-parametric statistics, focusing on their application in experiment and study design. It includes the processes of data collection, organization, summarization, presentation, and analysis, followed by interpretation and drawing conclusions from the 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 scientific 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	- Hands-on Assignments and Moodle-quizzes
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

EU Law and Regulations

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	The course provides an overview of the structure and institutions of the European Union, with a focus on the European Court of Justice (ECJ) and case-solving methods. Additionally, it covers the Medical Device Regulation (MDR), addressing its application in development and use of medical devices.
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Teaching methods	The lecture includes the presentation and plenty of opportunity for discussion.
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Learning outcome	After passing this course successfully students are able to ... - solve EU law cases on their own so that they know how to address legal issues in their jobs - describe and structure processes to address regulatory issues of medical devices, regarding especially the "Medical Device Regulation"
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Course contents	- EU law: institutions, types of lawsuits, legal bases, structure of laws - Medical Device Regulation and Harmonised Standards (ISO 13485, ISO 14971, EN 60601-x, IEC 80001-1, ...) - Classification, methods for evaluation of conformity)
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Prerequisites	- Grundkonzepte der Geräte- oder Softwareentwicklung
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Assessment Methods	- Final exam EU Law - Final exam Medical Device Regulatory Issues
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Recommended Reading and Material	- Script for EU law provided in the course - Directorate-General for Health and Food Safety of the EU: Public Health / Medical Devices Sector. Webpage, accessed 21.1.2026, https://health.ec.europa.eu/medical-devices-sector_en
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Attendance Attendance is mandatory, as solutions to specific cases and examples will be discussed interactively.

Comments

Self Management

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description This course focuses on personal development within the context of the healthcare ecosystem. Students will explore their current standing, future goals, and leadership roles within this environment. It includes reflections on learning from professional experiences and framing the Master's thesis as an opportunity for personal growth. The Life Design methodology is used to understand the individual starting points and challenges, develop goals for personal growth, overcome obstacles and implement prototypes in everyday life.

Teaching methods The main methodology is the Life Design Loop with the eight steps: Empathy-Focus-Inspiration-Overcoming-Prototyping-Feedback-Learn-Continuity. Every step involves simple methods to get from thinking to doing. The students apply the Life Design methodology to their career prospects, development goals and professional challenges. For this, self reflection and individual implementation of the methods learned are main elements.

Learning outcome After passing this course successfully students are able to ...

- Guide and manage themselves by using the Life Design methods
- Utilise the Life Design framework as a reflective and strategic tool to identify a relevant and meaningful direction for the master's thesis.
- Systematically analyse personal and academic challenges, generate low-risk solution pathways, and implement adaptive strategies.
- Engage with peer networks to facilitate mutual support and collaborative problem-solving.
- Create more sense of purpose and meaningfulness for themselves and others in personal, academic and professional contexts.

Course contents	- Life Design Loop with 8 steps: Empathy-Focus-Inspiration-Overcoming-Prototyping-Feedback-Learn-Continuity - Development of personal goals for both professional career and personal development - Development and implementation of prototypes for behavioural changes - Reflection of professional experiences - Identifying an inspiring and realistic topic for the Master's Thesis
Prerequisites	None.
Assessment Methods	- Active participation in exercises - Proactive contribution of questions, case studies and discussion points - Independent pursuit of learning objectives
Recommended Reading and Material	- Burnett, Evans: Designing your Life. How to build a well-lived, joyful life, 2016 - Kernbach, Eppler: Life Design. Mit Design Thinking, Positiver Psychologie und Life Loops mehr von sich in das eigene Leben bringen, 2020
Attendance	minimum 75% attendance is required
Comments	None.

Advanced / Applied Optics

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

Course description	The course covers the fundamentals and applications of advanced optical concepts, including geometric optics, microscopy techniques, and spectroscopy. Emphasis is placed on their implementation in medical devices and healthcare applications, providing insights into the optical principles behind diagnostic and therapeutic tools.
Teaching methods	Lecture (20 teaching units) + Laboratory (15 teaching units)
Learning outcome	After passing this course successfully students are able to ...

- understand the functioning principles, advantages and limitations of commonly used optical imaging techniques in biomedical scenarios (e.g. different types of microscopy, OCT, etc.)
- can select the appropriate optical imaging technique for a given clinical application (e.g. ophthalmology, endoscopy, histology, dermatology etc.)
- can recognize and evaluate common artifacts caused by optical systems on an image -can model ocular optics, including common refractive errors and aberrations
- understand the functioning principles, advantages and limitations of commonly used optical spectroscopy techniques in biomedical scenarios (e.g. transmission, fluorescence, FTIR, Raman, etc.)
- can assess fluorescence spectra for cell analysis and discuss spectroscopic results -can assess Raman/FTIR spectra and link them to the molecular composition of the sample
- can list curative laser applications (e.g. ablation therapy, phototherapy, fluorescence guided surgery etc.) and evaluate their clinical efficacy

Course contents

- Imaging
- Microscopy techniques
- Eye model
- Classical spectroscopy + fluorescence spectroscopy
- Raman & FTIR spectroscopy
- Coherence theory & OCT & tOCT
- Lasers and laser applications
- Clinical applications

Prerequisites

Mathematics: Vector fields, Nabla concept
Physics: Maxwell's equations, Snell's law, Brewster's law, total internal reflection, diffraction at single and double slits, Lens polisher rule

Assessment Methods

Recommended Reading and Material

- Bahaa E.A. Saleh & Malvin C. Teich. Fundamentals of Photonics. John Wiley & Sons, Inc. 2007. ISBN: 9781119506874

Attendance

80%

Comments

Informatics of Biological Systems

Degree programme

MME

Semester

2

Course methods	ILV
Language	English
ECTS Credits	5.00
Incoming places	Limited
Course description	This course covers the fundamentals and applications essential for analyzing, investigating, and modeling biological systems. The focus is on computer-based techniques, which are demonstrated using biomedical examples and highlighted in their application to current research and problem solving.
Teaching methods	Lectures, Self-Study exercises with supportive materials
Learning outcome	After passing this course successfully students are able to ... - understand the role of bioinformatics in biomedical engineering and digital health. - recognize and describe the processes and tasks performed in a laboratory for next generation sequencing (NGS). - understand fundamental algorithms and data structures used in the context of biology. - understand basic graph theory and its applications for describing biological systems. - apply computational methods to analyze biological and clinical data. - understand omics data in the context of health informatics. - critically assess bioinformatics tools and databases. - apply their skills and knowledge of omics to precision medicine. - design and execute small-scale bioinformatics projects relevant to eHealth.
Course contents	- Foundations of Bioinformatics - Genomics and Next Generation Sequencing - Algorithms Basics - Sequence Analysis - Graph Theory - Ordinary Differential Equations - Transcriptomics and Proteomics - System Biology and Network Analysis - Molecular Dynamics and Drug Discovery
Prerequisites	Basic molecular biology, statistics, and programming (Python/R or equivalent)
Assessment Methods	- Programming Assignments - Written Exam

Recommended Reading and Material - Arthur M. Lesk, Introduction to Bioinformatics, 5th Edition, Oxford University Press, 2019, ISBN 0198794142, 9780198794141

Attendance

Comments

Artificial Intelligence in Medicine

Degree programme MME

Semester 2

Course methods ILV

Language English

ECTS Credits 5.00

Incoming places Limited

Course description The course explores five key methodologies in AI: connectionism (neural networks), symbolism (logic-based systems), evolutionism (biologically inspired algorithms), Bayesian methods (probabilistic modeling), and analogizing (pattern matching for recommendations). Ethical implications and responsible AI use are also discussed.

Teaching methods lecture course / project

Learning outcome After passing this course successfully students are able to ...

- describe the classical approach to AI (Heuristic Methods)
- discuss the "5 schools" of AI
- discuss causal inference in AI
- apply selected AI Technologies in simple examples

Course contents

- Heuristic AI
- Connectionism
- Symbolism
- Evolutionary Algorithms
- Bayes school of AI
- Analogize / Simulation
- Causal Inference
- Artificial Intelligence in Medical Images

Prerequisites none

Assessment Methods - moodle-quizzes, project and presentation

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	N/A

Processes for Medical Device and System Design

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

Course description	The course covers key processes and steps involved in implementing quality management systems for the design, development, and market introduction of medical devices. It emphasizes the practical aspects of addressing regulatory requirements and provides a structured approach to ensuring compliance throughout the development process and the complete product life cycle.
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Teaching methods	Lectures will introduce the topics. Students will extend their knowledge and skills in assignments.
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Learning outcome	After passing this course successfully students are able to ... - design structures and processes to address regulatory issues of medical devices, especially the "Medical Device Regulation" - use and optimise 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 "health IT risk manager" (IEC 80001-1)
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Course contents	- Medical Device Regulation and Harmonised Standards (ISO 13485, ISO 14971, EN 60601-x, IEC 80001-1, ...) - Medical device development: Case examples and experiences in companies, from initial concepts to market. Classification, evaluation of conformity - Quality Management Systems and Risk analysis - Basic introduction to further regulations (EMC, biocompatibility, RoHS...). Basic of clinical trials. EU- vigilance system. IVD`s, AIMDD. International requirements (FDA, CMDCAS, GxP, UL, ...).
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Prerequisites	- Clinical evaluation, post market surveillance, and clinical follow-up - Basic concepts of device or software development. - Basic concepts of quality.
Assessment Methods	- Final exam - Assignments
Recommended Reading and Material	- See learning platform - Directorate-General for Health and Food Safety of the EU: Public Health / Medical Devices Sector. Webpage, accessed 21.1.2026, https://health.ec.europa.eu/medical-devices-sector_en
Attendance	
Comments	This course together with the "EU Law and Regulations" course prepares students to acquire a professional certificate from TÜV (www.tuv-akademie.at). Having passed the courses, you can apply for the following certification, after an additional exam at TÜV: Quality & Regulatory Affairs Manager for medical devices, junior certificate

Scientific Publishing

Degree programme	MME
Semester	2
Course methods	SE
Language	English
ECTS Credits	3.00
Incoming places	Limited
Course description	The course provides an introduction to the essentials of scientific publishing, including writing strategies, finding relevant literature, and navigating the publishing process. It also covers key aspects of participating in scientific conferences. The course complements the PRT and Self Management courses.
Teaching methods	Lectures, group work, presentations
Learning outcome	After passing this course successfully students are able to ... - explain the structure and components of a scientific paper. - write a scientific abstract according to the standards and conventions of academic journals. - prepare a scientific presentation (oral or poster) suitable for an academic conference.

- describe the process from the initial research idea to the acceptance of a scientific article.
- present a scientific poster confidently and concisely, responding to audience questions with clarity and scientific accuracy.
- use literature management tools (e.g., Zotero, Mendeley) to search, organize, and cite academic sources efficiently.
- apply principles of good scientific practice, including research integrity, correct citation, transparency, and avoidance of plagiarism.

Course contents

- Conferences, Scientific Practices, Scientific Publishing and Documents, Writing Abstracts, Evaluating Abstracts, Conference Procedures, Summarizing scientific documents
- Presentation of scientific focus topics in Life Science Engineering @ University of Applied Sciences Technikum Vienna
- Good Scientific Practice, Ethics Committee, Study Design, Evaluation Methods
- Literature Management & Tooling
- Poster Visualization
- Poster Presentation Session

Prerequisites

Basic writing skills

Assessment Methods

- Abstract writing
- Conference Publishing
- Good Scientific Practice
- Tooling
- Poster creation & presentation

Recommended Reading and Material

Attendance

Mandatory

Comments

eHealth

Degree programme

MME

Semester

2

Course methods

SE

Language

English

ECTS Credits

3.00

Incoming places

Limited

Course description	The course explores the concept of eHealth, examining existing applications and the requirements for implementation across legal, IT, medical, and economic dimensions. Students will learn how to evaluate eHealth applications, including cost-benefit analysis. The course incorporates perspectives from various stakeholders—politicians, patients, economists, industry, and medical experts—using a Problem-Based Learning (PBL) approach.
Teaching methods	The course uses problem-based learning, following input from the lecturer. Students formulate evidence-based project proposals, Proposals take into account the perspectives of various stakeholders, which are typically anchored as objectives in funding programs.
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 - develop funding applications that follow the typical guidelines of funding programs in the healthcare sector
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 funding proposal
Recommended Reading and Material	- Directorate-General for Health and Food Safety of the EU: Public Health / eHealth - Digital health and care. Webpage, accessed 21.1.2025, https://health.ec.europa.eu/ehealth-digital-health-and-care_en
Attendance	The course includes discussion and feedback sessions in which students are expected to give presentations and contribute. Attendance is therefore mandatory.
Comments	Attendance to relevant events (congresses, workshops: eHealth Summit, HL7 Jahrestagung, IHE Day, ...) can be accredited for the course, contact the lecturers.

Introduction to MATLAB for Applications in Life Sciences II (Elective Course)

Degree programme	MME
Semester	2
Course methods	ILV
Language	English
ECTS Credits	2.00
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

Robotics Engineering (MRE)

Critical Thinking in Science

Degree programme	MRE
Semester	2
Course methods	SE
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	How can we compose a seamless narrative about a technical project that can be followed by all potential project partners and stakeholders, while doing justice to the project's complexity? We grasp the significance of a project when we understand why it is being done. Precise factual answers to the question "why" are the glue that holds a narrative together, connecting each part to the one that follows. We will explore each of the students' projects to identify and describe the real-life needs as well as the weaknesses in the technical state of the art or start state that the project addresses. We will practice the art of following every statement we make by addressing these questions: Why are you trying to solve these particular problems? Why are you using this strategy/technology/method? We can follow a complex technical process (even if we can't decipher the algorithms or code or the like) if we first see what the complete device or system is and does, before we are told how it was done. We will describe who the project benefits, the real-life as well as the technical reasons why it is being done, and what the project output is and does, before we explain how the end-user uses it, how it works, how it was done, and how well it works (the results/performance evaluation of the output). We will also consider potential project impacts in global technological, economic and environmental contexts, and use gender-neutral language. Each student will apply the critical methodologies practiced in the workshops to write the 2nd semester project abstract, and to craft, rehearse, receive and incorporate feedback on the project presentation.
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Teaching methods	Seminar/Workshop/Writing and presentation assignments
Learning outcome	After passing this course successfully students are able to ... - Compose and effectively structure seamless narratives on complex technical projects and procedures by providing fact-based explanations of “why” for every statement made - Effectively and efficiently position a project as a response to a real-life problem or need - Demonstrate how a project addresses technical weaknesses in the state of the art and/or start state - Avoid mistaking the project output (what has been created and what it does) for the project results (how well it works, i.e. the performance evaluation of the project output) - Use the overview of the whole project output and what it does as the context for explaining how each part works and how it was done - Discuss choices of materials and methods in terms of their function (rather than as an inventory list) - Replace generalities with statistics and other facts, and use gender-neutral language - Compose and structure a master thesis and presentation in English
Course contents	- Workshopping the 2nd-semester project abstracts and presentations - Incorporating workshop feedback into the abstract and presentation composition process - Final version of abstract and presentation - Presentation practice and run-through
Prerequisites	Registered for MRE 2nd semester
Assessment Methods	- Assessment is based on the quality of the written and oral work and workshop participation. In a team project, any discernible differences in work quality and quantity will be reflected in individual grades.
Recommended Reading and Material	- Guidelines and instructions in course Moodle site
Attendance	75%
Comments	

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
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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

Digital Leadership

Degree programme MRE

Semester 2

Course methods ILV

Language English

ECTS Credits 5.00

Incoming places Limited

Course description This course will provide an overview of the latest practical and theoretical leadership concepts. Students will gain practical insights into the challenges of leadership and transformation, for example, in international organizations, and they will also develop new perspectives on the contemporary world of work and the theme of leadership. One of the course's fundamental components will be a student created reflection on specific issues concerning leadership and their implementation.

Teaching methods

Learning outcome After passing this course successfully students are able to ...

- identify and explain the tasks and instruments of leadership (for example, delegation, agreement on objectives) as well as to explain classical management models (for example, the leading continuum, the maturity model), to weigh the advantages and disadvantages of different leadership theories and concepts and to apply these to practical examples
- describe agile leadership (e.g. in expert organisations, transformation processes) and use it as an example of leadership
- explain the exact, academic, understanding of digital leadership (e.g. coaching culture) and apply this concept to specific cases
- apply the systemic loop (from the perspective of a leadership position) in a theoretical manner to interdisciplinary or intercultural teams
- understand the essential techniques of leadership in an intercultural context
- outline the most important trends in the labour market
- motivate employees and lead virtual teams in an increasingly digitalized world of work

Course contents

- Fundamentals of leadership, traditional traits, behavioural and situational theories of leadership
- Systems theory in social systems
- Leadership in a digital context
- Modern leadership concepts (agile leadership, transformational leadership, servant leadership and other such theories)
- Interdisciplinarity and interculturality
- Trends in the economy: the labour market, globalisation, digital

transformation and Industry 4.0
- The specifics of leading teams of experts

Prerequisites none

Assessment Methods - Participation in workshops, exercises, case studies, written exam

Recommended Reading and Material

- Berninger-Schäfer, E. (2019): Digital Leadership; Die Digitalisierung der Führung, managerSeminare Verlags GmbH
- Franken, S. (2019): Verhaltensorientierte Führung; Handeln, Lernen und Ethik im Unternehmen, 4. Auflage, Gabler
- Gasteiger, R., Kaschube, J., Rathjen, Ph. (2016): Interkulturelle Führung in Organisationen, Menschen in globalen Kontexten effektiv führen, essentials Springer Gabal
- Greßer, K., Freisler, R. (2020): Ready for Transformation; Neue Arbeitswelt, digital und agil..., managerSeminare Verlags GmbH
- Wunderer, R. (2011): Führung und Zusammenarbeit, Eine unternehmerische Führungslehre, 9. Auflage, Luchterhand
- Lerch, Sebastian (2017): Interdisziplinäre Kompetenzen, UTB
- Lüthi, E., Oberpriller, H., Loose, A., Orths, St. (2013): Teamentwicklung mit Diversity Management, Haupt
- Wunderer, R. (2011): Führung und Zusammenarbeit, Eine unternehmerische Führungslehre, 9. Auflage, Luchterhand

Attendance Attendance is compulsory

Comments none

Quantum Engineering (MQE)

Quantum Programming Languages and Frameworks

Degree programme MQE

Semester 2

Course methods ILV

Language English

ECTS Credits 5.00

Incoming places Limited

Course description This course provides an overview on state-of-the-art programming languages and frameworks for quantum computing.

Teaching methods

Learning outcome	After passing this course successfully students are able to ... - discuss the specificities of different quantum programming languages/frameworks - use existing software for specific applications such as quantum error correction and noise simulations - describe and compare advantages and use cases for different quantum programming frameworks - implement simple quantum algorithms on different quantum computing platforms - choose a programming language suited to solve a given problem
Course contents	- Quantum computing frameworks and languages, e.g. qiskit, Cirq, Q#, t ket, Ocean, quTip - Existing software and packages for specific applications - Creating your own toolkit - Interfaces to control software of quantum hardware
Prerequisites	Quantum Computing I (QUCP1), Python (HOCS), Enabling technologies I (QET1)
Assessment Methods	
Recommended Reading and Material	- Documentation, Skriptum
Attendance	
Comments	

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	

Learning outcome	After passing this course successfully 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
Course contents	- technology trends in quantum engineering - analysis of scientific publications in the subject area
Prerequisites	Knowledge on quantum information, quantum computing, enabling technologies, physics, electronics
Assessment Methods	- Course-immanent performance assessment
Recommended Reading and Material	- Material for reading and discussions will be provided throughout the course
Attendance	
Comments	

Data Modeling Lab

Degree programme	MQE
Semester	2
Course methods	LAB

Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	In this course students apply numerical methods for analyzing and processing experimental data.
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - read and interpret experimental data - extract model parameters from experimental data by curve fitting - depict experimental data graphically - analyze experimental data - create images from raw data fit for publication or presentation to an expert audience - present experimental data
Course contents	- Introduction to data processing in python - Curve fitting methods - Presentation experimental data
Prerequisites	
Assessment Methods	
Recommended Reading and Material	
Attendance	
Comments	

Quantum Communication Laboratory

Degree programme	MQE
Semester	2
Course methods	LAB
Language	English
ECTS Credits	2.00
Incoming places	Limited
Course description	In this lab course students implement quantum key distribution protocols both in free space and in fiber, thus supporting an

experience-orientated approach to quantum key distribution.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- implement the BB84-protocol in free space
- implement the BB84-protocol in fiber
- exchange keys using the BB84-protocol
- detect eavesdropping in the BB84-protocol
- implement the E91-protocol in free space
- implement the E91-protocol in fiber
- exchange keys using the E91-protocol
- evaluate laser safety measures
- couple a laser into a fiber
- extract a sifted key from a raw key
- calculate the QBER
- use a quantum random number

Course contents

- Implementation of QKD protocols in free space transmission
- Implementation of QKD protocols in fiber transmission
- Quantum Key Generation

Prerequisites

Laser Safety (QUINFL) Realization and manipulation of photonic qubits (QUINFL) Prepare and measure protocols for QKD (part of QUCOM1) Entanglement based protocols for QKD (part of QUCOM1)

Assessment Methods

- Course-immanent performance assessment

Recommended Reading and Material

- Technical manuals, scripts

Attendance

Comments

Data Modeling Lab

Degree programme MQE

Semester 2

Course methods LAB

Language English

ECTS Credits 2.00

Incoming places Limited

Course description

In this course students apply numerical methods for analyzing and

processing experimental data.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- read and interpret experimental data
- extract model parameters from experimental data by curve fitting
- depict experimental data graphically
- analyze experimental data
- create images from raw data fit for publication or presentation to an expert audience
- present experimental data

Course contents

- Introduction to data processing in python
- Curve fitting methods
- Presentation experimental data

Prerequisites

Assessment Methods

Recommended Reading and Material

Attendance

Comments

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

Learning outcome

After passing this course successfully 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)

Assessment Methods	- Course-immanent performance assessment
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

Comments

Enabling Technologies II

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

Course description	This course provides an overview on topics that are relevant for the realization of qubits, quantum computing and quantum communication systems. Focus topics are photodetectors, single-photon detectors, optical fibers, signal processing and amplification as well as superconductors.
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Teaching methods

Learning outcome	After passing this course successfully students are able to ... - understanding the different types of the noise in the physical device, how to measure it and explain how it affects the qubit's gate and readout fidelity - discuss different types of superconductors and Josephson junctions - describe different types of optical fibers and fiber couplers - understand signal amplification and noise sources - discuss different types of superconductors and Josephson junctions
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Course contents	- photodetectors - single-photon detectors - optical fibers - signal amplification and processing, noise - superconductors, Josephson junctions
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	- superconducting qubits
Prerequisites	Basic physics and electronics knowledge (HOEL, HOPH, Enabling Technologies I)
Assessment Methods	- Course-immanent performance assessment and final presentation
Recommended Reading and Material	
Attendance	
Comments	

Quantum Engineering Project

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

Course description	This course provides a hands-on approach to guide small groups or individual students through a well-defined project. Possible topics cover all aspects of quantum engineering, including the design and stabilization of optical systems, device characterization or software projects. This course furthermore provides a scenario to practice team leadership.
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Teaching methods

Learning outcome	After passing this course successfully students are able to ... - independently perform basic steps in designing and setting up optical or electronic systems or designing and testing software - explain the theoretical background, mechanisms, advantages and disadvantages and application scenarios of these system - identify relevant literature, write a scientific introduction and develop and implement a working plan on a given topic - comprehensibly analyze, critically evaluate and interpret their performance with the help of scientific-systematic methods, to summarize them in a written report according to the standard of scientific working and to present their results to supervisors, lecturers and fellow students
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- record experimental data in a laboratory book in a comprehensible manner
- approach and solve scientific problems within a team
- 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 and reference these in their own work
- plan the phases of an engineering task and document it comprehensibly
- relate research results to industry, society, the economy or the environment
- diagnose dynamics in project teams and to develop and argue case-related concrete opportunities for activities (for example delegation of responsibility, critical discussion)

Course contents

- Scientific literature research and writing of a scientific introduction
- Design and setup of optical and electronical systems
- Construction of optical systems
- Feedback and optimization
- Analysis and interpretation of data from experiments or simulations
- Writing a scientific report
- Leadership functions and tasks, Leadership tools in project teams, Leading without formal power and competence,
- Conflicts and difficult situations in leading project teams
- Presentation of the obtained data in front of an auditorium (consisting of the other teams and supervising lecturers)

Prerequisites

Basic knowledge about electronics and optical systems and corresponding lab experience (HOPH, HOEL) Electronic control engineering (QECE, QECE lab) Programming in python (HOCS) Digital Leadership

Assessment Methods

- Submission of a project report, including introduction, description of the project tasks, results, scientific references
- Presentation of the project in front of an audience (other students and lecturers)

Recommended Reading and Material

- State-of-the-art scientific literature (publications)
- Technical manuals, scripts
- Haeske, U. (2008): Teamentwicklung, Berlin: Cornelsen Verlag, [bilingual book: in English and German]

Attendance

Comments

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

Learning outcome After passing this course successfully 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

Assessment Methods

- Course-immanent performance assessment

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

Comments

Quantum Communication I

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

Course description	This course introduces the principles of cryptography and quantum key distribution (prepare-and-measure protocols, entanglement-based QKD protocols).
Teaching methods	
Learning outcome	After passing this course successfully students are able to ... - describe the principles of cryptography - define symmetric encryption and give examples for symmetric encryption algorithms - define asymmetric encryption and give examples for asymmetric encryption algorithms - program an algorithm for RSA encryption - program an algorithm for AES encryption - give an overview over the OSI modell - describe the authentication problem in quantum key distribution (QKD) - discuss the consequences of the no-cloning theorem in QKD - discuss degrees of freedom in which information can be encoded in QKD - describe prepare-and-measure protocols for QKD - discuss the safety of prepare-and-measure protocols for QKD - describe entanglement based protocols for QKD - discuss the safety of entanglement based protocols for QKD - describe the effect of eavesdropping in both prepare-and-measure protocols and entanglement based protocols - describe the effect of noise in both prepare-and-measure protocols and entanglement based protocols - explain how a sifted key is generated from a raw key - calculate the Quantum Bit Error Rate (QBER) - describe use cases for QKD
Course contents	- Principles of classical symmetric and asymmetric cryptography - Foundations of quantum key distribution - Prepare-and-measure protocols for QKD - Entanglement based protocols for QKD - Quantum key generation from raw quantum keys
Prerequisites	Fundamental principles of quantum information (QUINF) Principles of network technology (HOCS)
Assessment Methods	- Course-immanent performance assessment
Recommended Reading and Material	- Paar & Pelzl: Understanding Cryptography - BSI Technical Guideline BSI TR-02102-1 Cryptographic

Mechanisms

- Wolf: Quantum Key Distribution. An Introduction with exercises
- Gisin, Ribordy, Tittel & Zbinden: Quantum cryptography

Attendance

Comments

Enabling Technologies II

Degree programme MQE

Semester 2

Course methods ILV

Language English

ECTS Credits 3.00

Incoming places Limited

Course description This course provides an overview on topics that are relevant for the realization of qubits, quantum computing and quantum communication systems. Focus topics are photodetectors, single-photon detectors, optical fibers, types of noise, signal processing and amplification as well as superconductors.

Teaching methods

Learning outcome After passing this course successfully students are able to ...

- understanding the different types of the noise in the physical device, how to measure it and explain how it affects the qubit's gate and readout fidelity
- discuss and evaluate different types of photodetectors
- describe different types of optical fibers and fiber couplers
- understand signal amplification and noise sources
- discuss different types of superconductors and Josephson junctions

Course contents

- photodetectors
- single-photon detectors
- optical fibers
- signal amplification and processing, noise
- superconductors, Josephson junctions
- superconducting qubits

Prerequisites Basic physics and electronics knowledge (HOEL, HOPH, Enabling Technologies I)

Assessment Methods - Course-immanent performance assessment and final presentation

Recommended Reading and Material

Attendance

Comments

IT-Security (MCS)

Web Security

Degree programme MCS

Semester 2

Course methods ILV

Language English

ECTS Credits 2.00

Incoming places Limited

Course description The ILV covers the most common security errors that occur in the development and operation of web applications, based on the OWASP Top 10. The ILV is based on the analysis of real-world security incidents, which are examined for their suitability as examples for different OWASP categories. The teaching of theoretical content focuses on the OWASP Top 10, their interrelationships, code examples for vulnerabilities, and the development of the global threat actor landscape. Translated with DeepL.com (free version)

Teaching methods Flipped ClassroomLectureDiscussionGroup work

Learning outcome After passing this course successfully students are able to ...

- Identify and fix security vulnerabilities in web applications according to OWASP Top 10
- Ensure the secure development and deployment of web applications
- Classifying new developments in the global thread actor landscape
- Derive OWASP relevance from real-world security examples
- Use the OWASP Top 10 as a guideline for action.

Course contents - OWASP Top 10 Structure

- Thread actor landscape basics
- Pentesting basics
- Security Design
- Web application architecture
- OWASP TOP 10 Contents
- Security for AI (LLMs) / Security challenges by AI
- Threat Actor Landscape)

Prerequisites	Knowledge of web architectures and protocols; programming skills; basic understanding of cryptography, knowledge of security architectures.
Assessment Methods	- Quiz at the beginning of the course session (Moodle) - Final exam (Moodle) - Group work Analysis of an RW scenario and production of a podcast episode - Group work: technical example implementation (presentation & submission of documentation)
Recommended Reading and Material	- Script
Attendance	attendance is compulsory
Comments	

Security Architectures

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

Course description	This course guides students through the full lifecycle of secure system design. It starts with core architectural principles and builds toward modern paradigms like Zero Trust and cloud-native security. Students learn to apply threat modeling, define trust boundaries, and make risk-driven design decisions. Key technical focus areas include microservices, container security, cloud architecture, and monitoring strategies. Emerging topics such as AI security and architecture governance are also covered. Real-world case studies provide
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practical context, and the course concludes with a student project presentation.

Teaching methods

The course combines structured lectures with interactive elements, guided discussions, and applied project work. Core architectural concepts, design principles, and security models are introduced in instructor-led sessions and deepened through analytical examples and real-world case studies (e.g., major security incidents). Students engage in continuous formative learning through weekly quizzes that reinforce key concepts and support self-assessment. Selected sessions include hands-on threat modeling exercises and architecture analyses to foster practical application of theoretical frameworks. A central component of the course is a team-based architecture project, in which students design, document, and present a secure system architecture for a complex scenario. This project-based approach promotes higher-order competencies such as analysis, evaluation, and design. Independent study through targeted literature, preparation tasks, and project work complements the in-class sessions. The teaching approach follows a constructive alignment model, systematically progressing from foundational knowledge to applied architectural design and critical reflection.

Learning outcome

After passing this course successfully students are able to ...

- After successfully completing this course, students are able to systematically analyse, evaluate, and design secure IT system architectures in complex technical environments
- They can describe and explain the purpose, structure, and security objectives of IT security architectures, including core principles such as confidentiality, integrity, and availability. Students are able to apply established architectural design principles (e.g., defense in depth, least privilege, secure defaults) and use structured threat modeling techniques (e.g., STRIDE) to identify attack vectors and security-relevant trust boundaries.
- Furthermore, students can critically analyse architectural models for cloud-native, container-based, and Zero Trust environments, assess their security posture, and justify design decisions based on explicit criteria and trade-offs.
- Finally, students are capable of designing a coherent secure architecture for a complex scenario, integrating layered controls and risk-driven decision-making, and communicating and defending their architectural choices in a structured and academically sound manner.

Course contents

- The course covers foundational and advanced concepts of secure

IT system architecture, progressing from core principles to contemporary architectural paradigm

- It begins with an introduction to the role and scope of security architecture, including architectural security goals and the distinction between design, implementation, and operational security. Students explore essential architectural design principles such as defense in depth, least privilege, secure defaults, separation of duties, and trust boundary definition.
- A substantial part of the course focuses on structured threat modeling and risk-driven design. Students learn to apply established methodologies, derive security requirements, and link risk assessments to architectural decisions.
- Building on this foundation, the course addresses modern architectural contexts, including cloud security architectures, shared responsibility models, Zero Trust Architecture, microservices and container environments, and secure logging and monitoring strategies. Selected sessions analyse real-world security incidents to identify architectural weaknesses and derive lessons learned.
- Additional topics include governance and compliance aspects, integration of security into enterprise architecture frameworks, and selected considerations for AI-related systems. The course concludes with a project in which students design and critically evaluate a secure architecture for a complex system scenario.

Prerequisites

Students are expected to possess a solid foundation in fundamental IT security concepts prior to attending this course. This includes a sound understanding of confidentiality, integrity, and availability (CIA), common attack vectors, and basic defensive mechanisms. Familiarity with network architectures, communication protocols (e.g., HTTP, TLS), and operating systems is required. Students should understand core infrastructure components such as firewalls, proxies, load balancers, and authentication mechanisms. Basic knowledge of client–server models, APIs, and access control concepts is assumed. Experience with cloud environments or container technologies is beneficial but not mandatory. While no programming is required, participants must be comfortable analysing complex technical systems and reasoning at an architectural level.

Assessment Methods

- Weekly Quiz
- Presentation and written report

Recommended Reading and Material

Attendance Mandatory

Comments

Secure Systems Engineering

Degree programme MCS

Semester 2

Course methods ILV

Language English

ECTS Credits 3.00

Incoming places Limited

Course description The course deals with the fundamentals of systems engineering and the validation of the associated processes and technology. It focuses in particular on “security by design” concepts. The course agenda is as follows: • Course framework, introduction to the topic of Secure Systems Engineering • Secure Software Development Life Cycle • Security Requirements Engineering • Secure Design Patterns • Secure Design Principles • Risk Analysis • Low-level Security • Security Software Testing. Each topic will be practically implemented in a form of a group project. Each class building on the next while the final state of the project represents a state of the art secure engineering.

Teaching methods The course content is taught through practical exercises and advanced self-study projects. Performance assessment consists of several practical projects.

Learning outcome After passing this course successfully students are able to ...

- to apply the various software development models
- to apply the various software development models
- Create security requirements and implement them
- implementing the fundamentals of secure by design
- Create thread & risk analyses
- Explain low-level security threats and how to protect against them

Course contents

- Secure software development life cycle
- Software development models
- Requirements engineering with the SQUARE process
- SecDevOps
- Secure design principles

- Secure design patterns
- Security software testing
- Risk analysis
- Fundamentals of low-level attacks and defense

Prerequisites

Fundamentals of information and IT security, fundamentals of programming languages and software development processes, basic experience in the field of software and system development

Assessment Methods

- continuous practical implementation of a project

Recommended Reading and Material

Attendance

Comments

Ecotoxicology & Environmental Management (MUT)

Environmental Analysis

Degree programme	MUT
Semester	2
Course methods	UE
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description

Environmental analytics teaches methods for the qualitative and quantitative determination of substances in the environment. In this ILV, the theoretical basics of the accompanying exercises are learned.

Teaching methods

Learning outcome

- After passing this course successfully students are able to ...
- provide an overview of the methods of environmental analytics.
 - know the advantages and disadvantages of different analysis methods.
 - to explain the principle, implementation and evaluation of frequently used environmental analysis methods and to qualitatively and

quantitatively evaluate examples.

Course contents

- Calibration & Validation
- Modern water and soil analysis
- Principle of chromatography (thin-layer, HPLC, LC, IC, GC)
- UV/VIS spectroscopy
- IR spectroscopy
- Mass spectroscopy

Prerequisites

Applied chemistry, ecological chemistry

Assessment Methods

- Written module exam

Recommended Reading and Material

- Scripts of the lecturers

Attendance

Attendance of at least 75% is mandatory; if more than 25% of the units are missed, the first attempt at the examination will be lost

Comments

Environmental Analysis Lab

Degree programme MUT

Semester 2

Course methods LAB

Language English

ECTS Credits 3.00

Incoming places Limited

Course description

Independent development of laboratory examples

Teaching methods

Learning outcome

- After passing this course successfully students are able to ...
- to determine the quality of a water samples through the application of defined chemical tests
 - Water sampling according to ISO 5667-12 & ÖNORM 5667-6 and water analysis and testing for microbiological parameters
 - examine soil samples chromatographically for their substances and to determine their ion exchange capacity.
 - document final results (protocol with IMRAD structure or according to EU guidelines), analyze and interpret them
 - classify the chemical waste generated in the laboratory and to dispose it correctly under safety aspects, as well as to independently

calculate defined stoichiometric quantities (substance quantities, substance concentration, mass concentrations and pH) and to produce solutions under guidance.

- Prepare water and soil samples for analysis using ICP-MS, carry out measurements, interpret the data obtained and quantitatively determine the content of relevant elements.
- apply basic sterile cell culture techniques in order to learn basic bioanalytical testing procedures and perform initial simple cell analyses.

Course contents

- Safety in the laboratory
- Photometry
- Chemical characterization of water and soil samples
- Chromatography (thin-layer, HPLC, IC)
- Water sampling, water analysis and microbiological examination of water samples
- Basics of cell culture
- Writing protocols
- Handling chemical waste

Prerequisites

Basics in chemistry, ecology, ecological chemistry

Assessment Methods

- Lab protocols, written module exam

Recommended Reading and Material

- Scripts of the lecturers

Attendance

Full attendance is required; missed laboratory samples must be made up.

Comments

Applied Ecotoxicology

Degree programme MUT

Semester 2

Course methods ILV

Language English

ECTS Credits 2.00

Incoming places Limited

Course description

In this course, students learn about ecotoxicological test systems at different trophic levels and important parameters for describing the effect of a substance on the environment, including important

properties.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- name test organisms for eco-toxicity testing according to the trophic levels in ecosystems
- evaluate and assess a given substance (chemicals, biocides) according to its persistence, bioaccumulation and toxicity (especially according to REACH).
- use physical-chemical parameters of a substance to predict the fate and distribution of the substance in the environment (also using computer-aided models).
- name substances in the nano range and their areas of application and possible effects on the environment.

Course contents

- Ecotoxicological test organisms
- Nanotechnology
- Analysis of "nanos" in the environment
- PBT (persistent, bioaccumulating toxic)
- POPs (persistent organic pollutants)

Prerequisites

Chemistry, molecular biology, introduction to ecotoxicology

Assessment Methods

- LV-Immanent assessment, module exam

Recommended Reading and Material

- Newman, M. (2014): Fundamentals of Ecotoxicology, Taylor & Francis Inc.

Attendance

Attendance of at least 75% is mandatory. If more than 25% of the units are missed, the first attempt at the examination will be lost

Comments

Ecotoxicity Tests

Degree programme

MUT

Semester

2

Course methods

LAB

Language

English

ECTS Credits

3.00

Incoming places

Limited

Course description

In this laboratory course, students learn practical handling of selected ecotoxicity tests and biodiversity analysis tests.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- choose the right test system for a given question.
- write test reports according to the IMRAD structure.
- carry out ecotoxicity tests.
- to evaluate the effect of pollutants.

Course contents

Prerequisites

Ecotoxicological test systems

Assessment Methods

- Course immanent performance assessment, protocols, group discussion, module examination

Recommended Reading and Material

Attendance

Full attendance is desired; if missed, an alternative appointment or alternative work may be possible, a maximum of 25% may be missed

Comments

Epigenetics

Degree programme

MUT

Semester

2

Course methods

ILV

Language

English

ECTS Credits

2.00

Incoming places

Limited

Course description

The fundamentals of epigenetics, and the role of genome & epigenome, are presented and considered in context of their ecological impacts. Biochemical methods to study epigenetic modifications of the genome are discussed. Current results from literature on these topics will be presented by students and then discussed and evaluated in the group. Lectures, group discussions of central topics, presentations by the students.

Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- describe epigenetic processes in a cell.
- understand the relationship between the genome and the environment at the epigenetic level.

Course contents	- explain biochemical methods to study epigenetic processes.
	- Introduction to epigenetics
	- DNA sequencing technologies for studying epigenetics
	- Epigenetic effects & effects of environmental factors
	- Epigenetic effects & effects of environmental factors
	- Artificial Intelligence & Machine Learning as novel and powerful resources to analyse and decipher epigenomic data

Prerequisites

Assessment Methods	- Moodle quiz
	- Oral presentation
	- Written module exam

Recommended Reading and Material

Attendance	Attendance of at least 75% is mandatory, if more than 25% of the units are missed, the first exam entry will be lost.
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Comments

Cell Biology and Alternatives to Animal Testing

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

Course description	In ecotoxicological risk assessment exist a number of standardized tests that include model organisms (animals) as well as in vitro and in silico models. However, when using animals, conflicts arise: a balance must be struck between the assumed gain in knowledge for the benefit of humans and their environment on the one hand and the burden on animals on the other. This course therefore addresses the problem of using animals and legal aspects are discussed. Furthermore, possibilities for alternatives are introduced, such as in vitro cell culture systems. In order to understand this, students gain detailed knowledge of the molecular biological and (cellular) biological processes in eukaryotic cells. Finally, students can apply what they have learned in a practical laboratory exercise.
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Teaching methods

Learning outcome

After passing this course successfully students are able to ...

- Give and describe examples of alternatives to animal testing (focus on in vitro and in silico methods).
- To provide an overview of relevant legal aspects.
- Explain the 3R (reduce, replace, refine) strategy.
- Understand basic biological processes of eukaryotic cells (replication, gene expression, DNA repair, etc.).
- Work with in vitro cell culture systems.
- Conduct standard in vitro cell culture tests to monitor viability and/or cytotoxicity.
- Analyse and reflect on own obtained data as well as combine the data with findings from published and relevant scientific studies.
- Integrate the acquired knowledge into concepts of ecotoxicology.

Course contents

- Legal Aspects and 3R strategy
- Overview of animal model organisms (in vivo) and alternatives (in vitro and in silico)
- Molecular biology principles 1 – gene expression
- Molecular biology principles 2 – cell cycle and apoptosis
- In vitro cell culture systems 1 – 2D systems and selected tests (genotoxicity and cytotoxicity, dose-response)
- Molecular biology principles 3 – stem cells and differentiation
- In vitro cell culture systems 2 – 3D organoid systems
- In vitro cell culture systems 3 – selected tests (e.g. FISH, smFISH)
- Cytotoxicity Test Final Exam

Prerequisites

Assessment Methods

- Intermediate Exam
- Written Protocol
- Written exam

Recommended Reading and Material

Attendance

Attendance of at least 75% is mandatory, if more than 25% of the units are missed, the first exam entry will be lost.

Comments

Internet of Things and Smart Systems (MIO)

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
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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, ...)
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Prerequisites

Assessment Methods	- Laufende praktische Beispiele und theoretische Abschlussprüfung
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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
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Attendance	Mandatory
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Comments

Security

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, ... - characterize cryptographic mechanisms and compare them with respect to the required protection goals - describe and design mechanisms, concepts and models of access control with regard to identification, authentication as well as rights management - explain the requirements of secure communication (networks, services, distributed applications) and describe the procedures and protocols required for this purpose. - explain software security and categorize common vulnerabilities and threats/malware.
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Course contents	- Consolidation of the basics of cryptographic methods - Authentication - Access and access control - Security in networks - Internet Security - Software Security
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Prerequisites

Assessment Methods	- Immanent Performance Assessment, Final Examination.
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Recommended Reading and Material	- Stallings, William: Computer Security – Principles & Practice, Pearson, 3/E, ISBN: 9781292066172
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Attendance

Comments

IT- and Data Protection Law

Degree programme	MIO
Semester	2
Course methods	SE
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 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.
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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)
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Prerequisites

Assessment Methods	- Final written exam - Oral presentation on a recent judgment.
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Recommended Reading and Material	- Jahnel/Mader/Staudegger, IT-Recht, 4. Auflage (2020) - Jahnel/Pallwein-Prettner/Marzi, Datenschutzrecht, 2. Auflage (2020)
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- Case-by-case recommended literature essays

Attendance

Comments

Artificial Intelligence of Things

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

Course description

Teaching methods Self-study, interactive lecture with discussion, exercises and case studies as well as final exam

Learning outcome Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ...

- select appropriate sensors for the requirements of applications.
- analyze sensor signals based on their statistical properties.
- define, describe and explain the procedure for modeling and calibrating a sensor.
- select AIoT methods at sensor node level and train and deploy them at edge level.
- understand the effects of limited hardware resources in the IoT area on the respective algorithms.
- implement algorithms on devices commonly used in the IoT.
- assess the impact of AIoT devices on the aggregation of data.
- define and explain the principle of autonomous or highly automated driving.
- define, describe and explain intelligent sensor concepts of advanced sensor technology used in autonomous mobile robots and autonomous vehicles, such as monochrome/color camera, infrared camera, time-of-flight, stereo, ultrasound, GPS and 2D/3D LIDAR.
- discuss and evaluate the advantages and disadvantages of using a physical sensor system for an autonomous mobile robot and select and design a suitable system.

Course contents

- Principle of highly automated and autonomous driving
- Monochrome/color camera, infrared camera, time-of-flight, stereo,

ultrasound, GPS, 2D/3D LIDAR

- Modeling, calibration and design of selected sensors
- Data evaluation chain for an intelligent sensor system
- Application and case studies

Prerequisites IoT System Models, IoT Operating Systems

Assessment Methods

Recommended Reading and Material

Attendance

Comments

Data Analysis

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, ...

- prepare, visualize and evaluate structured data sets with selected tools
- read a data set into an iPython notebook, prepare it in this development environment, and explore it using descriptive statistics and selected statistical methods.
- identify relationships between a dependent variable and one or more independent variables and develop a predictive model using regression techniques.
- 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 methods
- 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, visualization and evaluation
- Use of Python in Data Science
- Correlation and regression analysis
- Time series analysis
- Classification
- Performance evaluation and improvement
- Cluster analysis

Prerequisites

Assessment Methods

- Immanent performance review (intermediate tests, 30%)
- Final exam (theory, practical tasks, 70%)

Recommended Reading and Material

- McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed). O'Reilly Media

Attendance

Comments

IoT Systems Development

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, ...

- design and integration of sensor nodes.
- ensure efficient communication in sensor clusters.
- design and install IoT Gateways (Edge) and Backends (On-Premesis or Cloud).
- understand container engines (Docker, ...) and use them as basis for IoT backends.
- install and configure communication, middleware, database and

visualization software based on application and project specific requirements.

- select and configure advanced concept in Linux based on application requirements.

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