

# UAS Technikum Wien

## COURSE GUIDE WS2024 COURSES OFFERED IN ENGLISH

→

Please note:

Incoming students have the possibility to combine courses from different study programs, but **BA students can only select courses at their level of studies**. The number of places available for Incoming students in each course may vary or be limited to a certain number.

**Please be aware, that incoming students are obliged to generate at least 9 ECTS from the Campus International.**

At the beginning of each semester an Orientation Week is held for all Incoming students as well as for all Double Degree students.

The Orientation Week takes usually place in the 2nd week of September resp. 2nd week of February.

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

Last update: 21.03.24

# OVERVIEW OF COURSES OFFERED ENTIRELY IN ENGLISH

## Content

GLOSSARY AND ABBREVIATIONS .....	9
CAMPUS INTERNATIONAL .....	12
Campus International (ECI) .....	12
Experience Erasmus+: Preparation and Awareness for a Profitable Semester Abroad	12
Empowering Intercultural Teams for Success: Theory - Tactics – Solutions .....	13
CI_German Language & Austrian Culture A1 .....	15
CI_German Language & Austrian Culture A2 .....	16
CI_German Language & Austrian Culture B1 .....	17
CI_German Language & Austrian Culture B2 .....	18
CI_Scientific Writing .....	19
CI_Audio Engineering .....	20
CI_Electronic Laboratory .....	22
CI_Traffic Safety Culture and Mobility .....	23
CI_Renewable Energy Laboratory .....	24
CI_Building Climate Engineering .....	26
CI_Cooperative International Student Project .....	27
Service and object-oriented Algorithms in Robotics .....	28
ASSIST HEIDI Designing and implementing Assistive Tools for people with disabilities	29
International Marketing .....	31
Mobile Robotics .....	32
Data Ethics & Open Data .....	33
Building and Solar Energy .....	34
BACHELOR DEGREE PROGRAMS .....	37
Mechatronics/Robotics (BMR) .....	37
Mobile and service robotics .....	37
Computer Science (BIF) .....	38
Technical English .....	38
Innovation Lab 1 .....	39
Innovation Lab 3 .....	40
Mechanical Engineering (BMB) .....	41
Manufacturing Engineering .....	41
Materials Science .....	42

Technical English.....	43
Applied Computer Science.....	44
Smart Homes and Assistive Technologies (BSA) .....	46
IT Security Basics .....	46
Software Security.....	47
Biomedical Engineering (BBE) .....	49
Technical English.....	49
Medical Imaging and Analysis.....	50
Bioinformatics .....	51
Medical Data Engineering 2 .....	51
Biomedical Engineering Projects.....	52
Biomedical Ex Vivo Models.....	53
Current Topics in Life Science Engineering .....	54
Mobile Computing in Medical Applications .....	55
Methods in Cell & Tissue Engineering .....	56
Project in Developmental Biology.....	57
Current Cell Technology Approaches .....	58
Medical Hospital Equipment.....	60
Photonics in Biomedical Engineering .....	61
Nuclear Medicine and Radiation Protection .....	61
Biomedical in Silico Modeling and Simulation .....	63
Neurorehabilitation.....	64
Neural Engineering .....	65
Gait Analysis Project.....	65
Biomechanics .....	66
Active Assistive Technologies.....	67
Web Based Medical Applications.....	68
Electronic Engineering (BEL).....	69
Technical English.....	69
Microcontroller Software Design .....	70
Information and Communication Systems and Services (BIC).....	72
Technical English.....	72
Microcontroller Software Design .....	73
International Business Engineering (BIW) .....	74
Manufacturing Engineering .....	74
Materials Science .....	75
Technical English.....	77
Industrial Informatics in a Digital Economy.....	78
Circular Economy and Sustainability .....	79
Renewable Energies (BEE) .....	81
Technical English.....	81
Conventional Power Plant Technology.....	82

Biomass Combined Heat and Power Systems .....	83
Heat Grids .....	84
Heat Grids Laboratory.....	85
Electricity Grids Laboratory .....	86
Electricity Grids.....	87
Strategies for Urban Energy Supply .....	88
Sustainable Environmental and Bioprocess Engineering (BUB) .....	89
Technical English.....	89
Electronics and Business (BEW) .....	90
Advanced Technical Communication and Engineering Ethics .....	90
Business Management .....	91
Industrial Electronics.....	93
Leadership.....	94
Quality Management.....	95
Scientific Practice .....	96
Business Informatics (BWI) .....	98
Scientific Writing and Research Methods.....	98
Digital Marketing .....	99
Software Engineering Project.....	100
IT Security Basics .....	101
Software Security.....	103
Backend Web Engineering.....	104
Frontend Web Engineering .....	105
IT Infrastructure .....	106
Cloud Computing .....	107
Data Science Engineering.....	108
Machine Learning .....	109
Agile Requirements Engineering.....	110
Rapid Application Development .....	111
Software Quality & DevOps .....	112
Agile Software Testing .....	113
Business Process Engineering .....	114
Human Factors and Sports Engineering (BHF).....	115
Technical English.....	115
Biomechanics and Ergonomics Laboratory .....	116
Current Topics in Life Science Engineering .....	117
Master DEGREE PROGRAMS .....	119
AI Engineering (MAI) .....	119
Machine Learning 1: Basics .....	119
Medical Engineering & eHealth .....	120
Project-Related Teamwork 1.....	120
Cellular Electrophysiology and Bioimpedance.....	121

EU-Law .....	122
Corporate Management in Life Science Technologies .....	123
Microprocessor Applications in Medicine .....	124
Team Management Skills.....	125
Medical Information Systems .....	126
Modelling in Cardiovascular Systems .....	127
Applications for Crowdsourced Healthcare .....	129
Engineering for Therapy & Rehabilitation.....	130
Workflows in Medicine .....	131
Economics and Marketing.....	133
Selected Problems in Medical Engineering & eHealth.....	134
Respiration Technologies .....	134
Biosignal Processing.....	135
Image Analysis .....	137
Advanced Analysis of Medical Data .....	138
Clinical Engineering .....	139
Healthcare and Rehabilitation Technology (MGR).....	140
Wahlfach - Introduction to MATLAB for Applications in Life Sciences .....	140
IT-Security (MCS).....	141
Intercultural Communication .....	141
Innovation and Technology Management (MTM).....	142
Digital Leadership & New World of Work .....	142
Empirical Market Research .....	143
Innovation and Technology Management .....	144
Data Science (MDS).....	145
Applied Mathematics.....	145
Statistical Computing .....	146
Data Engineering .....	148
Data Science Infrastructure.....	149
Analysis .....	150
Linear Algebra .....	151
Applied Statistics .....	152
Software Engineering (MSE) .....	154
Introduction to Graph-Database.....	154
Mental Power for IT Disciplines.....	155
Machine Learning 2 .....	156
Clean code: principles, advantages and examples .....	156
Industrial Engineering & Business (MIB).....	156
International Finance .....	156
International Law .....	157
Public Affairs & Lobbying .....	158
Professional Writing Skills.....	159

Managerial Economics and Operations Research .....	161
Quantum Information Laboratory .....	161
Introduction to Quantum Information .....	162
Tissue Engineering and Regenerative Medicine (MTE) .....	163
Tissue Engineering for Regenerative Medicine .....	163
Biomaterials in Tissue Engineering .....	165
Protein Chemistry .....	167
Current Problems in Regenerative Medicine .....	168
Stem Cells in Regenerative Medicine .....	169
Advanced Immunology and Vascular Tissue Engineering .....	170
Advanced Technologies in Biological Research .....	171
AI Engineering (MAI) .....	173
Machine Learning 1: Basics .....	173
Embedded Systems (MES) .....	174
Societal Impact Studies .....	174
Robotics Engineering (MRE) .....	175
Advanced Programming for Robots .....	175
Advanced Programming .....	176
Digital Leadership .....	177
Specialization 1 .....	179
Sports Technology (MST) .....	180
Materials sciences in sports .....	180
Applied biomechanics and biomechanical multi-body simulation .....	181
Sports wear .....	183
Design .....	184
Product management .....	184
Bionics .....	185
Aerodynamics .....	186
Power Electronics (MLE) .....	187
Presentation Techniques .....	187
Societal Impact Studies .....	188
Information Systems Management (MWI) .....	189
Artificial Intelligence in Enterprises (Spezialisierung) .....	189
Systems Engineering (Spezialisierung) .....	190
Big Data & Machine Learning (Spezialisierung) .....	191
IT-Governance (ITIL, Cobit) .....	193
Knowledge and Document Management (Spezialisierung) .....	194
IT Operations Management .....	195
Quantum Engineering (MQE) .....	196
Quantum Programming Lab I .....	196
Quantum Information Laboratory .....	197
Homologation Physics .....	198

Mathematics for Quantum Engineering .....	198
Quantum Computing I .....	199
Quantum Information I .....	200
Enabling Technologies I .....	201
Internet of Things and Smart Systems (MIO) .....	202
Innovation- and Technologiemanagement .....	202
Data Management .....	203
Mobile and Wireless Systems .....	204
IoT Operating Systems .....	206
IoT System Models .....	207
Networking .....	209
Automation .....	210



# 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 these phase the students have the introduction courses, attend the examinations or give their presentations in front of the class.  During the online-phase the students have to work on the course contents via moodle courses, where they have to hand in assignments, take part in forum discussions and/or read study letters and literature. During the online-phase the students do not have to be presence at the university.
Lecture	VO	Mediation of new knowledge by the means of frontal teaching.
Exercise	UE	Reduced transfer of new knowledge and practical strengthening in (small) groups.

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

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



# CAMPUS INTERNATIONAL

## Campus International (ECI)

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

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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!
<b>Teaching methods</b>	Theoretical input, group workshops, teamwork, group discussions, independent research, participant preparation of written documents.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- question their cultural stereotypes and prejudices in the context of Erasmus+;</li> <li>- reflect on different strategies for dealing successfully with likely cultural differences during their semester abroad;</li> <li>- understand the approaches they can use to prepare for the bureaucratic and technical challenges of their semester abroad;</li> <li>- negotiate a variety of typical challenging situations that they will</li> </ul>

	likely face in an international environment.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Tactics, personal behaviours and qualities to be strengthened for achieving success during the semester abroad;</li> <li>- Bettering intercultural awareness and recognition of stereotyping;</li> <li>- Hofstede's cultural dimensions;</li> <li>- Techniques for efficient communication in English as a Lingua Franca;</li> <li>- Practice in overcoming challenges and problems in an intercultural environment (role plays)</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- 50% student presentations</li> <li>- 25% completion of participation tasks</li> <li>- 25% final written task</li> </ul>
<b>Recommended Reading and Material</b>	- Script
<b>Attendance</b>	75% mandatory
<b>Comments</b>	

## Empowering Intercultural Teams for Success: Theory - Tactics – Solutions

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>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</p>
---------------------------	---

	<p>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.'</p>
<b>Teaching methods</b>	Theoretical input, group workshops, teamwork, group discussions, independent research, participant preparation of written documents.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- question their culturally formed stereotypes and prejudices;</li> <li>- reflect on different strategies for dealing successfully with cultural differences;</li> <li>- apply strategies to overcome problems related to intercultural differences;</li> <li>- work successfully in an English as a Lingua Franca environment;</li> <li>- cooperate effectively in intercultural teams to overcome and solve cultural problems and issues.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Attributes of a successful intercultural team participant/leader;</li> <li>- Hofstede's cultural dimensions;</li> <li>- Techniques for efficient communication in English as a Lingua Franca;</li> <li>- Strategies for working successfully in an intercultural team;</li> <li>- Problem based intercultural workshop</li> </ul>
<b>Prerequisites</b>	B2 English level
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- 25% student presentation</li> <li>- 50% successful completion of workshop</li> <li>- 25% final written task</li> </ul>
<b>Recommended Reading and Material</b>	- Script
<b>Attendance</b>	75% mandatory

Comments	
----------	--

## CI\_German Language & Austrian Culture A1

Degree programme	ECI
Semester	1
Course methods	ILV
Language	English
ECTS Credits	3.00
Incoming places	Limited

Course description	Starting from a very basic level of German (A1 of the Common European Framework of Reference for Languages), we aim at developing students for situations required for personal and social interaction in Austria on a basic level. The focus of the course is the development of oral communication skills within an intercultural context.
Teaching methods	discussions, integrative grammar work, role games, songs, group work and presentations
Learning outcome	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- ask questions about personal details</li> <li>- talk about themselves and others in terms of hobbies, preferences, dislikes</li> <li>- understand and write short e-mails, using an appropriate level of formality</li> <li>- understand and formulate simple questions and orders</li> <li>- understand and use numbers in various contexts as well as to ask for prices, such as in the furniture store, in the restaurant, at the Christmas market</li> <li>- give the time of day and make appointments</li> <li>- understand and use the phrases required for shopping and eating out as well in daily situations</li> <li>- talk about living circumstances as well as the weather and ask questions</li> <li>- talk and write about the past</li> </ul>
Course contents	<ul style="list-style-type: none"> <li>- personal topics</li> <li>- vocabulary and situations in terms of eating and drinking, living circumstances</li> </ul>

	<ul style="list-style-type: none"> <li>- weather</li> <li>- oral and written situations in the past (past perfect tense)</li> <li>- integrative grammar: articles in nominative and accusative, possessive pronouns in nominative and accusative, past perfect tense, prepositions, imperative, modal verbs</li> </ul>
<b>Prerequisites</b>	Basic knowledge in German language (GERS A1) such as ABC, numbers, conjugation of the verbs, articles, forms of negation, basic vocabulary is advantageous
<b>Assessment Methods</b>	- 20% personal language development; 30% tests during the semester; 50% final exam (written exam and presentation)
<b>Recommended Reading and Material</b>	- Scriptum and online-exercises
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_German Language & Austrian Culture A2

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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
<b>Teaching methods</b>	group work, role play, text production, homework
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- 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</li> </ul>



	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
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Grammar: regular and irregular verbs in Perfect, prepositions with Akkusativ+Dativ, separable verbs</li> <li>- Topics: Living together, Looking for an apartment, Furniture, clothes, Sights, Arts, Basic information about Austrian culture</li> </ul>
<b>Prerequisites</b>	A1
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	- PANORAMA, Deutsch als Fremdsprache A21, Kursbuch, Cornelsen Verlag; ISBN 978-3-06-120488-4 (also available as E-Book)/ PANORAMA Übungsbuch A2.1; ISBN 978-3-06-120604-8
<b>Attendance</b>	
<b>Comments</b>	

## CI\_German Language & Austrian Culture B1

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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).
<b>Teaching methods</b>	Group work, role plays, text production, excursion, audio- and video files, authentic texts
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- understand the main points of clear standard speech on familiar matters regularly encountered in work, school, leisure, etc</li> <li>- understand the main point of many radio or TV programmes on current affairs or topics of personal or professional interest when the</li> </ul>

	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.
<b>Course contents</b>	- 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
<b>Prerequisites</b>	German A2 level
<b>Assessment Methods</b>	- Tests (mid-term and final test,) performance in class, homework
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	80%
<b>Comments</b>	

## CI\_German Language & Austrian Culture B2

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Repetition, perfection and exercises of relevant grammatical structures • Vocabulary and useful phrases for B2 • Economy / career / work • New technology • Modern life / society
<b>Teaching methods</b>	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.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - understand grammatically complex texts which are rich in

	<p>vocabulary on the level B2</p> <ul style="list-style-type: none"> <li>- write a summary and comment the main topics of a text.</li> </ul> <p>Furthermore you have developed and enlarged your knowledge of German for the purpose of your studies</p> <ul style="list-style-type: none"> <li>- You have improved and clarified your writing skills as well as you can refer to phrases of argumentation.</li> <li>- describe and comment graphics and you can take a critical point of view in the context of a text.</li> <li>- write a request, a letter of complaint with the appropriate register</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Reading of press articles and exercises in global and close reading as well as training of vocabulary and grammar</li> <li>- Writing summaries and expressing your point of view with the right expressions</li> <li>- Expressing advantages or disadvantages</li> <li>- Writing a letter of complaint or a request with the right expressions</li> <li>- Reporting about texts, describing and commenting graphics in the context of an article</li> <li>- Making an interview in the context of your studies and writing about your learning outcome</li> </ul>
<b>Prerequisites</b>	Only for students with a good knowledge of German who are interested in improving their writing skills
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- 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)</li> <li>- 2) Exercises on Moodle (25 points)</li> <li>- 3) Active participation (25 points)</li> </ul>
<b>Recommended Reading and Material</b>	- Texts and exercises on Moodle and handouts of the regular class.
<b>Attendance</b>	Compulsary
<b>Comments</b>	

## CI\_Scientific Writing

<b>Degree programme</b>	ECI
<b>Semester</b>	1

<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	Exercises, peer-learning, talks, discussions, online-tasks
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Define, describe, identify and evaluate academic resources</li> <li>- Describe and apply the common structure of a scientific paper</li> <li>- Discuss the different kinds of research questions and apply them to their field or research</li> <li>- Describe and discuss the common structure of a Bachelor's Thesis or Master's thesis</li> <li>- Write text according to common standards of academic writing</li> </ul>
<b>Course contents</b>	- 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?
<b>Prerequisites</b>	Basic knowledge of scientific keyterms and principles.
<b>Assessment Methods</b>	- Course immanent assessment method and end exam
<b>Recommended Reading and Material</b>	- Leedy, Ormrod: Practical Research. Planning and Design. Pearson - Skern: Writing Scientific English. Facultas wuv UTB
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_Audio Engineering

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV

<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	The Lecturer will explain some basic concepts. The students will compete tasks in the computer using Matlab.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Understand the signal chain in a typical audio application, and be able to recognise and avoid distortions in all stages</li> <li>- understand how humans perceive sound,</li> <li>- record sounds using the appropriate equipment,</li> <li>- measure different attributes of sound and understand how they correlate to human perception,</li> <li>- analyse and interpret recorded sounds</li> <li>- synthesise sounds with specific attributes</li> <li>- perform audio processing on recordings</li> <li>- understand how audio compression works</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Sound and sound attributes</li> <li>- Human perception of sound</li> <li>- Signal chain in audio engineering</li> <li>- Microphones and amplifiers</li> <li>- Analog vs digital signals</li> <li>- Fourier Analysis, Spectrum, Spectrogram</li> <li>- Synthesis of sounds</li> <li>- Filters</li> <li>- Audio compression</li> <li>- Loudspeakers</li> </ul>
<b>Prerequisites</b>	Basic programming skills. Matlab knowledge advantageous.
<b>Assessment Methods</b>	- The students will be assessed according to how far they completed the task at hand
<b>Recommended Reading and Material</b>	- Script provided by the lecturer
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_Electronic Laboratory

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This integrated course provides students the opportunity to calculate and build electronic circuits, as well as measuring their characteristics with modern measuring devices.
<b>Teaching methods</b>	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.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- measure voltages and currents with a DMM and oscilloscope correctly</li> <li>- produce signals with the Function Generator</li> <li>- calculate electronic circuits, build them and measure their outputs and characteristics</li> <li>- measure the output of circuits involving resistors, capacitors, diodes and OpAmps with the oscilloscope</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Oscilloscope and Function Generator</li> <li>- Kirchhoff laws</li> <li>- Diode and Zener Diode</li> <li>- DC Power supply design and implementation</li> <li>- OpAmp circuits</li> <li>- RC Circuit: DC and AC analysis</li> <li>- Transistor Amplifiers</li> <li>- Project: Audio Equaliser</li> </ul>
<b>Prerequisites</b>	Students should have basic knowledge of electronics and electronic

	circuits.
<b>Assessment Methods</b>	- The students will be assessed according to how far they completed the experiment at hand.
<b>Recommended Reading and Material</b>	- Maxfield et al., "Electrical Engineering know it all", Newnes & Elsevier, 2008. - Scripts and materials provided by the lecturer.
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_Traffic Safety Culture and Mobility

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	Mandatory readings, individual investigation, presentations and group discussions in plenum and breakout sessions. Some frontal teaching.
<b>Learning outcome</b>	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
<b>Course contents</b>	<p>- 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.</p> <p>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</p>
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	<p>- Reports on mandatory readings (30%)</p> <p>- active participation (30%)</p> <p>- Exam</p>
<b>Recommended Reading and Material</b>	<p>- Ward, N. J., Watson, B., &amp; Fleming-Vogl, K. (Eds.). (2019). Traffic Safety Culture: Definition, Foundation, and Application. Emerald Group Publishing.</p> <p>- Shinar, D. (Ed.). (2017). Traffic safety and human behavior. Emerald Group Publishing.</p> <p>- Journal Transportation Research Part F</p> <p>- Journal of Transportation and Health</p>
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_Renewable Energy Laboratory

<b>Degree programme</b>	ECI
<b>Semester</b>	1



<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Experimental setup of different means of measuring methods to evaluate the performance of renewable energy technologies and systems.
<b>Teaching methods</b>	Laboratory exercises in small groups of typically 8-12 students
<b>Learning outcome</b>	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.
<b>Course contents</b>	- 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
<b>Prerequisites</b>	Basics in: - Electrical machines - Mechanical engineering - Thermodynamics - Instrumentation
<b>Assessment Methods</b>	- Laboratory notes - Laboratory reports - Grading of practical session - Laboratory reports
<b>Recommended Reading and Material</b>	- Scripts of the lecturers
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_Building Climate Engineering

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	Lectures combined with practical teaching on the construction site of an energy efficient building.
<b>Learning outcome</b>	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.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of building physics, heat, humidity and sound protection</li> <li>- Building construction components from the view point of building physics and energy efficiency, comparison on international basis</li> <li>- Heating, cooling and ventilation possibilities,</li> <li>- Energy benchmark levels, calculating of the energy demand of buildings</li> </ul>
<b>Prerequisites</b>	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
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Combined written and oral exam, written exam in 2-3 examples 40% Cooperation, attendance 20%</li> <li>- Project including energy layout and a short planning example of heating, ventilation and/or cooling 40%</li> </ul>
<b>Recommended Reading</b>	- Gerhard Hausladen, Saldanha, Liedl, 2013: Climate Skin Building

<b>and Material</b>	Skin Concepts that can do more with less energy, ISBN978-3-0346-0727-8, Birkhäuser Verlag Basel
<b>Attendance</b>	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.
<b>Comments</b>	

## CI\_Cooperative International Student Project

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The main focus of the specialization ,Cooperative International Project-Smart Cities' follows the integrated design of urban projects under consideration of technological options (energy, buildings, networks), design options (architecture in urban areas) and user behaviour (diversity). Through the integration of interdisciplinary and international teams the project gains additional benefit. Compared to the specialisation of the 4th semester technological options, geographic area and user behaviour get complexer.
<b>Teaching methods</b>	project work with international teams
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- solve integrated planning, design, construction and development procedures in the international context of a smart city</li> <li>- discuss and evaluate the interdisciplinary aspects of energy supply and demand, architecture and city planning for building complexes</li> <li>- analyse and integrate gender and diversity aspects in the international context of a smart city project</li> <li>- integrate measures and data analysis of international reference projects in the own project</li> <li>- formulate and state a problem of the respective discipline and write a scientific bachelor thesis adhering to a given template</li> <li>- explain and present the contents and results of their own scientific publications and those of others</li> </ul>

<b>Course contents</b>	- International Team work of an integrated planning process of a large SMC project, for instance a district in urban areas. Consequent procedure of characteristic project phases, requirement specifications, project plan, design concepts, variants, documentation and presentation. Integration of diversity aspects in the smart city context. Usage of complex simulation software. Contact with regional, urban administration officials.
<b>Prerequisites</b>	Basics in at least two sectors: building construction, electrical and/or mechanical installations, energy design and solar architecture
<b>Assessment Methods</b>	- Course immanent assessment method with a final presentation in front of an international commission
<b>Recommended Reading and Material</b>	- Transform, Transformation Agenda for Low Carbon Cities, 2013, <a href="http://urbantransform.eu">http://urbantransform.eu</a>
<b>Attendance</b>	Attendance ist mandatory
<b>Comments</b>	this project will be realised in cooperation of international University teams

## Service and object-oriented Algorithms in Robotics

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course discusses important concepts of robot control in the context of modern data-driven robotics. Thus, different methodologies from robotics and data-science are taught and utilised using Python and the robot operating system (ROS).
<b>Teaching methods</b>	This course is based on theory and exercises with mobile robot simulations/ robots. - Lecture (theory, methods, math and algorithms) - Exercises in small groups: problem solving with robot simulation/ real robots
<b>Learning outcome</b>	After passing this course successfully students are able to ... - explain components and operating modes of robots, - define and differentiate between navigation with plans, localisation

	<p>and trajectory planning,</p> <ul style="list-style-type: none"> <li>- identify required robot system components based on the system's desired use case and level of autonomy,</li> <li>- create ROS launchfiles and interface with ROS using Python and Jupyter notebooks,</li> <li>- implement pipelines for sensor data processing, and</li> <li>- explain and desvisualise various data types/structures required in robotics applications.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Introduction to important concepts in robotics and ROS</li> <li>- Sensor-based robot control</li> <li>- Mobile robot simulation</li> <li>- Programming and software documentation (Python and Jupyter notebooks)</li> </ul>
<b>Prerequisites</b>	Mandatory: - Sensor technology - Basic understanding of programming, in particular in Python or C
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- 70% Group project with presentation</li> <li>- 30% Exercises</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- <a href="http://wiki.ros.org/ROS/Tutorials">http://wiki.ros.org/ROS/Tutorials</a></li> <li>- C. M. Bishop, Machine Learning and Pattern Recognition, 2006</li> <li>- S. Russell and P. Norvig, Artificial intelligence: a modern approach, 1995</li> </ul>
<b>Attendance</b>	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.
<b>Comments</b>	-

## ASSIST HEIDI Designing and implementing Assistive Tools for people with disabilities

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course brings students and people with disabilities (HEIDI –
---------------------------	---

	Human being with disability) together, to design and prototype an individual assistive technology solution for them. Students will learn the basics about disability, existing assistive tools, rapid prototyping and microcontrollers and will have access to materials, tools and equipment (e.g. 3D printer etc.). The Smart Living Lab of the UAS Technikum Wien ( <a href="https://youtu.be/qv6cvPn4fNU">https://youtu.be/qv6cvPn4fNU</a> ) provide the perfect environment for the participants. This is the best opportunity to get to know people with disabilities, to contribute, develop and implement your own ideas. The course methodology and contents will be similar to the ASSIST HEIDI summer school 2022. Link: <a href="https://www.technikum-wien.at/en/course-assist-heidi/">https://www.technikum-wien.at/en/course-assist-heidi/</a>
<b>Teaching methods</b>	Co-Design, Problem-based learning
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- understand daily challenges of people with disabilities</li> <li>- understand and apply the principles of co-design</li> <li>- understand types and causes of disabilities</li> <li>- know the current technical aids to support people with disabilities and to be able to select suitable technologies for certain applications</li> <li>- design and implement assistive prototypes using rapid prototyping, microcontrollers, or computer vision / ML</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- At the beginning of the course the students will be introduced to people with disabilities and will interview them to understand their daily challenges and find inspiration for project work. After the project selection the students will form groups of 4-6 persons and collaboratively design and implement a project idea supervised by the lecturers. Finally, the project results must be presented and will be evaluated by the HEIDIs and lecturers.</li> <li>- In parallel, several topics will be covered including small exercises: <ul style="list-style-type: none"> <li><input type="checkbox"/> Physiological basics, Types and causes of disabilities</li> <li><input type="checkbox"/> Assistive tools</li> <li><input type="checkbox"/> Rapid Prototyping</li> <li><input type="checkbox"/> Computer vision + ML with python</li> <li><input type="checkbox"/> Arduino microcontroller</li> </ul> </li> <li>- In week 1, the classes will be on Wednesday and Thursday 15:15 – 17:40. Starting with week 2, the classes will be held weekly on Thursday 16:10-17:40 on campus. In parallel, regular sessions are provided for project supervision on Wednesday 16:10-17:40 (bi-weekly).</li> </ul>
<b>Prerequisites</b>	Programming, English
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	- Author: Dr. Wolfgang L. Zagler, Title: Rehabilitationstechnik, Date: March 1, 2008, Location: Vienna, Austria, Book URL:

	<a href="https://studyathome.technikum-wien.at:8092/">https://studyathome.technikum-wien.at:8092/</a>
<b>Attendance</b>	Attendance is mandatory in classes on campus.
<b>Comments</b>	

## International Marketing

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	SO
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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;
<b>Teaching methods</b>	Self-study, lecture, distance learning, case studies, group projects
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- discuss motives and triggers why firms go international</li> <li>- evaluate the factors influencing a firm's international competitiveness</li> <li>- define international market selection and identify the problems related with it</li> <li>- evaluate the factors to consider when choosing a market entry strategy</li> <li>- design global marketing programs</li> <li>- contribute to strategic marketing decisions</li> <li>- understand and contribute to marketing mix decisions</li> </ul>
<b>Course contents</b>	- Internationalization process

	<ul style="list-style-type: none"> <li>- Market segmentation</li> <li>- Creating competitive advantage</li> <li>- Global marketing communication</li> <li>- Market selection process</li> <li>- Brand building</li> <li>- Marketing Mix decisions</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Written examination (70%)</li> <li>- Group Assignment (30%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Global Marketing, Hollensen, 2016</li> <li>- International Marketing, Czinkota , Ronkainen 2012</li> <li>- Strategic Brand Management, Keller 2013</li> </ul>
<b>Attendance</b>	Attendance is compulsory.
<b>Comments</b>	Detailed information regarding the course is provided via Moodle.

## Mobile Robotics

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course provides an introduction to the basics in mobile robotics with regard to the main components of mobile robots. The students achieve a basic understanding of methods to control mobile robots and implement behaviours as well as methods for direct sensor-actor coupling. The knowledge learned is first applied in a simulation environment and finally tested on a real robot.
<b>Teaching methods</b>	The learning content is explained using PDF slides and Jupyter notebooks. Afterwards, the students are divided into groups and carry out a project independently with the help of the lecturer.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain components and operating modes of robots</li> <li>- define and differentiate between navigation with plans, localisation and trajectory planning</li> </ul>



	<ul style="list-style-type: none"> <li>- control mobile robots by applying behaviour methods for direct sensor-actor coupling</li> <li>- apply basic knowledge ROS</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Introduction to Mobile Robotics</li> <li>- Develop ROS nodes for robot applications</li> </ul>
<b>Prerequisites</b>	Mandatory: Programming in C++ and/or Python; Basic Linux Skills (there are warm-up slides)   Recommended: Computer Vision Basics
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Homework: 20%</li> <li>- Moodle Quizzes: 20%</li> <li>- Moodle Forum: 5%</li> <li>- Projekt: 55%</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- O'Kane: A Gentle Introduction To ROS, 2.1.6, 2018, <a href="https://www.cse.sc.edu/~jokane/agitr/">https://www.cse.sc.edu/~jokane/agitr/</a></li> <li>- <a href="http://wiki.ros.org/">http://wiki.ros.org/</a></li> </ul>
<b>Attendance</b>	
<b>Comments</b>	This course requires a (reasonably) powerful computer:- min i5 (7th gen.)- 8GB RAM (Ubuntu)   16GB RAM (Windows)

## Data Ethics & Open Data

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>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</p>
---------------------------	--

	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.
<b>Teaching methods</b>	The course consists of - lectures combined with discussions - project work and exercises
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- analyse and work with Open Data</li> <li>- determine different fields of Open Data applications</li> <li>- assess the quality of different Open Data sources</li> <li>- value the importance of responsible handling of data in different areas of application</li> <li>- discuss domain-related data ethics</li> <li>- analyse and describe the challenges and risks of an intelligent machine learning system (AI)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Open Data applications in different fields: Healthcare, finance, Smart Cities etc.</li> <li>- Open Data formats</li> <li>- Open Data policies</li> <li>- Project: analysing and processing open data</li> <li>- Data Ethics</li> <li>- Data Privacy, Transparency</li> </ul>
<b>Prerequisites</b>	Basic Knowledge in Web Technologies, Database Systems, and Data Management
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Participation in discussions and presentation (Data Ethics)</li> <li>- Project results and project presentation (Open Data)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Ethics Advisory Group (2018): Ethics Advisory Group Report 2018</li> <li>- European Union (2017): Open Data Maturity in Europe 2017</li> <li>- Specific papers related to domains</li> <li>- Open data Web sites and catalogues (e.g. <a href="https://open.wien.gv.at">https://open.wien.gv.at</a>)</li> </ul>
<b>Attendance</b>	Attendance is mandatory
<b>Comments</b>	Course Details will be provided in Moodle.

## Building and Solar Energy

<b>Degree programme</b>	ECI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English

<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	Project-Based Learning method. Combined with lectures and practical teaching on the remote laboratories. Supported by virtual learning environment and simulation.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Design preliminary concepts and design of energy efficient building supported by solar energy</li> <li>- Simulation of a solar energy system</li> <li>- Possibilities of building integrated photovoltaics and construction design</li> <li>- Overview of the market, drivers, stakeholders for integration of affordable renewable energy systems</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Energy characterization and energy planning of solar building</li> <li>- Designing a building-integrated photovoltaic installation by software tools</li> <li>- Measurement and analysis of solar systems in the lab</li> <li>- Best practice of solar design (Excursion)</li> <li>- Overview of the market, legislative and drivers for solar energy and buildings</li> </ul>
<b>Prerequisites</b>	Basic knowledge at least in one or two of the following topics: - Building construction - Solar energy system - Energy planning of buildings
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Lecture notes</li> <li>- Grading of practical session</li> <li>- Project reports</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Cost Optimal and Nearly Zero-Energy Buildings (nZEB) Definitions, Calculation Principles and Case Studies, Editors: Kurnitski, Jarek (Ed.)</li> <li>- Designing with Solar Power: Source book for Building Integrated Photovoltaics. D. Prasad, M. Snow Routledge</li> <li>- Modeling, Design, and Optimization of Net-Zero Energy Buildings Athienitis (Ed.), W.O'Brien (Ed.), ISBN: 978-3-433-03083-7, February 2015</li> <li>- Building integrated photovoltaics: A handbook S. Roberts and N.</li> </ul>

	Guariento, Editors: Springer
<b>Attendance</b>	Attendance is mandatory in this course, only 20% of absence is accepted.
<b>Comments</b>	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

# BACHELOR DEGREE PROGRAMS

## Mechatronics/Robotics (BMR)

### Mobile and service robotics

<b>Degree programme</b>	BMR
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course discusses the foundations of mobile and service robots. The main content of this course is classic mobile robot localization, path planning and path control. The participants learn the main concepts to control a mobile robot relying on traditional methods. During this course several exercises will be implemented by each participant relying on the robot operating system (ROS). Furthermore, they are going to implement and solve a mobile robot problem.
<b>Teaching methods</b>	Integrative lecture, exercises
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Understand the mechatronic modules of a module robot</li> <li>- Calculate and implement the kinematic model of mobile robots</li> <li>- Understand problems and solution of a mobile robot</li> <li>- Implement intelligent modules for mobile robot navigation</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Modules of a mobile robot</li> <li>- Kinematics of mobile robots</li> <li>- Path planning with and without maps</li> <li>- Foundations of probabilistic robotics</li> <li>- ROS</li> </ul>
<b>Prerequisites</b>	Math, industrial robots, C++
<b>Assessment Methods</b>	- Course-immanent performance assessment
<b>Recommended Reading and Material</b>	- Siegwart, R. und Nourbakhsh, I.R.; (2004) Introduction to Autonomous Mobile Robots (Intelligent Robots and Autonomous Agents), MIT Press

	- Russell, S., Norvig, P.; (2012) Artificial Intelligence: A modern approach, Pearson
<b>Attendance</b>	75%
<b>Comments</b>	

## Computer Science (BIF)

### Technical English

<b>Degree programme</b>	BIF
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> </ul>

	<ul style="list-style-type: none"> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Innovation Lab 1

<b>Degree programme</b>	BIF
<b>Semester</b>	3
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	project work
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Implement requirements in a team and transform them into an operational IT system</li> <li>- plan and coordinate a project in small groups</li> <li>- work in teams and to coordinate tasks</li> <li>- to present project results in front of colleagues and to argue possible solutions</li> </ul>
<b>Course contents</b>	- Practical deepening of the content of other courses in a project

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

### Innovation Lab 3

<b>Degree programme</b>	BIF
<b>Semester</b>	5
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Project Based Learning in Computer Science. The course is intended to combine acquired isolated knowledge of various lectures and to put it to practical use. Projects may be proposed by students or can be chosen from suggested projects. Participation in projects at the university or in companies is also possible. The projects need to match the requirements of the current semester (levels and workload). Projects need to have a real customer.
<b>Teaching methods</b>	project work
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Implement requirements in a team and transform them into an operational IT system</li> <li>- plan and coordinate a project in small groups</li> <li>- work in teams and to coordinate tasks</li> <li>- to present project results in front of colleagues and to argue possible solutions</li> </ul>
<b>Course contents</b>	- Practical application of the content of other courses in a project
<b>Prerequisites</b>	All courses of previous semesters
<b>Assessment Methods</b>	- Project results



<b>Recommended Reading and Material</b>	- depending on project
<b>Attendance</b>	partly
<b>Comments</b>	The supervision is done on an individual basis in synchronous or asynchronous settings and is supported by modern communication tools.

## Mechanical Engineering (BMB)

### Manufacturing Engineering

<b>Degree programme</b>	BMB
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course students acquire basic knowledge in the fields of production engineering according to DIN 8580.
<b>Teaching methods</b>	Integrated course
<b>Learning outcome</b>	After passing this course successfully students are able to ... - specify essential industrial requirements for manufacturing processes using appropriate technical parameters, - explain selected manufacturing processes from the main groups mentioned in DIN 8580 with regard to basic physical or chemical principles, - describe a manufacturing process using one or more of these methods by means of the underlying process flow logic (material flow).
<b>Course contents</b>	- Requirements for industrial manufacturing processes (incl. measured variables) - Overview of main groups of manufacturing processes (DIN8580)
<b>Prerequisites</b>	Basic knowledge according to admission requirements for the bachelor's program
<b>Assessment Methods</b>	- Participation, homework and Moodle-exams

<b>Recommended Reading and Material</b>	- Förster, R.; Förster, A.: Einführung in die Fertigungstechnik, Springer Vieweg, 2018
<b>Attendance</b>	75%
<b>Comments</b>	The course is held exclusively in English.

## Materials Science

<b>Degree programme</b>	BMB
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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 how to select the right material for a product design and carry out proper material tests in the laboratory course!
<b>Teaching methods</b>	Integrated course
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to explain the basic properties of metallic materials (steel, cast iron, aluminium, copper, titanium, magnesium and their alloys) from a scientific and technical point of view, using practical industrial examples</li> <li>- explain the basics of microscopy and electron microscopy</li> <li>- to be able to make a simple material selection of metals</li> <li>- To be able to name metallic materials.</li> <li>- be able to enumerate metallic materials compared to plastics and ceramics as well as composite materials with advantages and disadvantages</li> <li>- explain the basics of mechanical methods for testing materials as well as selected concrete test methods using appropriate technical terms and quantities (tensile test, hardness test, Charpy, Wöhler)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Terms (e.g. thermal expansion, modulus of elasticity, ...) and material properties</li> <li>- Atomic decomposition &amp; periodic table, chemical bonds</li> <li>- Structure of metals (krz, kfz, hdp)</li> </ul>

	<ul style="list-style-type: none"> <li>- Iron-carbon diagram</li> <li>- Steel and cast iron</li> <li>- Aluminium materials</li> <li>- Copper Materials</li> <li>- Titanium materials</li> <li>- Magnesium materials</li> <li>- Alloys, phase diagrams</li> <li>- Electrochemistry especially corrosion of metallic materials</li> <li>- Mechanical test methods (tensile test, notched bar impact bending test, hardness test, Wöhler test), PT, MT, VT; UT.</li> <li>- effects of mechanical stress (e.g. deformation, work hardening)</li> <li>- Interaction of material and production technology, example forging</li> <li>- Basic principles of material selection (presentation of software tools)</li> <li>- Differences of the material classes (metals, plastics, ceramics)</li> <li>- Electron microscopic examination of various materials</li> </ul>
<b>Prerequisites</b>	Basic knowledge according to admission requirements for the bachelor's program Prior knowledge of manufacturing technology from the course "Manufacturing Engineering"
<b>Assessment Methods</b>	- Participation and presentation, Moodle tests and final examination
<b>Recommended Reading and Material</b>	- - Ashby, M.F.; Jones, D.R.H.: Engineering Materials 1: An Introduction to Properties, Applications and Design, Elsevier, 2011
<b>Attendance</b>	75%
<b>Comments</b>	More detailed information can be found in the Moodle course.

## Technical English

<b>Degree programme</b>	BMB
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written
---------------------------	--

	skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ... - record and employ technical vocabulary - create and understand technical process instructions - identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Applied Computer Science

<b>Degree programme</b>	BMB
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00

<b>Incoming places</b>	Limited
<b>Course description</b>	<p>Software has become part of all areas of industrial engineering. Therefore, a basic education in applied computer science and the development of software are standard components of the graduates' toolbox. During the teaching, special emphasis is given to the abstraction of requirements and, subsequently, the realisation of corresponding software systems. In the first part of the course you will learn about the fundamentals of computer architecture, operating systems and virtualizations and you will work hands-on with file systems and bootable USB-Drives. In further classes and self-studies you will get insights into programming with python and the creation of algorithms using flowcharts in the first place and subsequently by using Python as a programming language. Python is a high-level programming language with use-cases in mechanic engineering, data aggregation, data analysis and many more. Working hands-on with datatypes and control structures will provide you the basic skills to create programs. Practical weekly moodle tests will keep you on track and will consequently challenge you to gain implementation expertise. Hands-on working with collections and files will expand your options in how to solve problems using your programming skills. In later classes you will expand your skills even further by working with an online simulation of a Raspberry Pi and by processing Open Data using APIs.</p>
<b>Teaching methods</b>	Combination of classes and self-study phases
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- understand and explain architectures, operating systems and peripherals of computers</li> <li>- analyze and explain problems/tasks, create algorithmic solutions (using flow charts) and implement them using structured programming techniques</li> <li>- 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).</li> <li>- execute software tests</li> <li>- develop practical applications on a Raspberry Pi simulation</li> <li>- develop practical applications based on open data</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Introduction Computer Science: Computer architecture, hardware, operating systems</li> </ul>

	<ul style="list-style-type: none"> <li>- Software and its characteristics</li> <li>- Programing paradigms, programing languages and their fields of application</li> <li>- Software development, development processes</li> <li>- Microcontroller vs. Microprocessor</li> <li>- Introduction to programming with python</li> <li>- Data processing: reading, processing, output of data</li> <li>- Contrul structures and loops</li> <li>- Dictionaries</li> <li>- Functions</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Weekly moodle tests</li> <li>- Practical exercises</li> <li>- Moodle exam at the end of the course</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Christian Baun, Operating Systems / Betriebssysteme, DOI: 10.1007/978-3-658-29785-5</li> <li>- Connor P. Milliken, Python Projects for Beginners – A Ten-Week Bootcamp Approach to Python Programming, DOI: 10.1007/978-1-4842-5355-7</li> <li>- Sunil Kapil, Clean Python – Elegant Coding in Python, DOI: 10.1007/978-1-4842-4878-2</li> <li>- Python® Notes for Professionals, <a href="https://books.goalkicker.com/PythonBook/">https://books.goalkicker.com/PythonBook/</a> (free)</li> </ul>
<b>Attendance</b>	75%
<b>Comments</b>	

## Smart Homes and Assistive Technologies (BSA)

### IT Security Basics

<b>Degree programme</b>	BSA
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course offers an overview of the fundamentals of IT security and deals with cryptographic methods, authenticity, key management, access control and secure communication.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to name the protection goals of IT security and to show threats as well as methods to guarantee the goals</li> <li>- know cryptographic methods and can name their respective strengths and weaknesses and thus possible application scenarios</li> <li>- Encrypt and sign emails and any documents</li> <li>- List methods for access control and monitoring at network, system and application levels and explain their function and application scenarios</li> <li>- Can explain basic technologies for secure communication</li> <li>- Explain basic procedures for evaluating the importance of systems or for risk analysis</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of Information Security</li> <li>- Threat to IT security and sources of danger (internal and external threats)</li> <li>- Basics of cryptography</li> <li>- HMAC</li> <li>- Public key infrastructures (PKI)</li> <li>- Signatures</li> <li>- Certificates</li> <li>- access control</li> <li>- Identification/Authentication/Authorization</li> <li>- Password security/entropy</li> <li>- DMZ, Firewall &amp; IDS/IPS</li> <li>- IPSec</li> <li>- Transport Layer Security</li> <li>- Secure communication mechanisms</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Software Security

<b>Degree programme</b>	BSA
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Introduction to the basic aspects of IT security with special focus on network security
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Implement protection goals for wireless and wired networks</li> <li>- create concepts for the protection of sensitive information in applications</li> <li>- To establish Identity &amp; Access Management in web applications the more the security standard is increased (system hardening).</li> <li>- to transfer security topics from the web environment to requirements from the cloud</li> <li>- Administrate security systems</li> <li>- to assess IT security of systems</li> <li>- Ensure confidentiality and integrity of data in transfer</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Cryptographic methods and their practical application</li> <li>- Protection of wired and wireless networks</li> <li>- Transport layer security and virtual private networks</li> <li>- Protection of mobile devices</li> <li>- Web Application Security</li> <li>- Identity &amp; Access Management</li> <li>- Data protection and data security on the web</li> <li>- Management of security systems</li> <li>- Hardening of systems</li> <li>- Cloud Security</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	



# Biomedical Engineering (BBE)

## Technical English

<b>Degree programme</b>	BBE
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> </ul>

	- Written Test (60%)
<b>Recommended Reading and Material</b>	- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag. - Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Medical Imaging and Analysis

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Medical imaging is crucial to the diagnosis, therapy planning and therapy monitoring of various pathologies. Essentially, a distinction can be made between anatomical (X-ray, CT, MRI, ultrasound) and functional (PET, SPECT, etc.) imaging modalities. While anatomical imaging modalities, as the name suggests, provide information about the anatomical features, functional imaging modalities provide information about the metabolic function of certain organ systems or tumors. Depending on the diagnostic question and indication of the imaging, different processing and analysis methods have to be applied in order to obtain a data set from the image that can be evaluated by medical personnel. This process is the subject of the course Medical Imaging & Analysis.
<b>Teaching methods</b>	The teaching and learning materials provided include video recordings of lectures on individual topics, as well as publications from research institutions or other subject-related international organizations. For the exercises and assignments, students will need MATLAB and other freely available software tools.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - Develop simple prototypes for basal image processing in concrete medical problems in MATLAB. - Understand the functionality of simple image processing operations

	in commercial software and apply them appropriately to the situation. - transfer medical image data to other systems for further use in medical technology issues.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of Medical Imaging Physics &amp; Imaging Modalities</li> <li>- Image Representation, File Formats and Simple Operations</li> <li>- Operations in Intensity Space</li> <li>- Filtering &amp; Image Transformations</li> <li>- Spatial Transformations &amp; Rendering</li> </ul>
<b>Prerequisites</b>	Mathematik für Engineering Science 1 Mathematik für Engineering Science 2 Grundlagen der Programmierung Anwendungen der Programmierung in Life Science Engineering Grundlagen der Physik für Ingenieurwissenschaften
<b>Assessment Methods</b>	- Performance assessment will be based on programming assignments (50%) and a final exam (50%).
<b>Recommended Reading and Material</b>	- W. Birkfellner, with contributions by M. Figl, J. Hummel, Z. Yaniv and Ö. Güler: Applied Medical Image Processing – A Basic Course, 2nd Edition, CRC Press, ISBN: 978-1-4665-5557-0
<b>Attendance</b>	Attendance of minimum 75% is mandatory. If attendance is less than 75% the first exam attempt is considered negative.
<b>Comments</b>	

## Bioinformatics

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

## Medical Data Engineering 2

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English

<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Continuation of the course "Medical Data Engineering 2
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to independently develop software for the health care system using the services of the Health Information Network (GIN, Austrian eCard System, electronic insurance card).</li> <li>- to develop database applications for the health care system.</li> <li>- to document the work in projects.</li> <li>- in writing and analysing texts the - to apply basic rules of scientific work, distinguishing a scientific approach from a non-scientific (everyday) one</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Software development in health care projects</li> <li>- IHE and basic standards</li> <li>- C# Programming</li> <li>- Austrian eCard infrastructure, - Health Information Network GIN, Applications</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Biomedical Engineering Projects

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Students develop advanced specialized knowledge by working on
---------------------------	---

	interdisciplinary problems (PBL cases) on biomedical engineering topics.
<b>Teaching methods</b>	student-centered, problem-based learning
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Analyze and discuss complex interdisciplinary problems in biomedical engineering in a broader context in a structured manner as part of a team.</li> <li>- identify knowledge gaps and to conduct targeted research based on this</li> <li>- to select, prepare and present own proposals for solutions and to defend them with scientific argumentation</li> <li>- Explain and present the content and results of one's own or another's scientific publication in a comprehensible manner</li> <li>- Apply the basic rules of scientific work when writing and analyzing texts</li> <li>- research selected scientific sources and cite them correctly in own texts</li> <li>- Prepare and present an academic poster</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Scientific Writing</li> <li>- Literature Research</li> <li>- Academic Poster</li> <li>- Presentation</li> <li>- Academic Discussions</li> </ul>
<b>Prerequisites</b>	Basic knowledge and special knowledge from the semesters 1-4.
<b>Assessment Methods</b>	- immanent assessment method
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Biomedical Ex Vivo Models

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00

<b>Incoming places</b>	Limited
<b>Course description</b>	In this course, students learn selected ex vivo models, which are important tools for biomedical research. There is a growing need for ex vivo systems, lab-on-a-chip technologies, and disease models for biomedical problems to overcome the shortcomings and drawbacks of traditional in vitro systems and animal models. A key advantage is the ability to perform tests or measurements that would not be possible or ethical in living subjects. This includes, for example, the study of the brain, spinal cord and peripheral nerve tissue regeneration or the measurement of physical, thermal, electrical, mechanical, optical and other tissue properties.
<b>Teaching methods</b>	Self-study preparation, in class lectures, Moodle quizzes
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Name common ex vivo organ models and explain their scope of application.</li> <li>- Explain selected respiratory and optical models.</li> <li>- Describe methods for creating cell-based systems and organoids.</li> <li>- Explain applications of cell-based systems and organoids in disease models and testing of chemicals and discuss them using specific examples.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Definitions - in vitro, in vivo, ex vivo, and in silico</li> <li>- 3D-Organoids</li> <li>- Modelling of different organs based on microfluidic technologies</li> <li>- Modelling of the lung as a whole organ</li> <li>- Modelling of the eye</li> </ul>
<b>Prerequisites</b>	ILV Biochemistry and Molecular Biology
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Moodle exams during the classes (30%)</li> <li>- Moodle exam (final exam) during the last class (70%)</li> </ul>
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Current Topics in Life Science Engineering

<b>Degree programme</b>	BBE
<b>Semester</b>	5

<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course, students will attend a series of expert lectures from the entire field of Life Science Engineering. Their contents are supplemented by current scientific literature in self-study and give students a comprehensive overview of current topics in Life Science Engineering. Groups of students from different study programmes will cooperate during the semester in creating a video explaining selected scientific concepts.
<b>Teaching methods</b>	Expert lectures, self-study with current articles and videos, feedback from lecturers, peer-review.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - ...name different research topics in the field of Life Science Engineering. - ...conduct research on selected research topics in the field of Life Science Engineering. - ...explain the results of research in the form of a short video.
<b>Course contents</b>	- Overview of tasks and activities in the subject areas of the study programme and beyond
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Mobile Computing in Medical Applications

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00

<b>Incoming places</b>	Limited
------------------------	---------

## Methods in Cell & Tissue Engineering

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course provides an overview of current methods in Cell&Tissue Engineering
<b>Teaching methods</b>	Self-study and presence phases alternate. In self-study, basic content is developed on the basis of the documents provided by the lecturers, in the presence phase these are discussed and deepened together.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain the basic principles of microscopy and the commonly used light (visible light and fluorescent light) and electron microscopy techniques with their respective advantages and disadvantages</li> <li>- give an overview of preclinical analysis methods and to compare and classify them for the field of tissue regeneration</li> <li>- explain the basic steps involved in the preparation and characterization of tissue samples (e.g.: routine staining, immunohistochemistry, histomorphometry) and possible applications</li> <li>- depict bioreactors schematically and explain the processes in these reactors</li> <li>- describe the function, effect on cells, and advantages and disadvantages of biomaterials</li> <li>- outline methods by which the genome of the cell can be modified and cell signaling pathways can be influenced</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of microscopy</li> <li>- Electron microscopy</li> <li>- Tissue FAXs and preclinical imaging</li> <li>- Immunohistochemistry</li> <li>- Molecular cloning</li> <li>- Biomaterials, mechanical sensing and bioreactors</li> </ul>



<b>Prerequisites</b>	Cell Culture TechniquesCel culture LabMolecular Genetics
<b>Assessment Methods</b>	- Entrance tests, group works and homeworks, final exam
<b>Recommended Reading and Material</b>	- Current documents are provided by the lecturers.
<b>Attendance</b>	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).
<b>Comments</b>	

## Project in Developmental Biology

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The project provides insight into developmental biology. Central points include early development in mice, humans and zebrafish as well as the role of stem cells in development. In the practical part at the end of the project, experiments on zebrafish embryos and larvae are performed and documented.
<b>Teaching methods</b>	Self-study and presence phases alternate; basics are worked out in the self-study phase, which are then discussed and deepened in the presence phase. At the end of the course, a staining of the blood vessel system of zebrafish in different stages will be performed in the laboratory.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Describe the processes of embryonic development, from fertilization to germ layer specification</li> <li>- Compare early embryonic development stages of humans and mice</li> <li>- Explain the basics of how the cells of our tissues and organs come to be specified and placed in their correct positions</li> <li>- Understand the origin of the germ layers, the tissues that arise from them and thereby, the embryonic origin of different cell types</li> <li>- Identify the master switches and stem cells that drive embryonic</li> </ul>

	<p>organ formation</p> <ul style="list-style-type: none"> <li>- Understand how the knowledge of embryonic development can aid in in vitro cell differentiation</li> <li>- Describe how stem cells contribute with which potential to the development and assess how to test for the distinct stem cell status</li> <li>- Understand how these properties of stem cells can be used in research and in the development of the therapies</li> <li>- Understand the principles of developmental biology, the development of zebrafish and of its blood vessels</li> <li>- Generate templates for standard operating procedures from publications</li> <li>- Conduct experiments on an important model system in developmental biology, the zebrafish</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Early development of mouse and human</li> <li>- Stem cells in development</li> <li>- Zebrafish as a model system</li> <li>- Classical Developmental Biology</li> </ul>
<b>Prerequisites</b>	Course "Allgemeine Chemie" in the 1st semester
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- entrance tests</li> <li>- Moodle final exam</li> <li>- report about laboratory project</li> <li>- group assignments</li> </ul>
<b>Recommended Reading and Material</b>	- Current publications, slide sets, audio files are provided.
<b>Attendance</b>	In principle, attendance is compulsory to the extent of 75%. For absences within the remaining 25% (tolerance limit), no reasons need to be given.
<b>Comments</b>	

## Current Cell Technology Approaches

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course provides an insight into current approaches in cell technology such as protein- and RNA detection methods and tools for genome engineering and molecular forensics.
<b>Teaching methods</b>	Self-study phases and presence phases alternate. In self-study, the basics are developed with videos, documents etc. provided by the lecturers. This knowledge is discussed, tested, deepened and applied in group works in the presence phase.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- name antibody-based analytical methods and explain their principles</li> <li>- explain the process of reverse transcription and quantitative PCR and the detection principle of a qPCR</li> <li>- design primers for qPCR applications and be able to evaluate RT-qPCR results</li> <li>- outline approaches to introduce mutations into the genome of cells, explain components and mechanisms of the CRISPR/Cas9 tool, and give examples of current applications of genome engineering</li> <li>- explain the main procedures and theoretical background of forensic DNA analysis and profiling</li> <li>- list advantages and disadvantages of analytical approaches in forensics, and give an overview on common complications and appropriate troubleshooting strategies</li> <li>- name procedures, applications and theoretical backgrounds for the use of specific genetic markers in criminal prosecution and to select suitable markers depending on the task at hand</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Western blot and ELISA</li> <li>- RTqPCR</li> <li>- Gene editing tools</li> <li>- Molecular Forensics</li> </ul>
<b>Prerequisites</b>	Instrumentelle Analytik in der Labormedizin Biochemie und Molekularbiologie Biochemie Labor Cell Culture Techniques
<b>Assessment Methods</b>	- Entrance tests, Group work, Moodle Final Exam
<b>Recommended Reading and Material</b>	- Current publications and documents will be provided by the lecturers; "Freshney's Culture of Animal Cells" (Edition 2021)
<b>Attendance</b>	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).
<b>Comments</b>	

## Medical Hospital Equipment

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Introduction in the field of "Medical Hospital Equipment"
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to present the most important aspects of blood compatibility and to identify critical points in the design of blood contacting components.</li> <li>- describe the procedures of dialysis, haemofiltration, peritoneal dialysis and apheresis and compare them in their fields of application</li> <li>- To describe the mode of operation of oxygenators and heart-lung machines and to justify the necessary alarm functions and possible side effects.</li> <li>- to describe modern multifunctional pacemakers and to select them for different applications.</li> <li>- To describe the design of respirators and discuss the function and possible malfunctions of the individual components.</li> <li>- explain the functioning of external defibrillators and identify the potential hazards they pose and the influence they have on other medical devices.</li> <li>- to apply procedures to optimise operating safety in concrete examples.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Aspects of blood compatibility of medical devices</li> <li>- Technologies and equipment for blood purification and apheresis</li> <li>- heart-lung machine and extracorporeal Membrane oxygenation</li> <li>- Lung mechanics, ventilators and lung Support</li> <li>- Complex pacemakers (Defi pacemakers, Multi-chamber systems, resynchronisation and de- remodelling method)</li> <li>- Defibrillators</li> <li>- Usability optimisation in medical devices (exercise)</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	

<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Photonics in Biomedical Engineering

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

## Nuclear Medicine and Radiation Protection

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Basics of nuclear medicine and radiation protection
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to describe examples from atomic, nuclear and radiation physics for medical technology</li> <li>- to explain the fundamental interactions between ionising radiation and electron sheath.</li> <li>- to reproduce the fundamental models of nuclear physics and radioactivity.</li> <li>- to reproduce the principles of signal processing in nuclear medical technology.</li> <li>- to apply basic knowledge of radiopharmaceuticals in practice.</li> <li>- to participate in projects concerning nuclear medical technology.</li> </ul>

	<ul style="list-style-type: none"> <li>- be able to explain the physical principles of radiation physics in medicine.</li> <li>- to explain which dose terms are relevant in radiation protection.</li> <li>- explain the basic principle in radiation protection (ALARA principle) and its practical implementation.</li> <li>- to categorise radiation damage and to describe the corresponding radiobiological processes.</li> <li>- to operate a radiation protection measuring instrument and to be able to explain the operating modes.</li> <li>- designate the tasks and duties of a radiation protection officer.</li> <li>- to explain the legal procedures in licensing procedures.</li> <li>- to act as radiation protection commissioner in medicine in accordance with AllgStrSchV § 41, whereby a corresponding special training must be completed.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Historical overview of nuclear physics</li> <li>- Elementary charge, Bohr model</li> <li>- X-rays, Auger effect</li> <li>- wave-particle dualism</li> <li>- Photoelectric effect, Compton scattering, pair formation</li> <li>- Quantum numbers</li> <li>- Periodic Table</li> <li>- Heisenberg uncertainty relation, Schrödinger equation</li> <li>- Historical overview of nuclear physics</li> <li>- Nuclear models</li> <li>- Radioactivity and nuclear reactions</li> <li>- Research and applications in nuclear physics</li> <li>- Basics of nuclear medicine</li> <li>- radiation detectors, gamma camera</li> <li>- Scintigraphy, PET, SPECT, multi-modal imaging</li> <li>- Fundamentals of nuclear physics including the physics of ionising radiation</li> <li>- Radiation sources</li> <li>- Fundamentals of radiation biology</li> <li>- Radiation damage, prevention and detection</li> <li>- Dosimetry</li> <li>- Fundamentals of radiation protection</li> <li>- Legislation in the field of radiation protection</li> <li>- Measuring instruments</li> <li>- Medical and physical control</li> <li>- Radiation accidents, first aid</li> <li>- exercises: Handling of equipment for personal and Local dose</li> </ul>

	determination including the use of Test lamps - Radiopharmaceuticals and their production - Dosimetry in nuclear medicine
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Biomedical in Silico Modeling and Simulation

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Modelling and simulation is an emerging and growing field in the industry and in biomedical engineering in particular. With modelling and simulation techniques, it is possible to conduct research in areas that would not be possible in the traditional way. This can be for ethical, technical or even financial reasons. Examples of developments that are now often supported by modelling and simulation include pacemakers (for ethical and financial reasons), hip implants (for technical and ethical reasons), the development of new drugs and many more.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... - Model, simulate, and explain simple natural processes in biomedical engineering using ordinary differential equations. - To explain the principle of the "read-across procedure". - Grundlegende cardiovasculäre und respiratorische Modelle zu entwerfen und zur Nutzung einfacher Simulationen anzuwenden
<b>Course contents</b>	- Knowledge and skills to represent natural processes using modeling and simulation (e.g. cell growth, movements, muscle

	fibers,...). - Skills in the use of numerical mathematics and the estimation of available results. - Presentation and analysis of the results - Read-Across procedure - Conversion of biological processes into simplified mathematical models
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Neurorehabilitation

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Practical applications of neurorehabilitation
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... - to be able to reproduce the not only technical equipment of a neurological rehabilitation centre, to explain the most frequent deficits and needs of the patients on site, and to reproduce the possibilities of a connection to their own professional orientation. - to describe the functions of the human sensory organs and also frequently occurring damage, in order to develop suitable technical measures to compensate for failures. - to be able to reproduce 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 man-machine



	interfaces to augmentative and alternative applications for disabled and elderly people.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Visual perception</li> <li>- Auditory perception</li> <li>- Tactile perception</li> <li>- Aging</li> <li>- Human-Computer Interface</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Neural Engineering

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

## Gait Analysis Project

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In small groups, students will apply their knowledge of biomechanics and motion-analysis, to carry out gait analysis related projects. Each group will work on an individual topic and will establish the state of
---------------------------	--

	the art, develop the methodology, carry out measurements in the lab and analyze the gathered data. The project concludes with a written project report and an oral presentation of the groups' findings
<b>Teaching methods</b>	Practical work in small groups.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - conduct a scientific literature search and present the results - plan and develop gait analysis related motion-analysis projects in small groups - carry out biomechanical data acquisition and analysis - write a project related scientific report (IMRAD structure) according to the fundamentals of scientific writing - hold a scientific presentation
<b>Course contents</b>	
<b>Prerequisites</b>	BBE4 Biomechanics and Ergonomics Laboratory
<b>Assessment Methods</b>	- Presentation of the results of the literature research - Final project presentation - Final project report
<b>Recommended Reading and Material</b>	- User manuals of measurement systems - Learning materials from BBE4 Biomechanics and Ergonomics Laboratory - Project specific scientific literature
<b>Attendance</b>	Mandatory
<b>Comments</b>	

## Biomechanics

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course's 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 Applied Biomechanics, 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.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- To describe the physiological and biomechanical principles underlying skeletal muscle force production</li> <li>- To interpret and compare stress-strain diagrams of various materials</li> <li>- To describe the mechanical properties of human tissue such as bone, cartilage, muscle, tendons and ligaments</li> <li>- To mathematically solve biomechanical problems of statics and dynamics (e.g. calculation of force-distribution during lifting)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Rate coding and population coding in skeletal muscle</li> <li>- Muscle fiber composition</li> <li>- Force-length and force-velocity relationship</li> <li>- Muscle architecture and moment arm</li> <li>- Fundamental principles of stress, strain, elasticity and plasticity</li> <li>- Mechanical properties of bone, cartilage, muscle, tendons and ligaments</li> <li>- Fundamental principles of statics and dynamics</li> <li>- Mathematical problems of statics and dynamics</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Active Assistive Technologies

<b>Degree programme</b>	BBE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00

<b>Incoming places</b>	Limited
------------------------	---------

<b>Course description</b>	Practice-oriented treatise on the subject of Active Assistive Technologies
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- to know the physiological changes typically associated with the ageing process in order to design suitable technical measures to compensate for such failures.</li> <li>- to transfer the basic principles of multimodal human-machine interfaces to augmentative and alternative applications for disabled and elderly people.</li> <li>- to practically apply the most important rules of accessible design and universal design</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Definitions and objectives of rehabilitation technology</li> <li>- What is disability? (based on the WHO definitions, ICDH and ICF)</li> <li>- Medical basics (anatomy and physiology with reference to disabilities)</li> <li>- Augmentative and alternative man-machine Interfaces</li> <li>- Communication technology for people with disabilities and elderly people</li> <li>- Tools for orientation and navigation</li> <li>- Aids for everyday life and work</li> <li>- Smart Homes, environmental controls and service Robots</li> <li>- Barrier-free environmental design and universal design</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Web Based Medical Applications

<b>Degree programme</b>	BBE
-------------------------	-----

<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Main features, practical examples and state-of-the-art in the field of "Web-Based-Medical-Applications"
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- List common web-based medical applications and discuss their characteristics</li> <li>- explain essential requirements for web-based medical applications</li> <li>- Implement simple platform diagnostic solutions</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of web development</li> <li>- Basics of frontend and backend aspects of medical Systems</li> <li>- Basic development opportunities of web-based solutions</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Electronic Engineering (BEL)

### Technical English

<b>Degree programme</b>	BEL
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering topics. Moreover, students will advance their technical verbal and written skills by creating technical object and technical process descriptions specifically for technical professional audiences and engineering purposes.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- record and employ technical vocabulary in English,</li> <li>- create and understand technical process instructions in English,</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description).</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Visualizing technical descriptions in English</li> <li>- Describing technical visualizations in English</li> <li>- Technical object descriptions in English</li> <li>- Technical process descriptions in English</li> <li>- Technical English talk</li> <li>- Exercises on selected technical topics</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	- group tasks, language tasks, in-class writing
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- R. Murphy, English Grammar in Use, 5th Edition, 2019, Klett Verlag</li> <li>- A. Oshima, A. Hogue, Writing Academic English, 4th Edition, 2006 Pearson Longman</li> </ul>
<b>Attendance</b>	obligatory
<b>Comments</b>	

## Microcontroller Software Design

<b>Degree programme</b>	BEL
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course covers microcontrollers, in particular to program software in order to interface with various peripherals.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- design and analyze bare-metal software for microcontroller systems,</li> <li>- use build systems for microcontrollers (cross-development, remote debugging ...) efficiently,</li> <li>- configure and program typical peripheral units of microcontrollers (e.g. GPIO, Timer, Interrupt Controller, ADC/DAC, UART, SPI, I2C etc.),</li> <li>- control sensors and/or actuators with the help of microcontroller's peripheral units</li> <li>- as well as to develop applications, as they occur in typical electronic systems, in the context of hands-on projects.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Architecture of modern microcontrollers</li> <li>- Cross-Development &amp; Debugging</li> <li>- Interrupts</li> <li>- General Purpose Input/Output (GPIO)</li> <li>- Timer, Real-Time Clock, Watchdog</li> <li>- Analog-to-Digital and Digital-to-Analog Conversion (ADC/DAC)</li> <li>- Serial interfaces like UART, SPI or I2C</li> <li>- Implementation of tasks and projects as they occur in typical electronic systems</li> </ul>
<b>Prerequisites</b>	Courses "Hardware-related Software Development" and "Fundamentals of Digital Systems"
<b>Assessment Methods</b>	- Exam, assessment of individual tasks and projects
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- M. Barr, Programming Embedded Systems in C and C++, 1999, O'Reilly Media, Inc.</li> <li>- W.A. Smith, C Programming for Embedded Microcontrollers, 2008, Elektor International Media BV</li> <li>- J. Yiu, The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors, 2014, Newnes, ISBN 978-0-12-408082-9</li> <li>- M. Fischer, ARM Cortex M4 Cookbook, 2016, Packt Publishing, ISBN 1782176500</li> </ul>
<b>Attendance</b>	mandatory
<b>Comments</b>	

# Information and Communication Systems and Services (BIC)

## Technical English

<b>Degree programme</b>	BIC
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	- Vocabulary Test (10%)



	<ul style="list-style-type: none"> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Microcontroller Software Design

<b>Degree programme</b>	BIC
<b>Semester</b>	3
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This class illustrates the use of microcontrollers - in particular, the development of embedded software in order to interface with various peripherals. This involves communication with sensors and control of actuators as well as interfacing with a remote PC for data visualization and remote control.
<b>Teaching methods</b>	Impulse lecture, labs to program a microcontroller by way of a commercial of the shelf evaluation board
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- develop bare-metal embedded systems software.</li> <li>- to make efficient use of embedded build systems (cross-development, remote debugging etc.).</li> <li>- explain the functionality of typical peripheral units (interrupt controller, GPIO, Timer, ADC, UART etc.) and be able to configure and program them.</li> <li>- interact with the environment using the microcontroller along with sensors and actuators.</li> <li>- develop embedded software for degree program tailored tasks and projects using a specific commercial of the shelf development platform.</li> </ul>

<b>Course contents</b>	<ul style="list-style-type: none"> <li>- CPU Architectures of modern microcontrollers</li> <li>- Cross-Development &amp; Cross-Debugging</li> <li>- Reading and working with Circuit Diagrams, Datasheets, Application Notes and a HAL API Documentation</li> <li>- Interrupts</li> <li>- General Purpose Input/Output (GPIO)</li> <li>- Timer, Real-Time Clock, Watchdog</li> <li>- Analog-to-Digital and Digital-to-Analog Conversion (ADC/DAC)</li> <li>- Universal Asynchronous Receiver/Transmitter (UART)</li> <li>- Serial Peripheral Interface (SPI)</li> <li>- Interchip Communication (I2C)</li> <li>- Implementation of degree program specific tasks and projects</li> </ul>
<b>Prerequisites</b>	Programming(solid programming skills using C), Digital Logic & Computer Architectures
<b>Assessment Methods</b>	- test, assessment of the submission of individual tasks and projects
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- H. Bernstein, "Mikrocontroller - Grundlagen der Hard- und Software der Mikrocontroller ATtiny2313, ATtiny26 und ATmega32", Springer Vieweg, 2020, ISBN 978-3-658-30066-1.</li> <li>- M. Fischer, "ARM Cortex M4 Cookbook", Packt Publishing, 2016, ISBN-10: 1782176500.</li> <li>- T. Martin, "The Insider's Guide To The STM32 ARM Based Microcontroller", Hitex Ltd., 2008, ISBN: 095499888.</li> <li>- A. Kurniawan, "STM32 Nucleo-32 Development Workshop", PE Press, 2018.</li> <li>- J. Yiu, "The Definitive Guide to ARM Cortex -M3 and Cortex-M4 Processors", Newnes, 2014, ISBN13: 978-0-12-408082-9.</li> </ul>
<b>Attendance</b>	mandatory
<b>Comments</b>	none

## International Business Engineering (BIW)

### Manufacturing Engineering

<b>Degree programme</b>	BIW
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00

<b>Incoming places</b>	Limited
<b>Course description</b>	In this course students acquire basic knowledge in the fields of production engineering according to DIN 8580
<b>Teaching methods</b>	Integrated course
<b>Learning outcome</b>	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)
<b>Course contents</b>	- Requirements for industrial manufacturing processes (incl. measured variables) - Overview of main groups of manufacturing processes (DIN 8580)
<b>Prerequisites</b>	Basic knowledge according to admission requirements for the bachelor's program
<b>Assessment Methods</b>	- Participation, Moodle tests and final examination
<b>Recommended Reading and Material</b>	- Förster, R.; Förster, A.: Einführung in die Fertigungstechnik, Springer Vieweg, 2018
<b>Attendance</b>	75%
<b>Comments</b>	none

## Materials Science

<b>Degree programme</b>	BIW
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course you will get an overview of the most important
---------------------------	---

	<p>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 how to select the right material for a product design and carry out proper material tests in the laboratory course!</p>
<b>Teaching methods</b>	<p>Our course consists of two sessions: the class and the self-study. During each class you will get information about some topics about material science. During the self-study you have to learn by yourself some additional information about materials. During some classes, you will have to write a test. The test will include the chapters, which were discussed during the class, as well as the chapters you had to learn during your self-study. After having 4 classes and 4 self study sessions, you will attend a laboratory course, where you will carry out by yourself material tests.</p>
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to explain the basic properties of metallic materials (steel, cast iron, aluminium, copper, titanium, magnesium and their alloys) from a scientific and technical point of view, using practical industrial examples</li> <li>- explain the basics of microscopy and electron microscopy</li> <li>- to be able to make a simple material selection of metals</li> <li>- To be able to name metallic materials.</li> <li>- be able to enumerate metallic materials compared to plastics and ceramics as well as composite materials with advantages and disadvantages</li> <li>- explain the basics of mechanical methods for testing materials as well as selected concrete test methods using appropriate technical terms and quantities (tensile test, hardness test, Charpy, Wöhler)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Terms (e.g. thermal expansion, modulus of elasticity, ...) and material properties</li> <li>- Atomic decomposition &amp; periodic table, chemical bonds</li> <li>- Structure of metals (krz, kfz, hdp)</li> <li>- Iron-carbon diagram</li> <li>- Steel and cast iron</li> <li>- Aluminium materials</li> <li>- Copper Materials</li> <li>- Titanium materials</li> <li>- Magnesium materials</li> <li>- Alloys, phase diagrams</li> <li>- Electrochemistry especially corrosion of metallic materials</li> <li>- Mechanical test methods (tensile test, notched bar impact bending test, hardness test, Wöhler test), PT, MT, VT; UT.</li> </ul>

	<ul style="list-style-type: none"> <li>- effects of mechanical stress (e.g. deformation, work hardening)</li> <li>- Interaction of material and production technology, example forging</li> <li>- Basic principles of material selection (presentation of software tools)</li> <li>- Differences of the material classes (metals, plastics, ceramics)</li> <li>- Electron microscopic examination of various materials</li> </ul>
<b>Prerequisites</b>	English language skills
<b>Assessment Methods</b>	- Written exam (Online)
<b>Recommended Reading and Material</b>	- Ashby, M.F.; Jones, D.R.H.: Engineering Materials 1: An Introduction to Properties, Applications and Design, Elsevier, 2011
<b>Attendance</b>	75%
<b>Comments</b>	More detailed information can be found in the Moodle course.

## Technical English

<b>Degree programme</b>	BIW
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended</li> </ul>

	audience and communication purpose (for example a technical article and a process description)
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Industrial Informatics in a Digital Economy

<b>Degree programme</b>	BIW
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	After presentation of basic principles of Computer Science and Software Engineering they will be applied on sample applications of Digitization in concrete industrial environments (Software 4.0).
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to apply basic principles of Computer Science and Software Engineering in industrial problem fields and projects</li> <li>- to adopt Requirements Engineering and Software Modeling for structured analysis and design</li> </ul>

	<ul style="list-style-type: none"> <li>- to elaborate sample applications of Digitization in a concrete environment</li> <li>- to identify, evaluate, select and introduce (Software) systems for industrial applications (using methodologic approaches for selecting appropriate options)</li> <li>- to understand principles of Software 4.0 (including Security &amp; Safety), to apply adequate methods and to implement software solutions in industry</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Computer Science Basics</li> <li>- Software Engineering</li> <li>- Software Life Cycle</li> <li>- Process models to develop Software (V-Model XT, Agile,...)</li> <li>- DevOps (Operationalization of Software)</li> <li>- Requirements Engineering &amp; Software Modeling</li> <li>- Software 4.0</li> <li>- Digital Transformation in industry</li> <li>- Reference architecture RAMI 4.</li> <li>- Interoperability</li> <li>- Security &amp; Safety</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	none

## Circular Economy and Sustainability

<b>Degree programme</b>	BIW
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course students deal with sustainable circular economy and apply the know-how to production technology.
---------------------------	---

<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- understand the fundamental concepts of sustainability; to be able to develop assessment criteria for monitoring sustainable development</li> <li>- recognise the development and concept of circular economy; to acquire the professional vocabulary to develop a corporate culture of sustainability</li> <li>- know about legal fundamentals at a European and national level</li> <li>- be able to explain how a circular economy differs from the current linear system; to be able to explain how an economically successful transition to a circular design is developed</li> <li>- be able to classify the differences between "reuse", "remanufacturing" and "recycling" principles</li> <li>- be able to explain the waste hierarchy and principles of waste prevention ("reduce") and Life Cycle Assessments (LCA)</li> <li>- be able to plan and implement sustainable business models for circular economy</li> <li>- understand the importance of engineers with regard to sustainable product design</li> <li>- understand the need to adapt marketing and sales strategies for the circular economy</li> <li>- be able to explain the international cycle of primary and secondary metal and raw material flows and the importance of anthropogenic deposits ("urban mining")</li> <li>- be able to explain the principles of non-financial reporting by companies within the framework of the CSR Directive (Corporate Sustainability Reporting Directive) of the EU</li> <li>- have an overview of sustainable financing models for companies and taxonomy.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Concept of sustainability</li> <li>- Policies for sustainable and circular economy</li> <li>- From linear to a circular economy (CE)</li> <li>- Closing loops for a CE</li> <li>- Business models for a CE</li> <li>- Concepts for circular product design</li> <li>- Thinking in global systems</li> <li>- Green governance and sustainable finance</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading</b>	



<b>and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Renewable Energies (BEE)

### Technical English

<b>Degree programme</b>	BEE
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> </ul>

	- Formal writing and paragraph construction
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Conventional Power Plant Technology

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Basics of gas combined cycle gas turbines
<b>Teaching methods</b>	Flipped Classroom: theory tests and final exam
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to analyze gas combined cycle gas turbines processes</li> <li>- analyse measures for the most efficient use of energy</li> <li>- analyse thermodynamic processes</li> <li>- propose best operation mode, heat or electricity related, for most efficient use</li> <li>- evaluate and critically scrutinize CO2 capture measures</li> <li>- propose measures for combined operation with renewable energy sources and with sustainable fuels</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Thermodynamic fundamentals of the Joule/Brayton cycle and the Clausius Rankine cycle</li> <li>- Basics and in-depth analysis of combined cycle gas turbines</li> <li>- Realistic design of combined cycle gas turbine's components and integration into energy systems</li> </ul>

	<ul style="list-style-type: none"> <li>- Carbon capture and storage technologies for CO<sub>2</sub> separation</li> <li>- Future directions of combined cycle power plants and the role of hydrogen and synthetic fuels</li> </ul>
<b>Prerequisites</b>	Basics in Physics and Thermodynamics
<b>Assessment Methods</b>	- Theory tests and final exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Zahoransky (2015): Energietechnik, Springer Vieweg Verlag;</li> <li>- Strauß (2016): Kraftwerkstechnik, Springer Verlag;</li> </ul>
<b>Attendance</b>	75 %
<b>Comments</b>	

## Biomass Combined Heat and Power Systems

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Bioenergy supply with focus on combined heat and power technologies
<b>Teaching methods</b>	Integrated course with presentations and project work
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to design the processes and main components of biomass CHP plants</li> <li>- assess and evaluate biomass CHP conversion technologies and their main usage: steam processes, organic rancine cycle processes (ORC), gas engines</li> <li>- assess and evaluate the operation procedure of heat and/or power driven biomass CHP plants</li> <li>- describe the energetic utilization possibilities of biomass through different conversion routes</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Engineering of components and thermal process design of biomass CHP plants</li> <li>- Biomass steam turbine plants</li> <li>- Biomass ORC plants</li> <li>- Biomass gas engines</li> </ul>

	- Production of biogenic fuels for the respective biomass technologies
<b>Prerequisites</b>	Basics in Physics, Thermodynamics and Thermal Biomass utilisation
<b>Assessment Methods</b>	- Presentations, test, and project work
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Kaltschmitt, Hartmann, Hofbauer (2016): Energie aus Biomasse, Springer VDI Verlag</li> <li>- Schmitz, Schaumann (2010), Kraft-Wärme-Kopplung, Springer VDI Verlag</li> <li>- Obernberger et al. (1999): Dezentrale Biomasse Kraft Wärme Kopplungstechnologie, Bios Verlag</li> </ul>
<b>Attendance</b>	75 %
<b>Comments</b>	

## Heat Grids

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Basics in thermal grids with focus on district heating and cooling
<b>Teaching methods</b>	Integrated lecture and exercise project
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- describe the main components of energy grids for district heating and cooling</li> <li>- describe the function and the operation of thermal energy grids</li> <li>- calculate the main parameters of thermal energy grids</li> <li>- describe the systems effects between producer and supplier on the operation of energy grids for district heating and cooling</li> <li>- describe the function and the operation of energy grids under consideration of renewable energy integration</li> <li>- calculate and simulate in an easy way the operation of thermal energy grids</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Structure of district and cooling networks</li> <li>- design parameters of thermal grids</li> </ul>

	<ul style="list-style-type: none"> <li>- techn.-econ.-ecol. efficiency parameters of thermal grids</li> <li>- heating/cooling transfer station</li> <li>- economic parameters</li> <li>- Consumer analysis and decentralised thermal grid design</li> <li>- Thermal grids under EU/A conditions, responsibility of grid operators, Effect of decentralised energy on grid quality, new solutions for the operation of distribution networks</li> <li>- Potentials of district cooling in EU/A, integration of district cooling in large heating networks, ecological effects of district cooling, technical aspects of district cooling, market and costs;</li> </ul>
<b>Prerequisites</b>	Basics in Physics and Thermodynamics
<b>Assessment Methods</b>	- exercise project of a grid simulation and final examination
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Schäfer (2013): Fernwärmeversorgung, Springer</li> <li>- Cube, Steimle, Lotz (1997): Lehrbuch der Kältetechnik Band 1 und 2, Verlag: Hüthig Jehle Rehm; Auflage: 4. Aufl.</li> </ul>
<b>Attendance</b>	75 %
<b>Comments</b>	

## Heat Grids Laboratory

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Measurement exercises concerning simulation, load behaviour and systemic integration of plants for urban heating and cooling supply
<b>Teaching methods</b>	<ul style="list-style-type: none"> <li>•Preparation for exercise through self-study (Moodle-Test)</li> <li>•Presentation of the laboratory exercise and exercise in groups</li> <li>•Recording of measured values</li> <li>•Writing of a laboratory report</li> </ul>
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- measure and analyse the main characteristics of transfer stations for heating and cooling supply under laboratory test conditions</li> <li>- configure and simulate thermal networks</li> <li>- optimise thermal networks in laboratory tests with regard to load</li> </ul>

	behaviour and to subject them to an economic analysis - analyse the tasks of the load distributor of an urban heating and cooling supplier
<b>Course contents</b>	- Safety instructions, laboratory regulations, protocol guidelines - Transfer stations for heating and cooling supply, - Simulation of thermal networks, - Load behaviour of thermal networks and evaluation with regard to technical-economic-ecological assessment - Laboratory excursion: load distributor, heating and cooling supply
<b>Prerequisites</b>	Basics in mechanical engineering, M2.3 Electrical engineering 2, M2.1 Thermodynamics
<b>Assessment Methods</b>	- Laboratory report and active participation
<b>Recommended Reading and Material</b>	- Schäfer (2013): Fernwärmeversorgung, Springer - Cube, Steimle, Lotz (1997): Lehrbuch der Kältetechnik Band 1 und 2, Verlag: Hüthig Jehle Rehm; Auflage: 4. Aufl.
<b>Attendance</b>	100 %
<b>Comments</b>	

## Electricity Grids Laboratory

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Electrical Networks Laboratory module, the contents imparted in the "Electrical Networks" and "Energy Generation Systems" modules are applied with practical exercises in the laboratory.
<b>Teaching methods</b>	- Preparation for exercise through self-study (Moodle-Test)· Presentation of the laboratory exercise and exercise in groups· Recording of measured values· Writing of a laboratory report
<b>Learning outcome</b>	After passing this course successfully students are able to ... - • to measure and interpret the energetic performance of components of energy generation, storage, consumption and conversion

<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Experimental setup of the most important metrological procedures for assessing the quality of machines and systems for energy conversion</li> <li>- Knowledge of solving measurement tasks</li> <li>- Metrological analysis and evaluation of the energetic performance of energy conversion components</li> <li>- Metrological analysis and evaluation of the energetic performance of heat pump systems, photovoltaic systems</li> </ul>
<b>Prerequisites</b>	• Electrical networks • Automation 1 • Power generation plants
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Hosemann (2000): Elektrische Energietechnik, Bd3 Netze, Springer</li> <li>- Schwab (2011): Elektroenergiesysteme, Erzeugung, Transport, Übertragung und Verteilung elektrischer Energie, Springer Verlag</li> </ul>
<b>Attendance</b>	100 %
<b>Comments</b>	

## Electricity Grids

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The electrical networks module gives a practical overview of the design and operation of electrical networks (in urban areas) from a systemic point of view.
<b>Teaching methods</b>	Integrated lecture
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- describe the main components of energy grids for electricity,</li> <li>- describe the function and the operation of the electricity grid,</li> <li>- calculate the main parameters of electricity grids</li> <li>- describe the systems effects between producer, supplier and storages on the operation of electricity grids</li> <li>- describe the function and the operation of electricity grids under consideration of renewable energy integration</li> </ul>

	- calculate and simulate in an easy way the main parameters (current, voltage, power) of electric energy grids
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Structure of el. grids, main parameters, switch gears, measuring transformers, transformer and controller, power lines, safety components;</li> <li>- Integration of renewables in electricity grids</li> <li>- El. grids under EU/A conditions, responsibility of grid operators, Power Quality, Effect of decentralised energy on power quality, new solutions for the operation of distribution networks;</li> <li>- Simulation of distributed networks</li> </ul>
<b>Prerequisites</b>	• Electrical engineering 1 and 2 • Electrical Power Engineering • Thermodynamics
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Hosemann (2000): Elektrische Energietechnik, Bd3 Netze, Springer</li> <li>- Schwab (2011): Elektroenergiesysteme, Erzeugung, Transport, Übertragung und Verteilung elektrischer Energie, Springer Verlag</li> </ul>
<b>Attendance</b>	75 %
<b>Comments</b>	

## Strategies for Urban Energy Supply

<b>Degree programme</b>	BEE
<b>Semester</b>	5
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Concepts of the current energy supply in cities and strategies for the future.
<b>Teaching methods</b>	project work
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- comment the background of urban energy strategies</li> <li>- give examples for environmentally friendly urban energy strategies</li> <li>- give best practise solutions for urban energy strategies</li> </ul>
<b>Course contents</b>	- Basics in urban energy strategies;



	<ul style="list-style-type: none"> <li>- best practises of urban energy supply,</li> <li>- potentials of renewable energies in urban areas,</li> <li>- legislation concerning urban energy strategies,</li> <li>- presentations of selected guest lecturers</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	75 %
<b>Comments</b>	

## Sustainable Environmental and Bioprocess Engineering (BUB)

### Technical English

<b>Degree programme</b>	BUB
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion

<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Electronics and Business (BEW)

### Advanced Technical Communication and Engineering Ethics

<b>Degree programme</b>	BEW
<b>Semester</b>	5
<b>Course methods</b>	FUV
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	Starting from the Common European Framework of Reference for Languages C1, students discuss ethics concepts and analyze real-life case studies, as well as work on the formal aspects of technical and scientific texts
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- formulate and justify a rationally defensible position on basic ethical Problems</li> <li>- analyze ethical dilemmas in case studies</li> <li>- identify given formal and language-related features of technical and scientific texts</li> <li>- apply given formal and language-related features of technical and scientific texts</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Principles of ethical judgement</li> <li>- Case studies</li> <li>- Formal and language-related aspects of technical and scientific texts</li> <li>- 30 seconds speeches</li> </ul>
<b>Prerequisites</b>	Common European Framework of Reference for Languages Level C1 Completion of previous semester course
<b>Assessment Methods</b>	- Course immanent assessment method, i.e. active participation in class activities and timely completion of assignments
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Connolly, P. / Kingsbury, P. et al. (2014): eSNACK, Lernplattform</li> <li>- Schökler, G. (2014): Einzelskripten, adapted from Maderdonner, O. / et al (2014): Ethics, Skriptum</li> <li>- Additional current handouts and audio-visual support</li> </ul>
<b>Attendance</b>	compulsory attendance during on-campus phases
<b>Comments</b>	

## Business Management

<b>Degree programme</b>	BEW
<b>Semester</b>	5
<b>Course methods</b>	FUV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00

<b>Incoming places</b>	Limited
<b>Course description</b>	The course shall provide an overview over the essential elements of Business Management in order to prepare the students for managerial tasks in practical business life. After an introduction to the basics of management (Definition of management, tasks and required skills of managers, environment, social responsibility) the course covers the 4 managerial steps Planning, Organizing, Leading and Control. There will be a special focus on Project Management.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- define tasks and steps of the managerial process for companies as well as explain examples for “effective” and “efficient” Management</li> <li>- explain the essential factors of good project management (Project steps, Project Manager/Project Team/Stakeholders, Tools such as Network Analysis or Gantt Chart, Key Success Factors)</li> <li>- develop and define company goals as a Manager</li> <li>- make decisions as a manager as well as to explain and justify them</li> <li>- recognize the importance of Ethical Behavior in business and develop according management activities</li> <li>- explain methods how to motivate employees and evaluate their applicability in practical cases</li> <li>- evaluate various methods of communication for practical Management</li> <li>- explain leadership styles and their advantages and disadvantages for specific situations and persons</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of Management</li> <li>- Decision making in business</li> <li>- Planning</li> <li>- Organizational structure and culture</li> <li>- Change Management</li> <li>- Project Management</li> <li>- Managing Teams</li> <li>- Motivation of employees</li> <li>- Leadership traits and styles</li> <li>- Communication in Business</li> <li>- Controlling</li> <li>- Effective management</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Course immanent assessment: Various homework during the online

	<p>phase – weight 30%</p> <p>- End Exam:Written Exam (2 h) at the end of the course – weight 70%</p> <p>Students must achieve at least 50% in both assessment elements</p>
<b>Recommended Reading and Material</b>	<p>- Stephen P. Robbins, David A. DeCenzo, Mary Coulter Fundamentals of ManagementPearson Education, Prentice Hall ,Auflage, 2012ISBN-10: 0273766171ISBN-13: 978-0273766179(Mandatory Reading)</p>
<b>Attendance</b>	compulsory attendance during on-campus phases
<b>Comments</b>	

## Industrial Electronics

<b>Degree programme</b>	BEW
<b>Semester</b>	5
<b>Course methods</b>	FUV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	BEW 5 Industrial Electronics Introduction to:Sensors, Measurement techniques, Power electronics
<b>Teaching methods</b>	Exercises, Own research and report, Discussion in forum, Written examination
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- choose appropriate descriptions of measurement results and calculate them</li> <li>- choose suitable approaches for statistical characteristics</li> <li>- point out options for measuring diverse physical quantities and choose the appropriate sensors</li> <li>- Roughly design Buck-, Boost-, and Buck-Boost DC/DC converters</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Sensor technologies and sensor types</li> <li>- Properties of measurement instruments</li> <li>- Buck converter, Boost converter, Buck-Boost converter</li> </ul>
<b>Prerequisites</b>	Basic knowledge in electro-technics semester 1 to 4
<b>Assessment Methods</b>	- Course immanent assessment method and end exam

<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Provided within the lecture materials</li> <li>- JCGM: Evaluation of measurement data- Guide to the expression of uncertainty in measurement GUM, 2008.</li> <li>- N. Mohan, T. Undeland, W. Robbins: Power Electronics, Jon Wiley &amp; Sons, Inc.</li> </ul>
<b>Attendance</b>	compulsory
<b>Comments</b>	See Moodle lessons

## Leadership

<b>Degree programme</b>	BEW
<b>Semester</b>	5
<b>Course methods</b>	FUV
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	This course provides an overview of both the latest practical and the current theoretical leadership theories. One of the course's fundamental components will be the student's reflection about particular issues concerning leadership.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- identify and to explain tasks and instruments of leadership (for example delegation, agreement on objectives).</li> <li>- explain classical management models (for example leading continuum, Maturity Model) and to apply to practical examples.</li> <li>- describe different assumptions about human nature (for example McGregor) and to derive the consequences for the leading of co-workers</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Leadership styles and instruments (for example staff appraisal)</li> <li>- Motivation, promotion and development of employees</li> <li>- Leadership functions versus professional tasks</li> <li>- Consequence of "not leading"</li> <li>- Role of the leader in a change process</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Case study (grade)

<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Blanchard, Kenneth H./Zigarmi, Patricia/Zigarmi, Drea (2009): Der MinutenManager: Führungsstile, 6. Auflage, Verlag Rowohlt, Reinbek bei Hamburg</li> <li>- Goleman, Daniel/Boyatzis, Richard/McKee, Annie (2012): Emotionale Führung, 7. Auflage, Ullstein Verlag, Berlin</li> <li>- Kasper, Helmut/Mayrhofer, Wolfgang (2009): Personalmanagement, Führung, Organisation, 4. Auflage, Verlag Linde, Wien</li> <li>- Malik, Fredmund (2006): Führen, Leisten, Leben. Wirksames Management für eine neue Zeit, 13. Auflage, Verlag Heyne, München</li> <li>- Wunderer, Rolf (2007): Führung und Zusammenarbeit, 7. Auflage, Verlag Luchterhand, Köln</li> </ul>
<b>Attendance</b>	Attendance is compulsory.
<b>Comments</b>	none

## Quality Management

<b>Degree programme</b>	BEW
<b>Semester</b>	5
<b>Course methods</b>	FUV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Understanding the terminology of quality management as well as the sense of such programs, Standards and Certification of management Systems, Quality management tools and methods
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- describe what Quality in an organisation means</li> <li>- describe how to plan, measure and improve quality</li> <li>- have an understanding of Quality Management and Quality Management Systems</li> <li>- have an overview of tools and techniques used in Quality Management</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Development and historical approach of Quality and Quality Management</li> </ul>

	<ul style="list-style-type: none"> <li>- Defining Quality</li> <li>- Quality for the Customer</li> <li>- Quality Planning, Controlling, Assuring and Delivering</li> <li>- Concepts of Quality</li> <li>- Quality Engineering</li> <li>- Auditing Quality</li> <li>- Statistics for Quality</li> <li>- Total Quality Management: definition, principles</li> <li>- ISO 9000 Standards</li> <li>- CMM and CMMI</li> <li>- Six Sigma</li> <li>- Kaizen</li> <li>- Quality in Project Management</li> <li>- Quality in the future</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Group assessments</li> <li>- Individual assessments</li> <li>- Written final examination</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- quality management DeMYSTiFieD; Author: Sid Kemp, PMP</li> <li>- Actual Version of ISO 9001 (ISO 9001:2015)</li> </ul>
<b>Attendance</b>	compulsory attendance during on-campus phases
<b>Comments</b>	

## Scientific Practice

<b>Degree programme</b>	BEW
<b>Semester</b>	5
<b>Course methods</b>	FUV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>The course consists of:- Exposition of the base elements of working scientifically on foundation of the guide version 2013- Draft of a question catalog for the first advice conversations with the own supervisor of the bachelor work- literature enquiry and correct quotation based on the software program Citavi- first research question and hypothesis formulations due to the bachelor work of</p>
---------------------------	--



	one's own- methods and reasoning- time management of the Bachelor scientific processes worked out by Gantt charts
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- draw up the structure of a bachelor work and particularly relevant operative research activities with the help of the 'Guideline for Bachelorpaper and Master Thesis' (version 2013) in the context of a written assignment (LO1).</li> <li>- excerpt the state-of-the-art of scientific literature under mentioning of the central key concepts of the subject area and to maintain into the knowledge database CITAVI in a correct way of quoting (LO2).</li> <li>- work out a first outline based on 'The components of a Bachelorpaper' (Essl, 2015) for the first coaching appointment with their Bachelor supervisors (a) to the structure of the Bachelorpaper in form of a proposal and (b) the project schedule in form of a Gantt chart LO3).</li> <li>- verbally account for both the bachelor title and the research questiondiscussed by means of quoted research literature with respect to the current state-of-the-art and developed as a knowledge subject for the respective bachelor work (LO4).</li> <li>- verify causal and circular effect connections in the form of hypothesesand to define in writing with the help of theoretical models (LO5).</li> <li>- make an empirically comprehensible method choice in view of claimed causal connections (based on their hypotheses) and to be more precise under a written mentioning (a) of the respective methodical knowledge possibilities and (b) of the simultaneously effective methodicalknowledge limitations (LO6).</li> <li>- develop an investigation design as a flow chart graphically justified methodologically for their bachelor work and given reasons for their action phases in this (LO7).</li> <li>- assess the data quality of their available data sources using their research issue and (possible) hypotheses (see LE04-05) and using the well-founded method choice (see LE06) knowledge critically and therefore also source critically (LO8).</li> <li>- analyse the discovered results in view of research question(s) and hypotheses in the context of a written assignment theory-orientedly and logically. (LO9).</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Presentation of the guide to the constitution of a bachelor work based on version 2013</li> <li>- What is a science-oriented question?</li> </ul>

	<ul style="list-style-type: none"> <li>- Why do hypotheses help us according to assertions?</li> <li>- How do I access to empirical data?</li> <li>- How to read scientific literature and empirical sources particularly effectively?</li> <li>- How is right to quote?</li> </ul>
<b>Prerequisites</b>	no previous knowledge necessary, therefore working in gradually into the topics of the bachelor work of one's own (as of 4th semester)
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Course immanent assessment method:</li> <li>- Assignments 1-6</li> <li>- Question catalogue for coaching dialogue with the supervisor of the bachelor work and its exploitation protocol after this conversation</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Essl, G. (2015), Components of a Bachelorpapier (Checklist for the self assessment).</li> <li>- Günter Essl, Karl Göschka, Susanne Teschl (2013), Guideline for Bachelorpapier and Master Thesis.</li> <li>- Skern, T. (2011), Writing scientific English: A workbook, 2nd. ed, Facultas Verlag, Wien.</li> </ul>
<b>Attendance</b>	compulsory attendance during on-campus phases
<b>Comments</b>	

## Business Informatics (BWI)

### Scientific Writing and Research Methods

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course prepares students for writing scientific papers, especially the bachelor thesis.
<b>Teaching methods</b>	The integrated course consists of three parts: The self-study phase teaches basic research methods. This is consolidated further in class through practical exercises. In addition, the writing phase offers the opportunity to implement the acquired knowledge in the form of a

	seminar paper.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain the standards that characterize scientific work.</li> <li>- formulate research questions and hypotheses.</li> <li>- select and apply methods for the chosen questions</li> <li>- structure a scientific paper in a formally correct manner.</li> <li>- write a proposal (exposé, disposition) for a seminar or bachelor thesis.</li> <li>- conduct (literature) research, to evaluate sources and to cite according to scientific standards.</li> <li>- explain formal and linguistic demands on a scientific text and to implement them in the writing phase.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Criteria of correct scientific conduct</li> <li>- Methods and theories of gaining knowledge</li> <li>- Structuring and composition of scientific work</li> <li>- Guidelines for ensuring good scientific practice</li> <li>- Research questions - their formulation, operationalization</li> <li>- Strategies of source acquisition</li> <li>- Documentation of sources</li> <li>- Proposal (exposé, disposition)</li> <li>- Scientific writing style and basic features of argumentation</li> <li>- Formal design of academic papers</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Ongoing performance review through mini-tests and written assignments
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Leedy, P.D. &amp; Ormrod, J.E., 2015. Practical research. Planning and design 11 Aufl., Harlow, GB: Pearson Education.</li> <li>- Skern, T., 2019. Writing scientific English. A workbook, Stuttgart: UTB.</li> <li>- Theuerkauf, J., 2012. Schreiben im Ingenieurstudium. Effektiv und effizient zur Bachelor-, Master- und Doktorarbeit, Paderborn: Schöningh.</li> </ul>
<b>Attendance</b>	100%
<b>Comments</b>	

## Digital Marketing

<b>Degree programme</b>	BWI
<b>Semester</b>	5

<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	After an introduction in classical marketing concepts, the course focuses on digital marketing methods.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Identify target groups and develop a marketing strategy</li> <li>- describe, plan and implement relevant aspects of digital marketing</li> <li>- distinguish between classical and digital marketing, as well as inbound and outbound marketing</li> <li>- give an overview on digital marketing tools and to use them</li> <li>- describe the customer life cycle and sales funnel, and to derive marketing decisions</li> <li>- consider challenges of cross-channel marketing in marketing plans</li> <li>- describe and implement growth hacking</li> <li>- implement E-Mail marketing and content marketing</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Target groups</li> <li>- 4 P's, 7 P's, 4 C's</li> <li>- Digital Marketing, mobile Marketing</li> <li>- Customer Lifecycle</li> <li>- Growth Hacking</li> <li>- Email Marketing</li> <li>- Content Marketing</li> <li>- Influencer Marketing</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Software Engineering Project

<b>Degree programme</b>	BWI
-------------------------	-----

<b>Semester</b>	5
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this project course, students practice the main phases of the software lifecycle (requirements engineering, software design, implementation, testing, deployment).
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... - plan and implement a software project in groups using engineering methods - create a software requirements specification, or analyse an existing one - plan and implement interfaces between (sub-)systems
<b>Course contents</b>	- Integration of skills from previous courses in the studies - agile project management
<b>Prerequisites</b>	Software Lifecycle ManagementAgile Project ManagementStructured and OO ProgrammingSoftware ArchitecturesDistributed SystemsData ManagementSoftware ArchitecturesDistributed Systems
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## IT Security Basics

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00

<b>Incoming places</b>	Limited
------------------------	---------

<b>Course description</b>	The course offers an overview of the fundamentals of IT security and deals with cryptographic methods, authenticity, key management, access control and secure communication.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to name the protection goals of IT security and to show threats as well as methods to guarantee the goals</li> <li>- know cryptographic methods and can name their respective strengths and weaknesses and thus possible application scenarios</li> <li>- Encrypt and sign emails and any documents</li> <li>- List methods for access control and monitoring at network, system and application levels and explain their function and application scenarios</li> <li>- Can explain basic technologies for secure communication</li> <li>- Explain basic procedures for evaluating the importance of systems or for risk analysis</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics of Information Security</li> <li>- Threat to IT security and sources of danger (internal and external threats)</li> <li>- Basics of cryptography</li> <li>- HMAC</li> <li>- Public key infrastructures (PKI)</li> <li>- Signatures</li> <li>- Certificates</li> <li>- access control</li> <li>- Identification/Authentication/Authorization</li> <li>- Password security/entropy</li> <li>- DMZ, Firewall &amp; IDS/IPS</li> <li>- IPSec</li> <li>- Transport Layer Security</li> <li>- Secure communication mechanisms</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	

<b>Comments</b>	
-----------------	--

## Software Security

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Establish identity &amp; access management in (web) applications</li> <li>- Recognize the 10 most common security vulnerabilities in software</li> <li>- Use established authentication methods (HTTP Digest, Single Sign On/SAML/OAuth2)</li> <li>- Development of secure applications and assessment of current security risks</li> <li>- Evaluate software projects using a Secure Software Lifecycle</li> <li>- Assessment of threats to applications using a risk matrix</li> <li>- Basics for conducting a security assessment / pentest</li> <li>- Software development: Secure by design, secure by default</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Application Security</li> <li>- Secure by design principles</li> <li>- Secure authentication in SW</li> <li>- Web Application Security</li> <li>- Identity &amp; Access Management</li> <li>- Risikobewertung in SW / Threat Modeling</li> <li>- DB Security</li> </ul>

<b>Prerequisites</b>	Knowledge of common web languages (HTML, JS, CSS, PHP, AJAX) Knowledge of object-oriented languages (Java    C#. / .net) Knowledge of handling databases (MySQL or Oracle) Basic knowledge of using Linux Knowledge of network protocols: Ethernet, IP/ARP, TCP/UDP, DNS, Application Layer protocols, Transport Layer Security or http/s, s/ftp, ssh,...
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- SAML Specifications 2.1</li> <li>- OAuth 2.0 Authorization Framework - RFC6749</li> <li>- OWASP 10 2021++/--</li> <li>- NIST Secure Software Development Framework</li> <li>- OWASP Secure Coding Guideline</li> </ul>
<b>Attendance</b>	
<b>Comments</b>	

## Backend Web Engineering

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course enables students to develop (mobile) web applications using current frontend web frameworks. Relevant web frameworks (such as Spring Boot, Symfony and FLASK) will first be presented, and an own project using Spring Boot implemented based on the framework-specific design and architectural principles. A REST-API will be implemented and authorized through JWT. Main focus will be given to practical work.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- plan and implement dynamic web applications using server-side programming (using Spring Boot)</li> <li>- use general concepts of server-side implementation (sessions, data transmission, authentication) for own projects</li> </ul>



	<ul style="list-style-type: none"> <li>- implement and link data bases to web applications</li> <li>- implement data exchange between client and server using Ajax and JSON</li> <li>- implement maintainable software using selected frontend frameworks</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Base technologies of webserver infrastructure</li> <li>- Fundamentals of server-side programming (sessions, cookies, data exchange)</li> <li>- Java Spring Boot Programming</li> <li>- Interfacing Data Bases</li> <li>- Provision of Restful Web Services</li> </ul>
<b>Prerequisites</b>	Structured and OO Programming; Data Management; Web Engineering
<b>Assessment Methods</b>	- Project Work
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	mandatory
<b>Comments</b>	Can be combined with Frontend Web Engineering.

## Frontend Web Engineering

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course enables students to develop (mobile) web applications using current frontend web frameworks. Relevant web frameworks (such as React, Angular and Vue.js) will first be presented, and an own project using Vue.js implemented based on the framework-specific design and architectural principles. The integration with a REST-API will be implemented using Ajax; JSON will be used for data exchange. Main focus will be given to practical work.
<b>Teaching methods</b>	Short presentations; project work; self-study with practical examples; coaching.

<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- give an overview of relevant frontend web frameworks and discuss pros and cons</li> <li>- implement maintainable software using selected frontend frameworks</li> <li>- implement data exchange between client and server using Ajax and JSON</li> <li>- explain the architecture and the design principles of specific frameworks and to apply them in SW development</li> <li>- deploy the implemented software</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- overview on relevant frontend frameworks</li> <li>- architecture and design principles of selected frameworks</li> <li>- components of a selected framework</li> <li>- programming using a selected framework</li> </ul>
<b>Prerequisites</b>	Structured and OO Programming; Data Management; Web Engineering
<b>Assessment Methods</b>	- Project Work
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	mandatory
<b>Comments</b>	Can be combined with Backend Web Engineering.

## IT Infrastructure

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course tackles important infrastructure (Hardware and Software) for digital Enterprises, ranging from computing centers to smart devices while focusing on selection, planning and rollout of this infrastructure.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...

	<ul style="list-style-type: none"> <li>- assess basic concepts of virtualization and container technologies</li> <li>- plan a redundant computing center and the required hardware</li> <li>- automate the rollout of infrastructure using Infrastructure as Code (IaC) and document and monitor it using a configuration management data base (CMDB)</li> <li>- define criteria for hardware tender procedures</li> <li>- describe use cases for smart devices in companies</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Data Center Basics</li> <li>- Server, Storage and Networking hardware and protocols</li> <li>- Scalability and Redundancy</li> <li>- Virtualization and different hypervisors, Virtual Machines vs. Container technologies</li> <li>- Infrastructure as Code (IaC) and configuration management, CMDBs and IT documentation, Monitoring</li> <li>- Smart Devices and equipment (e.g., cameras, drones, sensors)</li> <li>- Hardware procurement</li> <li>- Planning, Design and Rollout of enterprise IT infrastructure</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Cloud Computing.

## Cloud Computing

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course gives an overview on technical, managerial and legal aspects of cloud computing and enables planning, implementation and evaluation of native cloud- and migration projects, as well as the implementation of simple cloud applications.
---------------------------	--

<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- evaluate pros and cons of various deployment models (on premise vs. diverse cloud alternatives) and choose the best one for a project</li> <li>- evaluate Cloud Service Providers and applications according to suitable criteria, carry out a TCO calculation and select the best solution</li> <li>- configure and monitor several instances in a public cloud environment</li> <li>- develop own applications in a Platform as a Service (PaaS) context</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Cloud Computing NIST definition, architecture and deployment models</li> <li>- Cloud Computing NIST definition, architecture and deployment models</li> <li>- Hybrid Cloud Solutions</li> <li>- Cloud Computing platforms &amp; applications, basics of Cloud Application Development</li> <li>- Economic aspects of Cloud Computing, Outsourcing, TCO calculations</li> <li>- Legal aspects, cloud standards</li> <li>- Selection of CSPs, Vendor Lock-In</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with IT-Infrastructure.

## Data Science Engineering

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The third part of the specialization "Big Data & Data Science" introduces data engineering and data visualization
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- import raw data from various sources (data bases, internet) in various formats</li> <li>- preprocess raw data for further processing</li> <li>- critically assess diagrams</li> <li>- visualize data for exploration</li> <li>- create interactive graphics</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- create data science projects using R studio</li> <li>- manipulate data with the R tidyverse framework</li> <li>- Fundamentals of visualization</li> <li>- create meaningful diagrams using ggplot2</li> <li>- create interactive diagrams</li> </ul>
<b>Prerequisites</b>	Course: "Applied Probability and Statistics" Course: "Applied Statistics and Data Analysis"
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Machine Learning.

## Machine Learning

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The fourth part of the specialization "Big Data & Data Science" focuses on Machine Learning.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...

	<ul style="list-style-type: none"> <li>- fit machine learning models (supervised, unsupervised) to data</li> <li>- assess and compare the performance of predictive models</li> <li>- get into new data science topics</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Supervised Learning: Trees, Neural Networks, k-NN, Naive Bayes</li> <li>- Unsupervised Learning: PCA, Medoid-Based Clustering, Association Rules</li> <li>- Benchmarking and Tuning of machine learning algorithms</li> <li>- Special Topics (Text Mining, Network Analysis)</li> </ul>
<b>Prerequisites</b>	Course: "Data Engineering"; Course: "Applied Probability and Statistics"; Course: "Applied Statistics and Data Analysis"; Course: "Introduction to Statistical Learning"
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Data Science Engineering

## Agile Requirements Engineering

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The third part of the specialization "Business Applications" focuses on requirements engineering (also in an agile setting) and prepares for the IREB certification.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- clearly separate system from context</li> <li>- document requirements</li> <li>- administer requirements</li> <li>- identify, classify and administer sources for requirements (stakeholder, documents, systems)</li> <li>- apply techniques for gathering requirements</li> </ul>

	<ul style="list-style-type: none"> <li>- identify, analyse and solve conflicts during the requirements gathering process</li> <li>- carry out context modeling</li> <li>- model information structures (UML class diagrams)</li> <li>- model dynamic aspects (Use cases, data flow diagrams, activity diagrams)</li> <li>- model scenarios (sequence diagrams)</li> <li>- consider functional requirements, constraints and quality requirements in agile projects</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- requirements engineering projects</li> <li>- documentation</li> <li>- requirements gathering techniques</li> <li>- scenario modeling</li> <li>- requirements of agile requirements engineering projects</li> </ul>
<b>Prerequisites</b>	fundamentals of modeling (use cases, class diagrams)
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Rapid Application Development.

## Rapid Application Development

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The fourth part of the specialization "Business Applications" tackles the tool-based development of data base-intensive applications.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- assess the advantage of No-Code/Low-Code applications vs. classic software development</li> <li>- identify use cases for No-Code/Low-Code</li> </ul>

	<ul style="list-style-type: none"> <li>- Choose a suitable NCLC development platform</li> <li>- Using some platform (e.g., MS Power Apps), create simple business applications</li> <li>- Apply security mechanisms</li> <li>- Integrate the application with existing systems using interfaces</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- No-Code and Low-Code development platforms</li> <li>- Functions of Application Builder</li> <li>- Integration of DB applications into existing infrastructure</li> <li>- security aspects</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Agile Requirements Engineering.

## Software Quality & DevOps

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The fourth part of the specialization "UX & Software Quality Assurance" addresses software quality management and deployment.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- discuss basics of quality criteria</li> <li>- apply quality measures in practice</li> <li>- explain quality standards (e.g. IEEE) and apply aspects of them</li> <li>- Visualize core software quality criteria for decision making</li> <li>- assess the importance of software</li> <li>- carry out a risk assessment for software projects</li> <li>- explain the principles and advantages of devops and the relationship to quality management</li> </ul>



	<ul style="list-style-type: none"> <li>- Discuss cultural aspects of devops (communication, collaboration, integration, automatisisation)</li> <li>- practice roles, teams and project structures related to DevOps</li> <li>- Plan steps for the implementation of DevOps in a use case</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- quality management</li> <li>- quality standards</li> <li>- risk assessment</li> <li>- DevOps</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Agile Software Testing.

## Agile Software Testing

<b>Degree programme</b>	BWI
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The third part of the specialization "UX & Software Quality Assurance" tackles Software Testing in an agile setting.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- describe and use proper software testing terminology</li> <li>- describe the fundamental testing process and actively apply from a users' perspective</li> <li>- describe and apply IT standards of software testing (e.g., IEEE 829)</li> <li>- apply fundamental testing methods</li> <li>- plan and carry out simple test automatization using unit tests and UI-driven development</li> <li>- explain principles of agile software development</li> <li>- explain the challenges of testing and quality assurance in agile</li> </ul>

	projects - carry out and support suitable testing activities in agile teams
<b>Course contents</b>	- testing principles - testing planning - testing - testing documentation - agile methods of testing
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	Can be combined with Software Quality & DevOps.

## Business Process Engineering

<b>Degree programme</b>	BWI
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Students learn about the definition of business processes and the use of business processes in an organization. Based on different aspects, students also learn to assess, model and document business processes.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... - assess and describe business processes - model business processes (e.g. with EPC) - discuss relevant aspects of organization-wide business process management - develop a business process handbook - apply methods of process assessment and process description - improve processes

<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Assess and define business processes</li> <li>- Describe relevant aspects of business processes (e.g. inputs, outputs, KPIs, ...)</li> <li>- Model business processes</li> <li>- Create process maps</li> <li>- process handbook</li> <li>- business process management handbook</li> </ul>
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	- Course immanent assessment
<b>Recommended Reading and Material</b>	- slides
<b>Attendance</b>	mandatory
<b>Comments</b>	

## Human Factors and Sports Engineering (BHF)

### Technical English

<b>Degree programme</b>	BHF
<b>Semester</b>	1
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the Technical English course, students will expand their language toolkit to allow them to effectively record and apply technical vocabulary and terminology in the context of future engineering projects. Students will also advance their technical verbal and written skills by creating technical product and technical process descriptions specifically for technical professional audiences and engineering purposes. Moreover, students will consider the impact of technology on their field and on the world in general.
<b>Teaching methods</b>	small and medium tasks and activities; open class inputs and discussion; individual task completion settings; peer review and discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ...

	<ul style="list-style-type: none"> <li>- record and employ technical vocabulary</li> <li>- create and understand technical process instructions</li> <li>- identify and produce technical text types according to their intended audience and communication purpose (for example a technical article and a process description)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Understanding the importance of English in international technical communication</li> <li>- Technical product descriptions</li> <li>- Technical process descriptions</li> <li>- Analysing and describing the impacts of technologies</li> <li>- Formal writing and paragraph construction</li> </ul>
<b>Prerequisites</b>	B2 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Vocabulary Test (10%)</li> <li>- Self-Study and Class Preparation (30%)</li> <li>- Written Test (60%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Murphy, R. (2019). English Grammar in Use, 5th Edition. Klett Verlag.</li> <li>- Oshima, A., Hogue, A. (2006). Writing Academic English, 4th Edition. Pearson Longman.</li> </ul>
<b>Attendance</b>	Obligatory
<b>Comments</b>	

## Biomechanics and Ergonomics Laboratory

<b>Degree programme</b>	BHF
<b>Semester</b>	3
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>The recording and analysis of human movement is a central element in ergonomics and in the evaluation of the interaction between sports equipment and athletes. In this laboratory exercise, students learn in practical exercises how to handle the most important measuring instruments of biomechanics. They learn how objective data on the human body can be correctly recorded, processed, evaluated and</p>
---------------------------	---

	interpreted.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Use different methods to assess human motion (force plate, plantar pressure measurement, 2D video analysis)</li> <li>- Explain changes in ground reaction forces due to different walking speeds</li> <li>- Calculate plantar pressure distribution in walking and running</li> <li>- Calculate joint angles and velocities based on 2D motion analysis data</li> <li>- Use numerical computing software for basic data analysis</li> <li>- Analyse and display measurement data from different biomechanical measurements</li> <li>- To explain the origin of myoelectric signals, conduct an electromyography on a human subject</li> <li>- to present the mean time and amplitude normalized muscle activity of a cyclic movement.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Force plates (technical background, application, conclusion)</li> <li>- Pressure insoles (technical background, application, conclusion)</li> <li>- 2D motion analysis (setup, calibration, marker tracking)</li> <li>- Data analysis and parameter extraction using MATLAB</li> <li>- Data presentation (diagrams, boxplots, tables) using MATLAB</li> <li>- Surface electromyography</li> <li>- eye tracking</li> </ul>
<b>Prerequisites</b>	•Modul Grundlagen der Mechanik
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Current Topics in Life Science Engineering

<b>Degree programme</b>	BHF
<b>Semester</b>	5
<b>Course methods</b>	ILV
<b>Language</b>	English

<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course, students will attend a series of expert lectures from the entire field of Life Science Engineering. Their contents are supplemented by current scientific literature in self-study and give students a comprehensive overview of current topics in Life Science Engineering. Groups of students from different study programmes will cooperate during the semester in creating a video explaining selected scientific concepts.
<b>Teaching methods</b>	Expert lectures, self-study with current articles and videos, feedback from lecturers, peer-review.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - ...name different research topics in the field of Life Science Engineering. - ...conduct research on selected research topics in the field of Life Science Engineering. - ...explain the results of research in the form of a short video.
<b>Course contents</b>	- Overview of tasks and activities from the subject areas of the study program and beyond
<b>Prerequisites</b>	
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

# Master DEGREE PROGRAMS

## AI Engineering (MAI)

### Machine Learning 1: Basics

<b>Degree programme</b>	MAI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course the theoretical and applied basics of machine learning shall be taught.
<b>Teaching methods</b>	A combination of lectures and tutorials
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- self implement selected algorithms</li> <li>- explore data and perform analysis</li> <li>- analysis according to principles of machine learning (e.g. Cross Validation, Parameter Tuning)</li> <li>- applied tasks of machine learning (regression, classification, clustering)</li> <li>- possibilities and limitations of machine learning</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basic principles: Classification, Regression, Clustering, Over/-Underfitting, Cross Validation &amp; Performance Evaluation, Parameter Tuning;</li> <li>- Data handling: Data Cleaning, Handling Missing Values, Data Normalization, Class Balancing, Feature Selection, Dimensionality Reduction;</li> <li>- Algorithms: kNN, Linear Regression, K-Means, Hierarchical Clustering, Trees, principal component analysis, ANN</li> </ul>
<b>Prerequisites</b>	Python and basics of statistics and mathematics
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- 70% exam</li> <li>- 30% assignments</li> </ul>
<b>Recommended Reading and Material</b>	- James G., Witten D., Hastie T., Tibshirani R. (2017): An Introduction to Statistical Learning. – Springer.

	<ul style="list-style-type: none"> <li>- Marsland S. (2015): Machine Learning, An Algorithmic Perspective. – CRC Press.</li> <li>- Géron A. (2017): Hands-On Machine Learning with Scikit-Learn &amp; TensorFlow. – O'Reilly.</li> </ul>
<b>Attendance</b>	75%
<b>Comments</b>	

## Medical Engineering & eHealth

### Project-Related Teamwork 1

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<ul style="list-style-type: none"> <li>- The students design, handle, and finish a relatively complex cooperative project as a team in the field of biomedical engineering- They produce well-formed project plans and documents, a scientific paper and a poster. They present and discuss their work</li> </ul>
<b>Teaching methods</b>	Groups of students finish a joint project independently, under guidance from lecturers and with external cooperation They observe guidelines and principles of project management, and produce the necessary documents and project outcomes to reach the final goal of their project
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- plan a project for a team (requirements analysis, project structure, milestones)</li> <li>- handle the project autonomously</li> <li>- work on tasks using the methods of science and to document the results</li> <li>- implement a project for an external project sponsor</li> <li>- [WIAM03] 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</li> <li>- [WIAM04] plan the phases of a scientific study, conduct it precisely,</li> </ul>



	document it comprehensibly, and to ensure the comprehensibility, dependability, plausibility and transferability other problems areas and contexts
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Specific biomedical engineering knowledge, skills and methods necessary as required by the project</li> <li>- Problem analysis, developing concepts, evaluating problem solution approaches</li> <li>- Project management and documentation</li> <li>- Scientific working</li> </ul>
<b>Prerequisites</b>	Basic engineering / medical knowledge and skills in agreement with the project supervisor
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Repetitive project meetings with the responsible supervisor</li> <li>- Project documentation (Documentation)</li> <li>- 2 pages paper (Paper)</li> <li>- Final Presentation</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Templates</li> <li>- topic specific literature</li> </ul>
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	The work in this project will go on in the oncoming semester in the course "Project Related Teamwork 2"

## Cellular Electrophysiology and Bioimpedance

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Electric behaviour of cells and tissues under the influence of electromagnetic fields and their possible application in medicine.
<b>Teaching methods</b>	Lecture
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain the electric behaviour of cells and tissues under the influence of electromagnetic fields</li> <li>- explain applications of electrophysiology and bioimpedance in</li> </ul>

	medicine on examples - point out potentials for innovation using electrophysiology and bioimpedance methodology
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Electrolytes</li> <li>- Dielectrics</li> <li>- Electrical properties of molecules &amp; tissues</li> <li>- Instrumentation and measurement, data</li> <li>- Models and some selected applications</li> </ul>
<b>Prerequisites</b>	Basics of:- Physics/Chemistry- Electronic- Cellular physiology
<b>Assessment Methods</b>	- written final exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- S. GRIMNES / O.G. Martinsen, Bioimpedance and Bioelectricity Basics, Academic Press 2000 ISBN: 0-12-3003260-1</li> <li>- P.J. RITT et al (eds.) Electrical Bioimpedance methodes: Application to Medicine and Biotechnology, Annals of the N.Y. Academy of Siences, Volume 873, 1999,ISBN: 1-57331-190-1</li> </ul>
<b>Attendance</b>	Attendance not required
<b>Comments</b>	

## EU-Law

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	VO
<b>Language</b>	English
<b>ECTS Credits</b>	1.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this lecture the students will get an overview of the structure of the EU and its institutions. They will learn how to independently solve cases that are submitted to the ECJ.
<b>Teaching methods</b>	The lecture includes the presentation and plenty of opportunity for discussion.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- solving cases on their own so that they know how to solve legal problems in their jobs.</li> </ul>
<b>Course contents</b>	- EU institutions, types of lawsuits, legal bases, structure of laws

<b>Prerequisites</b>	No previous knowledge is necessary.
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	- It is necessary to have worked through my script, which is available in moodle, for the exam.
<b>Attendance</b>	Attendance is necessary because the script and the presentation (ppt) do not contain a solution to the cases.
<b>Comments</b>	none

## Corporate Management in Life Science Technologies

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Students will get a broad overview of corporate management
<b>Teaching methods</b>	Lecture: Discussion and examples Seminar: Seminar paper, discussion and examples Webinar, video calls
<b>Learning outcome</b>	After passing this course successfully students are able to ... - Students: •are able to analyse financial reports of companies according to managerial standards. •are familiar with common financial ratios and their interpretation. •can determine the cost of capital and the capital structure of a company •can calculate the value of a company •know how to apply risk management tools
<b>Course contents</b>	- •Value oriented management oCapital budgeting (NPV, IRR, etc.) oFinancial ratios oFinancial ratio systems (DuPont, BSC) oValue oriented ratios (EVA, CVA, MVA) oInterpretation of financial ratios •Weighted Average Cost of Capital (WACC) •Company valuation •Capital structure decisions •Business Modeling oIntroduction to forecasting oStatistical methods oScenario analysis •Risk management
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Seminar paper (30%), written exam (70%)
<b>Recommended Reading</b>	- •Dr. Karl Knezourek, Slides for the lecture, 2022 •Graham Friend,

<b>and Material</b>	Stefan Zehle, Guide to Business Planning, The Economist Newspaper Ltd., latest edition (Ch. 14 and 17) •Eugene F. Brigham, Michael C. Erhardt, Financial Management – Theory and Practice, latest edition •Pablo Fernandez, Company Valuation Methods, 2004
<b>Attendance</b>	Attendance of the course is mandatory. Students are allowed to miss a maximum of 20% of classes, otherwise they will lose their first exam attempt. Classes start on time. Students are reminded to arrive on time. Students who arrive late for a lecture will receive 0% attendance for that class.
<b>Comments</b>	

## Microprocessor Applications in Medicine

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course focuses on practical application of microcontroller basics and programming techniques in a biomedical engineering context. The utilisation of microcontroller peripheral units via the C/C++ programming language will be shown, and in a step-by-step process a firmware for measuring bioelectric signals and for sending this data to a PC will be programmed in small groups.
<b>Teaching methods</b>	Lecture slides Practical exercises Programming tasks Project works
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- utilize peripheral units like GPIO, UART and ADC</li> <li>- implement microcontroller firmware using C/C++ programming (HW-abstraction, Arduino IDE)</li> <li>- explain SW- and HW-components of microcontroller-based medical devices (e.g. clinical thermometer, blood pressure monitor, blood glucose meter, EEG)</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- AVR microcontrollers, peripheral units (GPIO, ADC, UART), Interrupts</li> <li>- programming using Arduino IDE</li> <li>- Embedded biomedical devices, sensors and actuators</li> </ul>

<b>Prerequisites</b>	programming- and electronics basics
<b>Assessment Methods</b>	- Immanent performance evaluation
<b>Recommended Reading and Material</b>	- Jack Purdum: Beginning C for Arduino, 2015, Apress, ISBN:978-1-4842-0940-0
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Team Management Skills

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	1.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the course the students get to know main principles of leading teams.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain the role of leadership in the different stages of team development (for example by Tuckman) and to derive relevant leading actions (for example directive leadership in the forming phase).</li> <li>- diagnose dynamics in project teams using models (for example Rank Dynamics, Drama Triangle, TZI) and to develop and argue case-related concrete opportunities for activities (for example delegation of responsibility, critical discussion).</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Leadership functions and tasks</li> <li>- Leadership tools in project teams</li> <li>- Role conflicts "colleague" and "project leader"</li> <li>- Leading without formal power and competence</li> <li>- Overview of theories to group dynamics</li> <li>- Conflicts and difficult situations in leading project teams</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Reflection paper (grade)

<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Berkun, S. (2005): The Art of Project Management, Sebastopol: O'Reilly Media</li> <li>- Cronenbroeck, W. (2008): Projektmanagement, Berlin: Cornelsen Verlag [bilingual book: in English and German]</li> <li>- Haeske, U. (2008): Teamentwicklung, Berlin: Cornelsen Verlag, [bilingual book: in English and German]</li> </ul>
<b>Attendance</b>	Attendance is compulsory.
<b>Comments</b>	none

## Medical Information Systems

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course focuses on IHE Technical Frameworks (Used in ELGA) and touches Continua Healthy Alliance Guidelines for establishing standardized, interoperable and future proof medical information systems.
<b>Teaching methods</b>	Lectures, discussions and group work, self organised work on given topics
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- use the basic terminologies of IHE</li> <li>- explain the processes of the IHE Connectathon and the requirements</li> <li>- describe the difference between all XDR, XDM and XDS and their interrelation</li> <li>- describe the IHE Cross-Community Profiles work (based on XCA, XCPD)</li> <li>- describe Identity Management in IHE (based on PIX, PDQ)</li> <li>- describe the basics of IT-Security according IHE Security Profiles (CT, ATNA, XUA, BPPC)</li> <li>- describe the Architecture and Security Requirements of ELGA</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- IHE/HL7/IEEE/Continua terminologies</li> <li>- General understanding of IHE</li> </ul>

	<ul style="list-style-type: none"> <li>- Document Exchange Profiles</li> <li>- IT-Security Profiles</li> <li>- PHR/EHR Integration</li> <li>- Clinical Document Architecture</li> </ul>
<b>Prerequisites</b>	- Basic programming skills- Basic concepts of healthcare
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- exercises in groups</li> <li>- Final Exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Teaching materials in the campus system</li> <li>- <a href="http://ihe.net/Technical_Frameworks/">http://ihe.net/Technical_Frameworks/</a></li> <li>- <a href="https://www.pchalliance.org/">https://www.pchalliance.org/</a></li> <li>- <a href="http://elga.gv.at/">http://elga.gv.at/</a></li> <li>- Moodle Links</li> </ul>
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Modelling in Cardiovascular Systems

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course provides basic knowledge of cardiovascular system dynamics, in particular focusing on the numerical modeling of cardiac pathophysiology and mechanical circulatory assistance.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain the basics of cardiovascular system dynamics</li> <li>- explain the basics of modeling of dynamical systems using analogies</li> <li>- solve (numerically) differential equations that model cardiovascular systems using Simulink</li> <li>- autonomously build numerical models of the cardiovascular system</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Selection from:</li> <li>- Introduction to blood flow hydrodynamics</li> </ul>

	<ul style="list-style-type: none"> <li>- Introduction to cardiac and vascular biomechanics</li> <li>- Introduction into compartmental models modeling through analogies</li> <li>- Modeling of cardiac mechanics</li> <li>- Modeling of vascular mechanics</li> <li>- Modeling of lung mechanics</li> <li>- Modeling of ventricular assist devices and cardiovascular interaction</li> </ul>
<b>Prerequisites</b>	<ul style="list-style-type: none"> <li>- Basic knowledge of Matlab and Simulink- Basic understanding of first and second order linear ordinary differential equations- Basics of cardiovascular anatomy and physiology</li> </ul>
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Intermediate assignments requiring a written report of the student work</li> <li>- Final written exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- BOOKS (comprehensive references marked with *):</li> <li>- Guyton AC, Hall JE. (2006) Textbook of medical physiology. 11th ed. Elsevier Saunders. *</li> <li>- Milnor WR. (1989) Hemodynamics. 2nd ed. Williams &amp; Wilkins.</li> <li>- Nichols WW, O'Rourke MF. (2005) McDonald's blood flow in arteries. 5th ed. Hodder Arnold.</li> <li>- Sagawa K, Maughan L, Suga H, Sunagawa K. (1988) Cardiac Contraction and the Pressure-Volume Relationship. Oxford Univ. Press.</li> <li>- Scherf HE. Modellbildung und Simulation dynamischer Systeme (2007). 3. Auflage. Oldenburg Verlag. *</li> <li>- Werner J (2014) Biomedizinische Technik - Automatisierte Therapiesysteme. Band 9. De Gruyter. *</li> <li>- West JB. (2008) Respiratory physiology: the essentials. 8th ed. Lippincott Williams &amp; Wilkins.</li> <li>- Zipes DP, Libby P, Bonow R, Braunwald E. (2004) Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 7th ed. Saunders.</li> <li>- PAPERS:</li> <li>- Carabello BA. Evolution of the study of left ventricular function: Everything old is new again. 2002 Circulation 105(23):2701-3.</li> <li>- Westerhof N, Lankhaar JW, Westerhof BE. The arterial Windkessel. Med Biol Eng Comput. 2009;47(2):131-41.</li> <li>- ONLINE DOCUMENTS (very informative about the key concepts of cardiovascular dynamics):</li> <li>- Burkhoff D. 2002. Mechanical Properties Of The Heart And Its Interaction With The Vascular System. Columbia University, NY (<a href="http://www.columbia.edu/itc/hs/medical/heartsim/review.pdf">www.columbia.edu/itc/hs/medical/heartsim/review.pdf</a>)</li> </ul>



	- Mark RG. 2004. CARDIOVASCULAR MECHANICS I, II, III. MASSACHUSETTS INSTITUTE OF TECHNOLOGY ( <a href="http://ocw.mit.edu/courses/health-sciences-and-technology/hst-542j-quantitative-physiology-organ-transport-systems-spring-2004/readings/cardio_mech.pdf">http://ocw.mit.edu/courses/health-sciences-and-technology/hst-542j-quantitative-physiology-organ-transport-systems-spring-2004/readings/cardio_mech.pdf</a> )
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Applications for Crowdsourced Healthcare

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course gives a practical introduction into IHE Technical Frameworks (TF). We will start by examining the IHE landscape of technical frameworks (Focused on IT-Infrastructure TF). Tools are presented and applied, which are needed in order to fulfill requirements defined by the different IHE profiles. The single assignments will sum up to a project showing a real-world implementation of communicating/storing/accessing medical information in the growing field of eHealth.
<b>Teaching methods</b>	Project work (in groups) Short-Inputs (lecturer)
<b>Learning outcome</b>	After passing this course successfully students are able to ... - plan and implement a basic Client – Server Architecture - analyse and implement IHE PCD Profile and the use of HL7 v2 - analyse and implement IHE XDS Document Source - establish and integrate and CDA document within an XDS Environment - develop an ATNA client to send audit messages to an open source ATNA
<b>Course contents</b>	- Continua Health Alliance Architecture for including medical device data in Electronic Health Records Standards/Basic Technologies: - HL7 v2, v3 (CDA) - Web Services: Http, Soap, WSDL

	- XML: XSD, XML-Parser, O/X - Mapper
<b>Prerequisites</b>	Fundamentals and Understanding of object-oriented programming (e.g. Java and Eclipse/Netbeans/IntelliJ)
<b>Assessment Methods</b>	- Continuous assessment - Project presentations and project report
<b>Recommended Reading and Material</b>	- Teaching materials in the campus system - IHE ITI-Technical Frameworks Vol 1-4 - IHE DEC-Technical Frameworks Vol 1-2 - HL7 FHIR Specification (online) - Moodle links
<b>Attendance</b>	Attendance to assignment deadlines is mandatory, otherwise no attendance is required.
<b>Comments</b>	

## Engineering for Therapy & Rehabilitation

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course provides knowledge of different rehabilitation issues in different areas of application.
<b>Teaching methods</b>	Lectures and group discussions, Laboratory Course Rehabilitation Engineering, Workshops
<b>Learning outcome</b>	After passing this course successfully students are able to ... - define rehabilitation - describe the roles of the different members of rehabilitation teams and the processes within the teams - explain rehabilitation within different medical fields - describe active and passive methods of rehabilitation and physical medicine - describe the role of biomedical engineers within rehabilitation teams - know the basics of prosthetics and orthotics.
<b>Course contents</b>	- Physical Medicine

	<ul style="list-style-type: none"> <li>- Rehabilitation</li> <li>- Rehabilitation team</li> <li>- Telerehabilitation</li> <li>- Biofeedback</li> <li>- Orthopedics</li> <li>- Prosthetics</li> <li>- Orthotics</li> <li>- Gait Analysis</li> <li>- Reha@home</li> </ul>
<b>Prerequisites</b>	- Physiology- Anatomy
<b>Assessment Methods</b>	- Multiple Choice Moodle Exam, presentation
<b>Recommended Reading and Material</b>	- See course material in moodle
<b>Attendance</b>	see requirements of the study program 80% mandatory
<b>Comments</b>	

## Workflows in Medicine

<b>Degree programme</b>	MME
<b>Semester</b>	1
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	The course provides an overview on workflows in healthcare systems especially at healthcare providers. It introduces typical examples of workflows with an emphasis on distributed and shared workflows.
<b>Teaching methods</b>	Lectures, self guided research, hands on experience in the lab, virtual visits to labs and healthcare provider sites and site visits (if possible)
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- describe workflows in healthcare as requirements from a technical point of view</li> <li>- evaluate existing and design new workflows using relevant literature (e.g. standards, clinical guidelines, research publications,</li> </ul>

	product documentation) - consider views of different stakeholders (doctors, care persons, other care providers, patients, administration, ...) in projects
<b>Course contents</b>	- Discussion of example workflows (Admission and discharge between GPs, resident care organisations and hospitals, radiology and laboratory workflows, use and maintenance of medical devices, clinical paths, ...) - elements and methods for documenting workflows (goals, results, contributions, roles, use cases, ...) - impressions from healthcare environments by e.g. (online) lab and site visits
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Workflow seminar paper
<b>Recommended Reading and Material</b>	- 2013 ACCF/AHA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Clyde W. Yancy, Mariell Jessup, Biykem Bozkurt, Javed Butler, Donald E. Casey, Jr, Mark H. Drazner, Gregg C. Fonarow, Stephen A. Geraci, Tamara Horwich, James L. Januzzi, Maryl R. Johnson, Edward K. Kasper, Wayne C. Levy, Frederick A. Masoudi, Patrick E. McBride, John J.V. McMurray, Judith E. Mitchell, Pamela N. Peterson, Barbara Riegel, Flora Sam, Lynne W. Stevenson, W.H. Wilson Tang, Emily J. Tsai and Bruce L. Wilkoff. Circulation, 2013;128:e240-e327; originally published online June 5, 2013 - doi: 10.1161/CIR.0b013e31829e8776, online (24.10.2014) <a href="http://circ.ahajournals.org/content/128/16/e240">http://circ.ahajournals.org/content/128/16/e240</a> - Connor, M. J. & Connor, M. J. Missing elements revisited: information engineering for managing quality of care for patients with diabetes. J Diabetes Sci Technol, iAbetics Inc., Menlo Park, California, USA., 2010, 4, 1276-1283 - Shepherd, M.; Painter, F. R.; Dyro, J. F. & Baretich, M. F.: Identification of human errors during device-related accident investigations. IEEE_M_EMB, 23, 2004, 66-72. - IHE Laboratory Technical Framework, Volume 1 ( <a href="http://www.ihe.net">www.ihe.net</a> ). - IHE Radiology Technical Framework Volume 1 ( <a href="http://www.ihe.net">www.ihe.net</a> ). - see course materials
<b>Attendance</b>	Attendance to the course is voluntary. Students are required to register for specific on site visits. If registered, students have to attend.
<b>Comments</b>	

## Economics and Marketing

<b>Degree programme</b>	MME
<b>Semester</b>	3
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The objective of this class is to provide an understanding how healthcare markets work and how market participants behave there. Students will learn how companies can use marketing tools to successfully conduct analyses, develop strategies and place products in the healthcare market.
<b>Teaching methods</b>	Lectures with Powerpoint charts, discussions and case studies of marketing- and businessplanning. In addition students will prepare a marketing plan for a new product.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- explain the economic behavior of supply and demand on markets</li> <li>- describe and evaluate the various types of markets</li> <li>- explain and evaluate various marketing strategies, particularly in connection with the product life cycle</li> <li>- evaluate the instruments of the "Marketing Mix" to achieve specific marketing goals</li> <li>- develop an understanding of the medical market processes</li> <li>- prepare a marketing plan for a health care product</li> </ul>
<b>Course contents</b>	- Healthcare markets, essential elements of microeconomic theory (Demand and supply, market types based on competition etc.), basics of healthcare marketing (Mix of marketing tools, strategies, marketing plan, sales call)
<b>Prerequisites</b>	
<b>Assessment Methods</b>	- Marketing Plan, oral exam
<b>Recommended Reading and Material</b>	- Walter J. Wessels – Economics, Barrons 2012, 5th Edition, ISBN 13: 978-0764147609 Recommended for Marketing: - Philip Kotler, Kevin Lane Keller, Friedhelm Bliemel - Marketing Management - Fred Harms, Dorothee Gänshirt - Gesundheitsmarketing

	- Nils Bickhoff, Svend Hollensen, Marc Opresnik - The Quintessence of Marketing
<b>Attendance</b>	Minimum 80%, otherwise first attempt to take the exam is counted as a failure
<b>Comments</b>	This class will partly be conducted for both students of MTE and MBE in the 3rd semester.

## Selected Problems in Medical Engineering & eHealth

<b>Degree programme</b>	MME
<b>Semester</b>	3
<b>Course methods</b>	VO
<b>Language</b>	English
<b>ECTS Credits</b>	1.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course gives an overview and offers experience reports from thematic fields in which alumni of this study program might work
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... - discuss current topics from the field of medical engineering and eHealth - discuss interfaces of medical engineering and eHealth to related fields of competence
<b>Course contents</b>	- Overview on tasks and activities within the topics of the study program and beyond
<b>Prerequisites</b>	
<b>Assessment Methods</b>	- Course immanent assessment method
<b>Recommended Reading and Material</b>	- Slide sets of the lecturers
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Respiration Technologies

<b>Degree programme</b>	MME
-------------------------	-----

<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course introduces different aspects of ventilation, lung simulation and the measurement of aerosols in respiratory processes and demonstrates the practical application in laboratory exercises
<b>Teaching methods</b>	Seminars, Group Work, Laboratory Experiments
<b>Learning outcome</b>	After passing this course successfully students are able to ... - Apply the basics of ventilation techniques - Identify and explain potential methods of lung simulation - Explain aerosol production and measurement techniques and apply them practically
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Pulmonary system testing</li> <li>- Techniques for ventilation</li> <li>- Methods for simulation of human lung</li> <li>- Techniques for aerosol production</li> <li>- Techniques for aerosol measurement</li> </ul>
<b>Prerequisites</b>	Lung Anatomy and Physiology, Basics in fluid dynamics
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Laboratory Protocols</li> <li>- Assignments</li> <li>- Final Exam</li> </ul>
<b>Recommended Reading and Material</b>	- Teaching material in the moodle course
<b>Attendance</b>	Attendance in lectures is optional Attendance in laboratories is mandatory
<b>Comments</b>	

## Biosignal Processing

<b>Degree programme</b>	MME
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English

<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course provides a theoretical and practical introduction into the technologies used to record and analyze data from biosignals.
<b>Teaching methods</b>	Lectures about theory and background, practical student work using Python.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - develop an algorithm in Python to recognize patterns in annotated biosignal data and to measure its performance by applying state-of-the-art signal processing and pattern recognition technologies (machine learning). - describe the most important concepts related to polysomnographic sleep scoring (e.g. sleep stages, transient patterns, scoring standards).
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basics about biosignal recording: sensor positions, recording settings, referencing</li> <li>- Basics about biosignal processing: spectral analysis, frequency bands, filtering, event-related potentials (ERP) analysis</li> <li>- Introduction to polysomnography: sleep stages, transient patterns like spindles, scoring standards</li> <li>- Practical student work using Python: European Data Format (EDF), signal processing with numpy and scipy</li> <li>- Artifacts and their treatment: types of artifacts, artifact minimization and rejection</li> <li>- Sleep analysis: Somnolyzer 24x7 as a reliable sleep stager, quality reviewing of automatic analysis</li> <li>- Spatial EEG analysis: topography, source localization methods: low-resolution brain electromagnetic tomography (LORETA)</li> <li>- Applications: EEG, ERP and sleep studies in clinical practice and scientific research</li> </ul>
<b>Prerequisites</b>	Basic statistics. Python knowledge is helpful but not mandatory.
<b>Assessment Methods</b>	- Project in small groups
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Kemp, Bob, et al. "A simple format for exchange of digitized polygraphic recordings." <i>Electroencephalography and clinical Neurophysiology</i> 82.5 (1992): 391-393.</li> <li>- Kemp, Bob, and Jesus Olivan. "European data format 'plus'(EDF+), an EDF alike standard format for the exchange of physiological data." <i>Clinical Neurophysiology</i> 114.9 (2003): 1755-1761.</li> </ul>



	<ul style="list-style-type: none"> <li>- Anderer, Peter, et al. "Artifact processing in computerized analysis of sleep EEG – a review." <i>Neuropsychobiology</i> 40 (1999): 150-157.</li> <li>- Anderer, Peter, et al. "Advanced analysis of pharmaco-sleep data in humans." <i>Neuropsychobiology</i> 72 (2015): 178-187.</li> <li>- Bakker, Jessie et al. "Scoring sleep with artificial intelligence enables quantification of sleep stage ambiguity: Hypnodensity based on multiple expert scorers and auto-scoring" <i>Sleep</i> (2022) Jul 3:zsac154. doi: 10.1093/sleep/zsac154.</li> </ul>
<b>Attendance</b>	Attendance is required at the practical exercises and at the project deadline meeting, otherwise voluntary (but advisable)
<b>Comments</b>	

## Image Analysis

<b>Degree programme</b>	MME
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Methods for Image processing for medical image technologies, e.g. CT, PET
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- list and explain the usage of file formats</li> <li>- perform simple operations of image processing in intensity, image and spatial space</li> <li>- visualize and render image data for display</li> <li>- describe the basics of the fusion of multimodal image data</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Image representation, file formats, and simple operations</li> <li>- Operations in intensity space</li> <li>- Filters and image transforms</li> <li>- Spatial Transformations</li> <li>- Registration</li> <li>- Visualization and Rendering</li> </ul>
<b>Prerequisites</b>	

<b>Assessment Methods</b>	- Course immanent assessment method and end exam
<b>Recommended Reading and Material</b>	- See course material in the campus system
<b>Attendance</b>	Attendance not required
<b>Comments</b>	

## Advanced Analysis of Medical Data

<b>Degree programme</b>	MME
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Theory of Multivariate Statistics
<b>Teaching methods</b>	Interactive Lecture with lots of MatLab examples and assignments
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- do Multiple Regression Analysis</li> <li>- name MVA Techniques</li> <li>- test and prepare statistical data</li> <li>- do a Factor Analysis</li> <li>- do an independent component analysis</li> <li>- find classifiers and do general pattern recognition</li> <li>- analyse time and synchronisation problems using using statistical methods</li> <li>- apply support vector machines SVM to problems</li> <li>- analyse nonstationary problems using statistical methods</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Multiple Regression Analysis</li> <li>- Classification of MVA Techniques</li> <li>- Basis of MVA – testing and preparing data</li> <li>- Factor Analysis</li> <li>- ICA – independent component analysis</li> <li>- Classification / Pattern Recognition</li> <li>- Time and synchronisation Problems</li> <li>- SVM</li> <li>- Nonstationary Problems</li> </ul>

<b>Prerequisites</b>	Statistics and linear algebra, MatLab
<b>Assessment Methods</b>	- Assignments
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Multivariate Data Analysis by Joseph F. Hair</li> <li>- Computer-Aided Multivariate Analysis by Abdelmonem Afifi</li> <li>- Pattern Classification by Richard O. Duda</li> <li>- Independent Component Analysis by Aapo Hyvarinen</li> </ul>
<b>Attendance</b>	not mandatory
<b>Comments</b>	

## Clinical Engineering

<b>Degree programme</b>	MME
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This lecture gives an overview on the wide field of medical equipment installed and used in hospitals, the special focus is laid upon - how is the equipment used- what is required for its proper installation and application.
<b>Teaching methods</b>	Presentations, Excursions - if possible due to Covid, Presentations from the Students.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain the function and application of the most important medical equipment</li> <li>- explain the key parameters for a technical evaluation of the most important medical equipment</li> <li>- explain the pre-installation - requirements of the most important medical equipment for a functional and proper installation of the equipment</li> <li>- explain the processes of hospital planning using examples</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Project Phases in a Hospital Project</li> <li>- Basics of functional Hospital Planning (Zoning, Layout)</li> <li>- special requirements for electrical installations in a hospital (UPS, line impedance, ...)</li> </ul>

	- Medical Equipment from A to Z
<b>Prerequisites</b>	Basics of Anatomy, Physiology, Physics, Electrical engineering and Mechanics
<b>Assessment Methods</b>	- Multiple choice exam (Computer) at the end of the semester
<b>Recommended Reading and Material</b>	- See material in the campus system CIS, Moodle
<b>Attendance</b>	Attendance in the lectures is voluntary and recommended.
<b>Comments</b>	

## Healthcare and Rehabilitation Technology (MGR)

### Wahlfach - Introduction to MATLAB for Applications in Life Sciences

<b>Degree programme</b>	MGR
<b>Semester</b>	1
<b>Course methods</b>	SO
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	The course focuses on building a strong foundation of programming in MATLAB. Additionally, the basics of signal processing and the design of graphical user interfaces are covered. At the end of the course, students should be able to use MATLAB confidently for their work and be prepared to deepen their skills in the subsequent course MLS 2. Each lesson includes an interactive introduction of the theory followed by practical assignments ranging in difficulty. Additional topics can be introduced into the course setup upon request.
<b>Teaching methods</b>	Presentation of lecturers and contribution of students
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Work with various data types in MATLAB</li> <li>- Use logical operations, arithmetic operations and algorithm control structures</li> <li>- Write scripts, functions and algorithm flow charts</li> <li>- Operate with selected I/O file types and visualise data</li> <li>- Create GUIs</li> </ul>

<b>Course contents</b>	<ul style="list-style-type: none"> <li>- MATLAB data types</li> <li>- Control structures, logical and arithmetic operators</li> <li>- Scripts and functions</li> <li>- Data visualisation</li> <li>- Script debugging and flow charts</li> <li>- Signal processing introduction</li> <li>- Graphical User Interfaces</li> </ul>
<b>Prerequisites</b>	Basic programming knowledge. General knowledge from the field of Life Sciences on a Bachelor level.
<b>Assessment Methods</b>	- Contribution during lectures, individual assignments
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- [1] S. Attaway, MATLAB. A Practical Introduction to Programming and Problem Solving. London: Butterworth-Heinemann, 2013.</li> <li>- [2] A. B. Biran, What Every Engineer Should Know About Matlab and Simulink. New York: Taylor &amp; Francis Group, 2010.</li> </ul>
<b>Attendance</b>	Attendance is optional
<b>Comments</b>	

## IT-Security (MCS)

### Intercultural Communication

<b>Degree programme</b>	MCS
<b>Semester</b>	1
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	In the 21st century, with globalisation having become a reality above all in science, technology and business, it is crucial that our graduates have a solid understanding of intercultural communication.
<b>Teaching methods</b>	Interactive, multi-channel, real-life-based presentations and discussions, with an emphasis on student participation.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- function successfully in an intercultural, international business environment</li> <li>- explain key intercultural theories</li> </ul>

	<ul style="list-style-type: none"> <li>- the ability to adapt their own cultural behaviour</li> <li>- appreciate the link between culture and ethics and its impact</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Lecture modules on intercultural theory and key differences between cultures</li> <li>- Presentations of real-life examples</li> <li>- Exercises &amp; discussions</li> </ul>
<b>Prerequisites</b>	Completion of previous semester courses
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Class participation (including quizzes &amp; discussions)</li> <li>- Presentations</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Trompenaars, F., and Hampden-Turner C., (2012) Riding the Waves of Culture, London: Nicholas Brealey ISBN 1-85788-176-1 (on CIS)</li> <li>- Additional handouts, case studies, and audio-visual support</li> </ul>
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	For further details please see the semester plan on CIS

## Innovation and Technology Management (MTM)

### Digital Leadership & New World of Work

<b>Degree programme</b>	MTM
<b>Semester</b>	3
<b>Course methods</b>	UE
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course, students acquire knowledge and skills in the areas of leadership (personnel management), organization and work design.
<b>Teaching methods</b>	Self-study, lecture, guest lectures, exercises, discussion, articles and case studies, presentations
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- outline the most important trends in the labor market as well as in HR management</li> <li>- evaluate the advantages and disadvantages of different leadership theories and concepts and assess the understanding of leadership in</li> </ul>

	<p>the future</p> <ul style="list-style-type: none"> <li>- motivating employees and leading virtual teams in an increasingly digitalized work environment</li> <li>- weigh up the advantages and disadvantages of centralized or decentralized organizational structures</li> <li>- use productivity-enhancing work tools (e.g., video conferencing tools, enterprise social network, etc.)</li> <li>- understand critical core competencies in future-oriented leadership</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Trends in the economy: globalization, digital transformation and Industry 4.0, etc.</li> <li>- Trends in the labor market: demographic change, diversity, changing values, etc.</li> <li>- Trends in HR management (e.g. talent management, age management, diversity management, internationalization etc.)</li> <li>- Traditional trait, behavioral, and situational theories of leadership</li> <li>- Modern leadership concepts (e.g. transformational leadership, agile leadership, servant leadership, etc.)</li> <li>- Motivation and leadership in increasingly virtual contexts</li> <li>- Democratization of leadership (e.g. decentralization, scrum, holocracy, etc.)</li> <li>- Productivity-enhancing tools for the New World of Work (e.g., video conferencing tools, etc.)</li> <li>- Lean Administration &amp; Paperless Office</li> <li>- Life Long Learning</li> <li>- Competence requirements and teaching in the digitalized world of work</li> </ul>
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	- written test (60%) + Participation in terms of content/presentation (40%)
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Franken, Führen in der Arbeitswelt der Zukunft</li> <li>- Petry, Digital Leadership. Erfolgreiches Führen in Zeiten der Digital Economy</li> <li>- Redmann, Agiles Arbeiten in Organisationen</li> <li>- Laloux, Reinventing Organizations</li> </ul>
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	Further information and teaching materials will be made available via the accompanying Moodle course

## Empirical Market Research

<b>Degree programme</b>	MTM
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

## Innovation and Technology Management

<b>Degree programme</b>	MTM
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course students acquire basic knowledge and develop competences in the field of Innovation Management.
<b>Teaching methods</b>	self-study, lecture, discussion, group work, case studies, multimedia presentations, short online tests, final exam
<b>Learning outcome</b>	After passing this course successfully students are able to ... - distinguish between different forms of innovation - know about different innovation strategies - to establish an innovation-friendly corporate culture - to apply various project selection methods - to know about a systematic innovation process from idea finding to market entry
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Innovation</li> <li>- Motivation and Relevance of Innovation Management</li> <li>- Sources of Innovation</li> <li>- Open Innovation</li> <li>- Types of Innovation</li> <li>- Innovation Diffusion</li> <li>- Innovation Strategies</li> <li>- Innovation process incl. Stage Gate Process</li> <li>- Management of the NPD process</li> <li>- R&amp;D project selection</li> </ul>



	<ul style="list-style-type: none"> <li>- Management of teams in the NPD process</li> <li>- Industrial property rights (in particular patents, utility models, designs)</li> </ul>
<b>Prerequisites</b>	key concepts in business administration
<b>Assessment Methods</b>	- written test (60% at least half of the points must be achieved in order to pass the course) + teamwork on 'methods of innovation management' (20%) + teamwork 'case study' (20%)
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Schilling, M. A. (2022). Strategic Management of Technological Innovation. 7th ed., New York: McGraw-Hill Education. [International Edition!]</li> <li>- additional papers will be provided</li> </ul>
<b>Attendance</b>	<p>Attending 75% of the synchronous teaching units is compulsory, regardless of whether they are held in presence or online.</p> <p>Attendance of less than 75% will result in the reduction of one possibility of repeating the final exam.</p>
<b>Comments</b>	Further information and material regarding this course are provided via LMS moodle.

## Data Science (MDS)

### Applied Mathematics

<b>Degree programme</b>	MDS
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course "Applied Mathematics" aims to convey fundamental mathematical concepts and methods needed in the context of Data Science, particularly in relation to optimization.
<b>Teaching methods</b>	Lecture and exercises.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain fundamental concepts and methods of linear algebra, particularly in relation to inner products, orthogonality, eigenvalue theory, and linear optimization, and apply them in the context of Data</li> </ul>

	Science. - explain fundamental concepts and methods of multivariable calculus, especially gradient descent methods and optimization with constraints, and apply them in the context of Data Science.
<b>Course contents</b>	- Linear Algebra: inner product, orthogonality; eigenvalue and singular value decomposition; linear optimization. - Analysis of multivariable functions: partial derivatives, total differentiability; gradients, directional derivative, linear and quadratic approximation, local extrema; optimization methods: gradient descent methods, Lagrange method.
<b>Prerequisites</b>	Basic knowledge of calculus and linear algebra (see compensatory modules).
<b>Assessment Methods</b>	- The performance assessment takes place during the course and in the module examination.
<b>Recommended Reading and Material</b>	- Will be provided in the course.
<b>Attendance</b>	Attendance is mandatory.
<b>Comments</b>	

## Statistical Computing

<b>Degree programme</b>	MDS
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	R is not only an environment for statistical computing and graphics, it is also a full programming language. Hence, users are not limited to the mere execution of ready-made commands, but can write their own functions if additional functionality is needed. Apart from that, this course imparts knowledge about the different data structures used in R as well as functions that operate on them. This allows for an efficient generation of the desired output, e.g., custom-made summary statistics, visualizations and models. Furthermore, a selection of important statistical or R-specific topics will be covered,
---------------------------	--

	including design matrices and contrasts, R's formula interface, the role of matrix decomposition techniques in statistics etc.
<b>Teaching methods</b>	Both classroom teaching (lecture, practical exercises, discussion) and self-study (preparation and post-processing) are integrated
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- generate dynamic documents</li> <li>- manage data using the available data structures</li> <li>- use elements of structured programming</li> <li>- apply object-oriented concepts</li> <li>- create and interpret graphics</li> <li>- manage packages, measure performance and do profiling</li> <li>- perform in-depth regression analysis</li> <li>- apply selected time series analysis methods</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- R Markdown, Quarto, TinyTeX</li> <li>- Vectors, matrices, arrays, data frames, lists</li> <li>- Strings and factors</li> <li>- Missing values</li> <li>- Loops, conditions, functionals (apply and friends), vectorization</li> <li>- Working with functions, defining new functions, passing functions to other functions</li> <li>- Object-oriented systems: Base types, S3, S4, RC</li> <li>- Base graphics</li> <li>- Grid graphics: Lattice</li> <li>- Measuring speed and memory usage</li> <li>- Categorical predictors in linear regression</li> <li>- Analysis of variance, analysis of covariance</li> <li>- Effect plots, Parallel coordinates, Biplots</li> <li>- Formulas: Intercept, main effects and interactions, formula operators</li> <li>- Contrasts: Coding schemes, planned contrasts, post hoc contrasts</li> <li>- Diagnostics: Non-normality, nonlinearity, heteroscedasticity, regression outliers, leverage values and influential observations, multicollinearity</li> <li>- Transformations of predictors and/or response</li> <li>- Local regression, nonlinear regression, regression splines</li> <li>- Model selection and validation</li> <li>- Long-term forecasts (using regression), ARIMA models</li> </ul>
<b>Prerequisites</b>	Basics of Probability and Statistics (as taught in the bridging courses)
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Partial Exams throughout the semester</li> <li>- In-Class participation</li> </ul>

<b>Recommended Reading and Material</b>	- Wickham, 2019: Advanced R. CRC Press. - Everitt, Hothorn, 2011: An introduction to multivariate data analysis with R. Springer.
<b>Attendance</b>	mandatory
<b>Comments</b>	

## Data Engineering

<b>Degree programme</b>	MDS
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course addresses the practical challenges of one of the main process steps in a data science project: the data engineering, both in R and Python.
<b>Teaching methods</b>	WorkshopsDiscussionExercises
<b>Learning outcome</b>	After passing this course successfully students are able to ... - describe the workflow of a data science project - access various data sources for data import (e.g., relational data bases, web data, text, pictures, videos, streams) - perform data wrangling (import, tidy, transform) - explore and visualize data - assess data plausibility and quality - use relevant tools such as TidyVerse (R) and Pandas (Python) - assess the usefulness of R and Python
<b>Course contents</b>	- Design of Data Science Projects - Data formats for structured and unstructured data (in particular data frames) - data import, data cleansing - data visualization - TidyVerse, ggplot2; Pandas, Numpy - Compare R and Python
<b>Prerequisites</b>	Scripting with R and Python, Descriptive Statistics
<b>Assessment Methods</b>	- Continuous assessment and final project

<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Grolemund, Wickham, 2016. R for Data Science, O'Reilly</li> <li>- Baumer, Kaplan, Horton, 2017. Modern Data Science with R. CRC Press.</li> <li>- VanderPlas, 2017. Python Data Science Handbook. O'Reilly</li> </ul>
<b>Attendance</b>	Attendance is mandatory
<b>Comments</b>	

## Data Science Infrastructure

<b>Degree programme</b>	MDS
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course addresses aspects of ICT infrastructure that is relevant for Data Science activities. Besides getting an overview of computational problems and technologies in the scope of Data Science, course participants will learn how to store and process the different types of data with state-of-the-art software tools and libraries. Amongst others, topics include different kind of data storages (NoSQL databases, hdfs), computing techniques (Python packages, Hadoop, Spark), performance optimization, stream data processing, or the utilization of cloud services for Big Data.
<b>Teaching methods</b>	In the on-site sessions, brief lectures on the specific topics are given. Students need to prepare for each session in which hands-on skills are practiced. In further consequences, these computing infrastructure skills should be applied in a group project. At the end of the course, each participant must pass a practical task in form of a computer-based exam.
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- give an overview of computational problems in the field of Data Science and explain relevant technologies in this context.</li> <li>- store and access structured, semi-structured as well as unstructured data with NoSQL database technologies.</li> <li>- run data-based computations on one or more processors and using different Python libraries (pytorch, sklearn, mxnet, tensorflow).</li> </ul>

	<ul style="list-style-type: none"> <li>- give an overview of dimensions and challenges of Big Data as well as store and process data in a distributed manner using the Hadoop ecosystem (hdfs, map/reduce).</li> <li>- configure a Spark cluster and measure performance improvements of machine learning algorithms executed on such an infrastructure.</li> <li>- manage and process data streams, such as sensor data, using InfluxDB, Kafka and Spark.</li> <li>- utilize cloud services to store, process and exploit Big Data.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Computing Infrastructure for Data Science</li> <li>- Data Storage: From Databases to Data Lakes</li> <li>- Data Processing: From distributed computing to machine learning frameworks</li> <li>- Big Data (Hadoop)</li> <li>- Analytics Engine (Spark)</li> <li>- Stream Data Processing (InfluxDB, Kafka)</li> <li>- Cloud Services for Big Data</li> </ul>
<b>Prerequisites</b>	Databases (SQL, NoSQL) Programming (Python/R) Operating Systems (Linux)
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Weekly Moodle quizzes to assess subject matter knowledge (20%)</li> <li>- Computer-based exam to assess hand-on skills (40%)</li> <li>- Group-based project on a realistic scenario (40%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- White, 2015. Hadoop: The Definitive Guide, O'Reilly</li> <li>- Seidman, Shapira, Malaska, Grover, 2015. Hadoop Application Architectures.</li> <li>- Vohra, 2016. Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related Frameworks and Tools, Apress</li> <li>- Simon, 2015. Too Big To Ignore: The Business Case for Big Data , Wiley</li> <li>- Kleppmann, 2017. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, O'Reilly</li> <li>- Harrison's Guy, 2015, Next Generation Databases: NoSQL, NewSQL, and Big Data, Apress</li> </ul>
<b>Attendance</b>	Attendance is mandatory
<b>Comments</b>	

## Analysis

<b>Degree programme</b>	MDS
<b>Semester</b>	1

<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

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

## Linear Algebra

<b>Degree programme</b>	MDS
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this lecture the main concepts of linear algebra are introduced.
<b>Teaching methods</b>	The class is split into lectures and exercises. For the lectures the method „inverted classroom“ is used. This means that students prepare the topics via reading the recommended literature and make short moodle-test before the lectures. In the lectures students' questions are answered and a deeper insight into the topics is given. For the exercises students calculate exercise in advance and present them at the blackboard.
<b>Learning outcome</b>	After passing this course successfully students are able to ...

	<ul style="list-style-type: none"> <li>- solve elementary problems in vectors spaces as well as simple geometric tasks in two- and three-dimensional euclidean space.</li> <li>- make basic matrix calculations, work with linear maps and calculate determinants and inverse matrices.</li> <li>- solve systems of linear equations via matrices and the gaussian algorithm.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- vector spaces</li> <li>- matrices and linear maps</li> <li>- systems of linear equations</li> </ul>
<b>Prerequisites</b>	A-Levels
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Two parts:</li> <li>- 1. Assessment during the course: a)moodle-test: 25 %, b) exercises: 25%</li> <li>- 2.exam: 50%</li> <li>- For passing the course at least 50% of the points (individually!) in each part must be reached.</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- G. Teschl und S. Teschl, Mathematik für Informatiker, Band 1, 4. Auflage, 2013, Springer Verlag</li> <li>- M. Drmota et al, Mathematik für Informatik, 4. Auflage, 2014, Heldermann Verlag</li> <li>- T. Arens et al, Mathematik, 4. Aufl. 2018, Springer Spektrum</li> </ul>
<b>Attendance</b>	Compulsory attendance in the exercises.
<b>Comments</b>	

## Applied Statistics

<b>Degree programme</b>	MDS
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>“Angewandte Statistik” is targeted on providing a hands-on introduction to the applied analysis of empirical data. Students will gain an understanding of the need to be able to select the correct statistical method for a given problem, and will learn how to execute</p>
---------------------------	--



	<p>the corresponding analysis step by step, i. e., reading and manipulating data as well as applying descriptive and inferential statistical methods. A special focus is on the interpretation and communication of analysis results by means of statistical reports. The "Literate programming"-approach guarantees the reproducibility of results, imperative in modern research. In order to show that data used for statistical analyses are the result of a structured process, the course also covers the main features of empirical social research.</p>
<b>Teaching methods</b>	<p>Both face-to-face learning (lecturing, computer-based practical exercises) and self-study (preparation and post-processing) are integrated.</p>
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain main tasks of statistics and relate them to real-world tasks.</li> <li>- understand mode of operation and requirements of empirical social research.</li> <li>- preprocess, describe and visualize data in R.</li> <li>- carry out hypothesis tests for categorical and metric variables.</li> <li>- test associations between two categorical or two metric variables.</li> <li>- establish and check regression model for metric variables.</li> <li>- perform basic time series analyses.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- fundamentals of empirical social research (design, sampling)</li> <li>- data management in R</li> <li>- one categorical variable: absolute and relative frequencies, bar charts, chi-squared test</li> <li>- two categorical variables: contingency tables, grouped bar charts, spine plots, chi-squared tests for independence and homogeneity</li> <li>- one metric variable: histogram, indicators for mean and variance, boxplots, t-test</li> <li>- two metric variables: scatter plot, correlation analysis, regression analysis</li> <li>- time series analysis: time series plots, regression models, naive forecasting</li> <li>- Reproducible Scientific Research: Literate Programming using R Markdown</li> <li>- choosing the appropriate statistical method for a given problem</li> </ul>
<b>Prerequisites</b>	<p>Applied Probability Calculus and Statistics (in particular: distributions, confidence intervals and statistical tests)</p>
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- In-class exercises,</li> <li>- final exam</li> </ul>

<b>Recommended Reading and Material</b>	- Lecture notes - Hatzinger, Hornik, K., Nagel, H., & Maier, M. J. (2014). R - Einführung durch angewandte Statistik (2., aktualisierte Auflage.). Pearson Deutschland.
<b>Attendance</b>	75%
<b>Comments</b>	

## Software Engineering (MSE)

### Introduction to Graph-Database

<b>Degree programme</b>	MSE
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The goal of this course is to introduce the students into the main concepts related to graph databases (GDB), with emphasis in Neo4j. The first (online, face-to-face) part of the course will introduce the context for GDB, and how they situate within the NoSQL paradigm. The main concepts, tools, and techniques for GDB will be studied, with emphasis in the property graph data model and Neo4j (and its accompanying query language, Cypher). RDF triple stores will be covered, as an alternative to the property graph data model. The offline part of the course consists in assignments related to querying graph databases.
<b>Teaching methods</b>	Online face-t-face lectures and take-home assignments.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - Design and query graph databases
<b>Course contents</b>	
<b>Prerequisites</b>	Knowledge of databases at an intermediate level.
<b>Assessment Methods</b>	- Exam at the end of the online part (40%), two projects for the offline part (60%)
<b>Recommended Reading</b>	- A. Vaisman and E. Zimányi. Data Warehouse Systems: Design and

<b>and Material</b>	Implementation, 2nd Edition, Chapter 13, Springer, 2022 - Ian Robinson, Jim Webber, and Emil Eifrem. Graph Databases. O'Reilly Media, Inc., 2013 - Bechberger, D. Graph Databases in Action, Manning, 2020.
<b>Attendance</b>	Mandatory (75%) for the face-to-face online part.
<b>Comments</b>	

## Mental Power for IT Disciplines

<b>Degree programme</b>	MSE
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course you will learn to use the whole capacity of your brain to solve problems and to achieve any goal you wish
<b>Teaching methods</b>	Seminar and distant learning
<b>Learning outcome</b>	Nach erfolgreichem Abschluss sind die Studierenden in der Lage, ... - formulate goals you want to achieve which are suitable for your subconscious mind - practicing basic elements of attention meditation - focus the conscious mind on goals to align unconscious processes
<b>Course contents</b>	- Processing of information in the human brain - Consciousness and unconsciousness parts of the brain - Gaining consciousness use of primarily unconsciousness parts of the brain - Using skill full meditation techniques to improve business performance
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Continuous assessment
<b>Recommended Reading and Material</b>	- James Borg, "Mind Power", Pearson 2010 - Kazuo Inamori, "A Compass to Fulfillment", Mc Graw Hill 2010 - Heinz Hilbrecht, "Meditation und Gehirn", Schattauer, 2010 - Richard Bandler, "Veränderung des subjektiven Erlebens", Jungferner Verlag 2007, Original: "Using your brain - for a change", Real People

	Press, U.S. (August 1985) - Henry P. Stapp, "Mindful Universe" 2nd Edt Springer 2011 - Chade-Meng Tan "Search Inside Yourself" Optimierte dein Leben durch Achtsamkeit, Goldmann Verlag 2015 - David Eagleman, "Incognito: The Secret Lives of the Brain", Canons 2016 - Leonard Mlodinow, "Subliminal: How Your Unconscious Mind Rules Your Behavior", Vintage books 2013
<b>Attendance</b>	not required
<b>Comments</b>	Elective course for regular students. This course maybe doesn't take place.

## Machine Learning 2

<b>Degree programme</b>	MSE
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

## Clean code: principles, advantages and examples

<b>Degree programme</b>	MSE
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

## Industrial Engineering & Business (MIB)

### International Finance

<b>Degree programme</b>	MIB
<b>Semester</b>	1

<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Students will get a broad overview of international finance
<b>Teaching methods</b>	Lecture, case studies, exercises
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- analyse financial reports of companies according to managerial standards.</li> <li>- apply common financial ratios and interpret their results.</li> <li>- identify financial risks and know how to apply hedging instruments to manage these risks.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Analysis of financial statements and specific topics</li> <li>- Financial ratios</li> <li>- Risk management</li> </ul>
<b>Prerequisites</b>	None required
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Company analysis (Group assignment) 30%</li> <li>- Written exam 70%</li> <li>- Students have to achieve at least a passing level on the written exam and the company analysis respectively to finish the course with an overall positive grade</li> <li>- Written retake exam 70%</li> <li>- Company analysis (individual assignment) 30%</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Dr. Karl Knezourek, Slides for the lecture, 2022</li> <li>- Jeff Madura, Roland Fox, International Financial Management, Thomson, 2019</li> <li>- Graham Friend, Stefan Zehle, Guide to Business Planning, The Economist Newspaper Ltd., latest edition (Ch.I 14)</li> </ul>
<b>Attendance</b>	Attendance of the course is mandatory. Students are allowed to miss a maximum of 20% of classes, otherwise they will lose their first exam attempt. Classes start on time. Students are reminded to arrive on time. Students who arrive late for a lecture will receive 0% attendance for that class.
<b>Comments</b>	

## International Law

<b>Degree programme</b>	MIB
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course explains the major European institutions, their structure, tasks and influence and focuses relevant topics of International Economic Law.
<b>Teaching methods</b>	Lector and student presentation, group work, case studies
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- •list the main bodies of the European Union and list their competencies and impacts on international business</li> <li>- •list relevant topics of international business law and explain the impact on international business</li> <li>- •explain main differences between international tax, competition and business law compared to national Austrian regulations</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- •Major European regulations</li> <li>- •International tax and anti-trust law</li> <li>- •UN Regulations and INCOTERMS</li> <li>- •Company and Corporation Law</li> <li>- •Intellectual Property</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Participation in class</li> <li>- Student presentation</li> <li>- Management Paper</li> <li>- Exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Publicly available sources</li> <li>- My presentations</li> </ul>
<b>Attendance</b>	online
<b>Comments</b>	

## Public Affairs & Lobbying

<b>Degree programme</b>	MIB
-------------------------	-----

<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Corporate public affairs are the "foreign policy" of a company or organisation. Lobbying is the instrument to influence political, legal and socio-political decisions as well as technical regulations in a targeted and strategically planned way. These competences have gained a lot of importance in companies in Austria and the EU. This course provides an insight into what lies behind lobbying and public affairs and how the interaction between business, politics, and society works in practice. It introduces how specific corporate goals can be supported through lobbying and public affairs and how quality and compliance can be ensured.
<b>Teaching methods</b>	The teaching content and correlations are conveyed according to the state of scientific knowledge and deepened by numerous practical examples. Complex contexts are additionally made comprehensible through video material. The students apply the knowledge acquired in the final thesis and supplement it with their research.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - After successful completion of the course, students can analyse the socio-political environment of a company and improve the competitiveness of the company through concrete, professional measures.
<b>Course contents</b>	
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Development of a written public affairs and lobbying concept based on a self-selected example.
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	80%
<b>Comments</b>	

## Professional Writing Skills

<b>Degree programme</b>	MIB
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course you will enhance your ability to write effective texts in English for professional purposes, taking into consideration specific genres, purposes and audiences. In an era of GPT writing tools, this course focuses on the 'human' side of writing, including engaging in collaborative writing tasks, better reflecting the demands of the workplace.
<b>Teaching methods</b>	This course takes a flipped-classroom approach whereby students engage with self-learning materials outside of class in preparation for graded writing assignments in class. All writing assignments then receive detailed feedback from expert lecturers.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - Analyze and interpret the linguistic design of texts for different target groups and for various purposes in a business context. - Improvement of competencies for formal English texts in a business context. - Write a variety of text forms without technical support (emails, internal offer memos, literature analyses for process improvement). - Apply writing skills in collaborative writing contexts.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Text analysis</li> <li>- Formal writing</li> <li>- Emails and memos</li> <li>- Text synthesis and recommendation reports</li> </ul>
<b>Prerequisites</b>	B2-C1 level English
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Continuous assessment of writing skills (in class) (50%)</li> <li>- Written exam (50%)</li> </ul>
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	Compulsory as per study programme regulations
<b>Comments</b>	



## Managerial Economics and Operations Research

<b>Degree programme</b>	MIB
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

## Quantum Information Laboratory

<b>Degree programme</b>	MIB
<b>Semester</b>	3
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course complements the course Introduction to Quantum information by demonstarting and conducting hands-on experiments in which we produce, manipulate and detect qubits.
<b>Teaching methods</b>	Lecture, discussion, independent conduct of experiments
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- work in a physics laboratory</li> <li>- work safely with laser radiation</li> <li>- take data and evaluate measurement results</li> <li>- understand concepts like superposition and interference</li> <li>- understand entanglement and how entangled states can be produced</li> <li>- know about the polarization of photons and its manipulation</li> <li>- know and apply protocols to distribute quantum keys</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Laser safety</li> <li>- Lasers and detectors</li> <li>- Double slit experiment, diffraction at a grating</li> <li>- Interference and interferometers</li> <li>- Entanglement and Bell inequality</li> <li>- Quantum key distribution: BB84 protocol</li> </ul>

<b>Prerequisites</b>	Introduction to Quantum information (class 1 and 2)
<b>Assessment Methods</b>	- Laser safety test (10%) - Lab Reports (90%)
<b>Recommended Reading and Material</b>	- Rainer Müller, Franziska Greinert: Quantentechnologien für Ingenieure (2023)
<b>Attendance</b>	Presence during the classes is obligatory and will be monitored. At least 75% of the classes must be attended in order to pass the course.
<b>Comments</b>	

## Introduction to Quantum Information

<b>Degree programme</b>	MIB
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Quantum technologies currently take the decisive leap from foundational research to market readiness. They are one of the key technologies of the 21st century. We study the foundational principles of quantum computing, quantum cryptography and quantum sensing. We put a focus on the state-of-the-art of these technologies as well as chances and risks of their implementation in enterpresis and practical aspects such as the certification of quantum technologies.
<b>Teaching methods</b>	<ul style="list-style-type: none"> <li>• learning together: input by the lecturer mixes with contributions by the studends. we aim at a flipped classroom</li> <li>• learning yourself: material for literature research and a moodle-course guide the self-study phases</li> <li>• learning hands-on: this course is complemented by a Lab class in which the students apply the knowledge gained</li> </ul>
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- give an overview over the state-of-the art of quantum technologies</li> <li>- explain quantum computing, quantum cryptography and quantum sensing as well as their differences</li> <li>- differentiate between enabling technologies and applications of</li> </ul>

	<p>quantum technologies</p> <ul style="list-style-type: none"> <li>- explain fundamental mathematical concepts of quantum information and apply them to simple cases</li> <li>- explain fundamental concepts of quantum information: superposition, entanglement, measurement, no cloning, teleportation</li> <li>- describe protocols of quantum key distribution</li> <li>- discuss practical aspects of quantum key distribution</li> <li>- describe physical platforms for quantum computing</li> <li>- apply measures for quantum computers (T1, T2, quantum volume)</li> <li>- understand quantum gates and apply them in simple algorithms</li> <li>- discuss use cases for quantum algorithms</li> <li>- describe quantum sensors and their applications</li> <li>- discuss ethical aspects of quantum technologies</li> <li>- discuss the certification of quantum technologies</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- quantum computing, quantum cryptography and quantum sensing</li> <li>- complex valued linear algebra</li> <li>- foundations of quantum information</li> <li>- BB84-protocol</li> <li>- E91-protocol</li> <li>- free space and fiber based implementation of QKD</li> <li>- hardware for quantum computers</li> <li>- quantum algorithms</li> <li>- quantum sensors</li> <li>- ethical aspects of quantum technologies</li> <li>- certification of quantum technologies</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- moodle tests</li> <li>- student's presentations</li> <li>- final exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Müller/Greinert: Quantentechnologien für Ingenieure</li> <li>- Wong: Introduction to Classical and Quantum Computing</li> </ul>
<b>Attendance</b>	75%
<b>Comments</b>	

# Tissue Engineering and Regenerative Medicine (MTE)

## Tissue Engineering for Regenerative Medicine

<b>Degree programme</b>	MTE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	6.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the first part of the course the most important tools used in tissue engineering (e.g. cells, scaffolds, cell-cell communication,...) are discussed. After an intermediate exam, the second part of the course at the one hand deals with tissue engineering concepts and strategies of different tissue types (e.g. cartilage, bone,...), on the other hand with the application of cells in regenerative medicine. Course contents are deepened by activities of the students during the course.
<b>Teaching methods</b>	- Lectures- Distance learning- Team work and presentations of the students- Guest lectures
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- name different cell types, explain their characteristics and select them for different applications in tissue engineering</li> <li>- list different methods for scaffold production and explain their advantages and disadvantages for application in tissue engineering</li> <li>- describe different methods for cell differentiation and select suitable detection methods for cell differentiation</li> <li>- describe the correlation between different tissue components (cells, extracellular matrix,...) and define differences between selected tissue types</li> <li>- describe and compare different tissue engineering concepts using examples</li> <li>- give an overview about the application of cells for regenerative medicine, name examples and explain advantages and disadvantages of stem cells as therapeutics</li> <li>- evaluate subject specific literature sources (also in English) regarding confirmability, dependability, plausibility, and transferability of insights for comparable problems or contexts and use and reference these in their own work</li> <li>- 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</li> </ul>

	<ul style="list-style-type: none"> <li>- relate research results to industry, society, the economy or the environment.</li> <li>- present own or other scientific publications comprehensibly, evaluate them and formulate suggestions for further development.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Components used in tissue engineering</li> <li>- Primary cells, cell lines and immortalization of cells</li> <li>- Extracellular matrix</li> <li>- Communication between cells</li> <li>- First steps of animal development</li> <li>- Cell differentiation and stem cells</li> <li>- Scaffolds for tissue engineering</li> <li>- Tissue engineering of bones and cartilage</li> <li>- Skin tissue engineering and application</li> <li>- Heart valves tissue engineering</li> <li>- Cell therapy in regenerative medicine</li> <li>- Immunomodulation of mesenchymal stem cell</li> <li>- Biofabrication</li> </ul>
<b>Prerequisites</b>	- basic knowledge in cell biology- basic knowledge in biochemistry
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Collaboration during lessons</li> <li>- Distance learning</li> <li>- Presentations</li> <li>- Intermediate written exam</li> <li>- Final written exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Gordana Vunjak-Novakovic, R. Ian Freshney (2006): Culture of Cells for Tissue Engineering, Wiley</li> <li>- Ulrich Meyer, Thomas Meyer, Jörg Handschel, Hans Peter Wiesmann (2009): Fundamentals of Tissue Engineering and Regenerative Medicine, Springer</li> <li>- Relevant literature (e.g. papers) will be provided</li> </ul>
<b>Attendance</b>	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.
<b>Comments</b>	

## Biomaterials in Tissue Engineering

<b>Degree programme</b>	MTE
<b>Semester</b>	1
<b>Course methods</b>	ILV

<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The students obtain knowledge medical applications of biomaterials as well as about basic concepts regarding design and mechanical properties of selected natural and synthetic biomaterials. Topics from current research projects of the UAS Tech are explained and discussed.
<b>Teaching methods</b>	- Lecture/Presentation- Discussion
<b>Learning outcome</b>	After passing this course successfully students are able to ... - describe the basic techniques to manufacture scaffolds from raw biomaterials and explain the different prerequisites for the biomaterials. - explain nature design concepts in the biomaterials field. - differentiate biomaterials regarding their properties and assess their usage in a specific application. - describe the most common techniques to test cell biocompatibility of biomaterials and apply them on different biomaterials. - correlate the protein structure of a biomaterial with its properties as a biomaterial.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Elements of biomaterials</li> <li>- Self-assembly and growth</li> <li>- Mechanical concepts in biomaterials</li> <li>- Different protein fibers: collagen, silk, keratin</li> <li>- Methods for the determination of biocompatibility</li> <li>- Soft tissue - skin</li> <li>- Cartilage</li> <li>- Biological composite materials e.g. fibers</li> <li>- Hierarchical design bone, wound care und suture materials, vascular implants, biomimetic and bio-inspired materials</li> </ul>
<b>Prerequisites</b>	Basics of chemistry and protein chemistry
<b>Assessment Methods</b>	- Final exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Gordana Vunjak-Novakovic, R. Ian Freshney (2006): Culture of Cells for Tissue Engineering, Wiley</li> <li>- Ulrich Meyer, Thomas Meyer, Jörg Handschel, Hans Peter Wiesmann (2009): Fundamentals of Tissue Engineering and Regenerative Medicine, Springer</li> </ul>

	- Relevant publications will be provided via CIS
<b>Attendance</b>	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.
<b>Comments</b>	

## Protein Chemistry

<b>Degree programme</b>	MTE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Students gain knowledge about the structure and function as well as the analytics of proteins.
<b>Teaching methods</b>	Web-based trainings, lectures, group work and discussions
<b>Learning outcome</b>	After passing this course successfully students are able to ... - explain the structure and chemistry of proteins and name modifications and their functions - name the most important methods for the chemical analysis of proteins and explain their principles - explain the function of proteins in detail - explain interactions of proteins with other biomolecules using examples
<b>Course contents</b>	- Repetition of the basics of protein chemistry by means of web-based trainings (amino acids, protein structure, protein modifications, protein quantification, chromatography, electrophoresis) - Antibody engineering - Mass spectrometry of proteins - Recombinant proteins for medical use - Expression Systems - Structure determination of proteins - Protein Folding Stability and Dynamics - Nuclear Magnetic Resonance Spectroscopy (NMR) - Clinical examples of diseases due to protein misfolding - Online exercise - protein folding

<b>Prerequisites</b>	Basic knowledge of protein chemistry
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Completion of the Moodle tests for the web-based trainings (&gt;70% correct answers): 20 points</li> <li>- Moodle final test in attendance at the UAS: 80 points</li> </ul>
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	Attendance is compulsory in this course (25% absences are tolerated). If you are absent more than 25%, you will lose your first exam entry.
<b>Comments</b>	

## Current Problems in Regenerative Medicine

<b>Degree programme</b>	MTE
<b>Semester</b>	3
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Analysis of scientific publications, peer-review process, important publications in the subject areaA selection of current issues of regenerative medicine is worked on in small groups with experts, using problem-based learning methodology
<b>Teaching methods</b>	Lecture; problem-based learning part
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- to analyze and discuss complex problems of regenerative medicine and their broader context in a structured manner</li> <li>- to identify knowledge gaps and based on these to carry out targeted research, to evaluate possible solutions and to develop their own solutions</li> <li>- to select, prepare and present their own solutions, and to defend them backed up with scientific arguments</li> <li>- to analyse, evaluate and select scientific publications based on common quality standards in the subject area</li> <li>- identify the basic types of scientific publications and differentiate between them, especially original papers, review papers, conference</li> </ul>



	<p>articles, journals and books</p> <ul style="list-style-type: none"> <li>- evaluate subject specific literature sources (also in English) regarding confirmability, dependability, plausibility, and transferability of insights for comparable problems or contexts and use and reference these in their own work</li> <li>- 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</li> <li>- relate research results to industry, society, the economy or the environment.</li> <li>- present own or other scientific publications comprehensibly, evaluate them and formulate suggestions for further development.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- current problems in regenerative medicine</li> <li>- analysis of scientific publications in the subject area</li> </ul>
<b>Prerequisites</b>	semester 1 & 2
<b>Assessment Methods</b>	- immanent assessment method
<b>Recommended Reading and Material</b>	- differs according to area selected
<b>Attendance</b>	Mandatory 100% in problem-based learning part
<b>Comments</b>	

## Stem Cells in Regenerative Medicine

<b>Degree programme</b>	MTE
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In the first part of the course selected chapters of stem cell biology and the application potential of stem cells (course contains self-study units) are discussed. After accomplishing an exam in the second part of the course students as well as experts in the field of stem cell research present current data.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...

	<ul style="list-style-type: none"> <li>- name the different types of stem cells including their properties and functions.</li> <li>- explain the factors guiding the different processes in stem cells.</li> <li>- define possible applications of stem cells in the field of tissue engineering.</li> <li>- prepare given papers about stem cells and present them to their colleagues.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- different types of stem cells (ESC, adult SC, iPS, fetal SC)</li> <li>- definition and characteristics of stem cells</li> <li>- stem cell niche and its relevance in the development of diseases</li> <li>- fate decision of stem cells</li> <li>- application potential of stem cells</li> <li>- ethics and legal issues of stem cells</li> </ul>
<b>Prerequisites</b>	- Molecular Biochemistry and Cell Biology of the first semester- Gene Regulation and Signal of the second semester
<b>Assessment Methods</b>	- intermediate and end exam
<b>Recommended Reading and Material</b>	- Robert Lanza and Anthony Atala (2014): Essentials of Stem Cell Biology, (third edition), Elsevier., ISBN: 978-0-12-409503-8
<b>Attendance</b>	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.
<b>Comments</b>	

## Advanced Immunology and Vascular Tissue Engineering

<b>Degree programme</b>	MTE
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>This lecture helps to extend and deepen the knowledge of immunological processes in connection to tissue engineering. Furthermore, basic knowledge in vascular biology will be taught. This is necessary to understand the principles of vascular tissue engineering</p>
---------------------------	---

<b>Teaching methods</b>	- Lecture- Presentations- Group puzzle
<b>Learning outcome</b>	After passing this course successfully students are able to ... - apply complex immunological processes to tissue engineering - describe the cascades of the wound healing process - describe the processes of formation of blood and lymphatic vessels - recapitulate the principles of vascular tissue engineering
<b>Course contents</b>	- Wound healing - Inflammation - Complement system - Transplantation - Graft rejection - Angiogenesis - Lymphangiogenesis - Endothelial cells in research - Examples of Vascular tissue engineering
<b>Prerequisites</b>	Basic knowledge of immunology
<b>Assessment Methods</b>	- Group puzzle - Collaboration - Paper presentation - Examination (the grades of the exam is the basis, up- or down grading is possible by the other assessment criteria)
<b>Recommended Reading and Material</b>	- Current literature (papers) provided during the lecture
<b>Attendance</b>	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.
<b>Comments</b>	

## Advanced Technologies in Biological Research

<b>Degree programme</b>	MTE
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Overview of the nanobiotechnological application potential as well as deepening of several sub-topics.
<b>Teaching methods</b>	lectures, presentations, self-dependent working on exercises
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- define the concept of thermal energy and relate such concept to understand life-time interactions in biological systems.</li> <li>- describe the principle of electron microscopy (EM) and atomic force microscopy (AFM) for the elucidation of the nanostructure of biomaterials as well as to measure molecular forces between molecules (AFM).</li> <li>- explain molecular modifications for synthetic biointerfaces that control interactions with molecules in biological fluids.</li> <li>- describe and evaluate the colloidal aspects of current nanoscale drug delivery systems.</li> <li>- explain the term biosensor and describe the physical background of optical biosensors (focus on plasmonic properties) including their application in bioassays.</li> <li>- explain different microfabrication methods and microfluidic components, describe the physical principles regarding fluids on a microscale and give application examples for cell analysis based on lab-on-chips.</li> <li>- explain the biochemical principles behind binding events relevant for microarrays and give specific examples in which fields microarrays are used.</li> <li>- describe the biochemical principles of molecular nanomotors based on proteins and nucleic acids and give examples of the application potential of such structures.</li> <li>- relate research results to industry, society, the economy or the environment.</li> <li>- present scientific publications comprehensibly, evaluate them and formulate suggestions for further development.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Biosensors</li> <li>- Functional biointerfaces</li> <li>- Biomembranes</li> <li>- Characterization of nanostructures</li> <li>- Drug delivery</li> <li>- Lithography and miniaturization</li> <li>- Microfluidics</li> <li>- Lab-on-a-chip application</li> <li>- Molecular recognition and interaction</li> <li>- Microarrays</li> </ul>

	- Molecular nanomotors
<b>Prerequisites</b>	biochemistry, basics in physics
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Collaboration during the lectures</li> <li>- Presentations</li> <li>- Self-dependent solution of exercises</li> <li>- Final exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Nanobiotechnology II, Wiley-VCH by Mirkin et al.</li> <li>- Biomedical Nanostructures, Wiley by Consalves et al.</li> <li>- Matthew A. Cooper, Label-Free Biosensors, Cambridge University Press, 2009.</li> <li>- F. S. Ligler (editor), Optical Biosensors: Present and Future, Elsevier, 2002</li> <li>- B. E. A. Saleh, M. C. Teich, Fundamentals of Photonics, John Wiley &amp; Sons, 1991.</li> <li>- scientific literature from the lecture</li> </ul>
<b>Attendance</b>	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.
<b>Comments</b>	

## AI Engineering (MAI)

### Machine Learning 1: Basics

<b>Degree programme</b>	MAI
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course the theoretical and applied basics of machine learning shall be taught.
<b>Teaching methods</b>	A combination of lectures and tutorials
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- self implement selected algorithms</li> <li>- explore data and perform analysis</li> </ul>

	<ul style="list-style-type: none"> <li>- analysis according to principles of machine learning (e.g. Cross Validation, Parameter Tuning)</li> <li>- applied tasks of machine learning (regression, classification, clustering)</li> <li>- possibilities and limitations of machine learning</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basic principles: Classification, Regression, Clustering, Over/-Underfitting, Cross Validation &amp; Performance Evaluation, Parameter Tuning;</li> <li>- Data handling: Data Cleaning, Handling Missing Values, Data Normalization, Class Balancing, Feature Selection, Dimensionality Reduction;</li> <li>- Algorithms: kNN, Linear Regression, K-Means, Hierarchical Clustering, Trees, principal component analysis, ANN</li> </ul>
<b>Prerequisites</b>	Python and basics of statistics and mathematics
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- 70% exam</li> <li>- 30% assignments</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- James G., Witten D., Hastie T., Tibshirani R. (2017): An Introduction to Statistical Learning. – Springer.</li> <li>- Marsland S. (2015): Machine Learning, An Algorithmic Perspective. – CRC Press.</li> <li>- Géron A. (2017): Hands-On Machine Learning with Scikit-Learn &amp; TensorFlow. – O'Reilly.</li> </ul>
<b>Attendance</b>	75%
<b>Comments</b>	

## Embedded Systems (MES)

### Societal Impact Studies

<b>Degree programme</b>	MES
<b>Semester</b>	1
<b>Course methods</b>	SE, FL
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	We aim at assessing problem areas in a society which increasingly
---------------------------	---

	depends on electronic communication systems.
<b>Teaching methods</b>	ILV-SE
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- recognize potential sources of error in electronic systems and to evaluate their impacts on safety;</li> <li>- analyze the opportunities and limitations of automation;</li> <li>- evaluate the loss of privacy in electronic communication systems;</li> <li>- propose countermeasures to government surveillance.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Case studies of safety in aviation and public transport systems</li> <li>- Automation of aviation and rail transport</li> <li>- Autonomous vehicles</li> <li>- Smart Homes – Internet of Things</li> <li>- Case studies of government surveillance</li> <li>- Limitation of privacy and citizen's rights</li> </ul>
<b>Prerequisites</b>	<ul style="list-style-type: none"> <li>- Listening, reading and speaking skills at level C1 of the Common European Framework of Reference for Languages.- Knowledge and skills necessary to write short scientific papers in English.</li> </ul>
<b>Assessment Methods</b>	- Course immanent assessment method
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Recommendations:</li> <li>- I. Asimov (1983): The Complete Robot, Harper Collins</li> <li>- J. C. Augusto, Hg. (2012): Handbook of Ambient Assisted Living: Technology for Healthcare, Rehabilitation and Well-Being, Ios Press</li> <li>- M. Rausand (2014): Reliability of Safety-Critical Systems: Theory and Applications, John Wiley &amp; Sons</li> <li>- Learning materials:</li> <li>- Dedicated scripts and lecture notes</li> <li>- O. Maderdonner et al. (2014): Privacy, Skriptum</li> </ul>
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Robotics Engineering (MRE)

### Advanced Programming for Robots

<b>Degree programme</b>	MRE
<b>Semester</b>	1
<b>Course methods</b>	LAB
<b>Language</b>	English

<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this lecture, you will learn, how to communicate with a robot by the help of TCP/IP, to be able to control it, send data and receive data.
<b>Teaching methods</b>	Lecture, moodle exercises, hands-on exercises
<b>Learning outcome</b>	After passing this course successfully students are able to ... - After the LV you will be able to communicate with a robot via network. - After the LV you will be able to launch parallel processes and controll them - After the LV you will be able to launch threads and controll them
<b>Course contents</b>	- Process handling - Thread processing - TCP/IP kommunikation
<b>Prerequisites</b>	C/C++
<b>Assessment Methods</b>	- Projekt
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	100%
<b>Comments</b>	

## Advanced Programming

<b>Degree programme</b>	MRE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	A modern approach to object oriented programming.
<b>Teaching methods</b>	lectures and webinars - with additional Moodle exercises / examples.
<b>Learning outcome</b>	After passing this course successfully students are able to ... - program console applications in C++



	<ul style="list-style-type: none"> <li>- perform basic object-oriented programming</li> <li>- apply object-oriented concepts</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- classes and objects</li> <li>- inheritance / polymorphism</li> <li>- templates, interfaces, STL</li> <li>- RAI</li> </ul>
<b>Prerequisites</b>	basic knowledge of a structured programming in C (C++)
<b>Assessment Methods</b>	- continuous assesment in course
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- C++: das umfassende Handbuch, Will Torsten T., ISBN-9783836275958</li> <li>- Schaum's Outline of Programming with C++John Hubbard ISBN-10: 3826609107ISBN-13: 978-3826609107</li> </ul>
<b>Attendance</b>	attendance not required but recommended!
<b>Comments</b>	

## Digital Leadership

<b>Degree programme</b>	MRE
<b>Semester</b>	3
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- 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,</li> </ul>

	<p>the maturity model), to weigh the advantages and disadvantages of different leadership theories and concepts and to apply these to practical examples</p> <ul style="list-style-type: none"> <li>- describe agile leadership (e.g. in expert organisations, transformation processes) and use it as an example of leadership</li> <li>- explain the exact, academic, understanding of digital leadership (e.g. coaching culture) and apply this concept to specific cases</li> <li>- apply the systemic loop (from the perspective of a leadership position) in a theoretical manner to interdisciplinary or intercultural teams</li> <li>- understand the essential techniques of leadership in an intercultural context</li> <li>- outline the most important trends in the labour market</li> <li>- motivate employees and lead virtual teams in an increasingly digitalized world of work</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Fundamentals of leadership, traditional traits, behavioural and situational theories of leadership</li> <li>- Systems theory in social systems</li> <li>- Leadership in a digital context</li> <li>- Modern leadership concepts (agile leadership, transformational leadership, servant leadership and other such theories)</li> <li>- Interdisciplinarity and interculturality</li> <li>- Trends in the economy: the labour market, globalisation, digital transformation and Industry 4.0</li> <li>- The specifics of leading teams of experts</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Participation in workshops, exercises, case studies, written exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Berninger-Schäfer, E. (2019): Digital Leadership; Die Digitalisierung der Führung, managerSeminare Verlags GmbH</li> <li>- Franken, S. (2019): Verhaltensorientierte Führung; Handeln, Lernen und Ethik im Unternehmen, 4. Auflage, Gabler</li> <li>- Gasteiger, R., Kaschube, J., Rathjen, Ph. (2016): Interkulturelle Führung in Organisationen, Menschen in globalen Kontexten effektiv führen, essentials Springer Gabal</li> <li>- Greßer, K., Freisler, R. (2020): Ready for Transformation; Neue Arbeitswelt, digital und agil..., managerSeminare Verlags GmbH</li> <li>- Wunderer, R. (2011): Führung und Zusammenarbeit, Eine unternehmerische Führungslehre, 9. Auflage, Luchterhand</li> <li>- Lerch, Sebastian (2017): Interdisziplinäre Kompetenzen, UTB</li> <li>- Lüthi, E., Oberpriller, H., Loose, A., Orths, St. (2013):</li> </ul>

	Teamentwicklung mit Diversity Management, Haupt - Wunderer, R. (2011): Führung und Zusammenarbeit, Eine unternehmerische Führungslehre, 9. Auflage, Luchterhand
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	none

## Specialization 1

<b>Degree programme</b>	MRE
<b>Semester</b>	1
<b>Course methods</b>	PRJ
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Within the framework of this course, (subject-specific) technical problems are dealt individually or in groups. Regardless of the area of specialization, a systematic approach will be applied: In the first semester (Specialization 1), the requirements will be gathered, the fundamentals will be investigated, the system will be designed, the domain-specific phase will be started, and the documentation will be created. In the second semester (specialization 2), the domain-specific phase will be continued, the system integration will be performed and the final documentation will be written.
<b>Teaching methods</b>	Project
<b>Learning outcome</b>	After passing this course successfully students are able to ... - plan, execute, document and present technical projects - requirement engineering - design technical systems - to adopt domain-specific requirements and use them for the solution - write scientific publication
<b>Course contents</b>	- Project-dependent - Project requirements - System design - domain specific phase - System integration - Documentation

<b>Prerequisites</b>	Basic knowledge of scientific work Project management
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Project-dependent</li> <li>- W. Jakoby, Projektmanagement für Ingenieure: ein praxisnahes Lehrbuch für den systematischen Projekterfolg, 3., Aktualisierte u. erw. Aufl. Wiesbaden: Springer Vieweg, 2015.</li> </ul>
<b>Attendance</b>	Attendance must be discussed with the supervising staff at the beginning of the project.
<b>Comments</b>	

## Sports Technology (MST)

### Materials sciences in sports

<b>Degree programme</b>	MST
<b>Semester</b>	1
<b>Course methods</b>	VO
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course Materials Science in Sports Technology teaches the fundamentals of materials testing as well as the structure and properties of materials (metals and polymers). Building on the basics, the understanding of materials is deepened. The lecture is divided into two parts. Part 1 Basics Materials testing, polymers, metals (steel, Al, Mg, Ti) Part 2 Depression Strengthening mechanisms for metals, creep of plastics and metals, nanocrystalline materials, rheology, wood
<b>Teaching methods</b>	Presentation with PowerPoint slides
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- select and develop appropriate test methods for materials and sports equipment.</li> <li>- select suitable materials for sports equipment.</li> <li>- use strengthening mechanisms in metals for applications.</li> </ul>

	- to assess new developments in the field of materials.
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Materials testing and special test methods</li> <li>- Polymers</li> <li>- Steel</li> <li>- Light metals (Al, Mg, Ti)</li> <li>- Strengthening mechanisms for metals</li> <li>- Creep of metals and plastics</li> <li>- Nanocrystalline Materials</li> <li>- Rheology</li> <li>- Wood</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- Two partial tests: Part 1 multiple choice + free text, Part 2 written, free text
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Seidel, W., 2001, Werkstofftechnik, Hanser Verlag</li> <li>- Ehrenstein, G. , 2011, Polymer-Werkstoffe: Struktur - Eigenschaften - Anwendung, Hanser Verlag</li> <li>- Rösler, J., Harders, H., Bäker, M., 2012, Mechanisches Verhalten der Werkstoffe, Springer Vieweg (eBook)</li> <li>- Weißbach, W., Werkstoffkunde: Strukturen, Eigenschaften, Prüfung, Springer Vieweg Verlag (eBook)</li> </ul>
<b>Attendance</b>	mandatory, no attendance required at the first part for graduates of BHF (BST)
<b>Comments</b>	

## Applied biomechanics and biomechanical multi-body simulation

<b>Degree programme</b>	MST
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	After an introduction to the basics of mechanics and biomechanics, the theory of biomechanics is prepared and in addition biomechanical multibody-simulation software is used. The biomechanics of different sports is developed using hands-on
---------------------------	---

	examples.
<b>Teaching methods</b>	ILV
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- name and discuss inner and outer forces acting on athletes during sports</li> <li>- calculate inner forces resulting from outer forces acting on athletes</li> <li>- quasi-statically calculate the center of gravity during exercise based on different anthropometric models</li> <li>- name advantages and disadvantages of biomechanical multibody-simulation software and discuss their sensible use depending on specific research questions</li> <li>- develop simple models based on anthropometric data using multibody-simulation software</li> <li>- conduct biomechanical analyses using multibody-simulation software</li> <li>- describe phases, ground reaction forces and center of pressure for different running styles</li> <li>- describe the most important elements of the mechanics and biomechanics of cycling and to calculate pedal-forces</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- calculation of Center of Gravity</li> <li>- anthropometric models</li> <li>- basic biomechanics of different movements and sports</li> <li>- basic biomechanics of different movements and sports</li> <li>- torque</li> <li>- inertia</li> <li>- work</li> <li>- power</li> <li>- impulse</li> <li>- current biomechanical multibody-simulation software (e.g. AnyBody, OpenSim..)</li> <li>- calculation of muscle forces</li> <li>- calculation of joint forces</li> </ul>
<b>Prerequisites</b>	basic mechanics
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- exam</li> <li>- different exercises</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Winter, D.A., 2005, Biomechanics and motor control of human movement, Hoboken</li> <li>- Bartlett, R., Introduction to Sports Biomechanics Analysing Human Movement Patterns, Second Edition, Routledge</li> <li>- AnyBody Tutorials, <a href="https://anyscript.org/tutorials">https://anyscript.org/tutorials</a></li> </ul>

	<ul style="list-style-type: none"> <li>- Open Sim Tutorials, <a href="https://simtk-confluence.stanford.edu/display/OpenSim/Examples+and+Tutorials">https://simtk-confluence.stanford.edu/display/OpenSim/Examples+and+Tutorials</a></li> <li>- recent scientific literature</li> </ul>
<b>Attendance</b>	cf. Statute on Studies Act Provisions / Examination Regulations
<b>Comments</b>	

## Sports wear

<b>Degree programme</b>	MST
<b>Semester</b>	3
<b>Course methods</b>	VO
<b>Language</b>	English
<b>ECTS Credits</b>	4.00
<b>Incoming places</b>	Limited

<b>Course description</b>	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.
<b>Teaching methods</b>	Interactive lecture. Cooperation is constantly encouraged! Literature examples from current scientific publications
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Detection of different fiber types</li> <li>- Understanding of complex material architectures</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- natural fibers - origin, processing, properties</li> <li>- synthetic fibres</li> <li>- complex material compositions</li> <li>- Understand and think further about innovative developments</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	- written examination
<b>Recommended Reading and Material</b>	- slides will be shared
<b>Attendance</b>	

Comments	
----------	--

## Design

Degree programme	MST
Semester	3
Course methods	ILV
Language	English
ECTS Credits	2.00
Incoming places	Limited

Course description	In this course students will get an introduction to Industrial Design/Product design and an overview on workflow, tasks and tools a designer uses. A project will be done during the semester by each student - going through all the steps of the design process.
Teaching methods	Project work. Introduction design history. Introduction Render software.
Learning outcome	After passing this course successfully students are able to ... - to understand the workflow, tasks and tools a designer uses - to know the process of a complete design project - to visualize/render CAD files
Course contents	- Complete workflow of a design project done by each student
Prerequisites	CAD software
Assessment Methods	- Intermediate and final presentation
Recommended Reading and Material	
Attendance	Mandatory
Comments	

## Product management

Degree programme	MST
Semester	3
Course methods	ILV
Language	English



<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course will teach basics of product management. You will learn about product stages until the launch and tools of successful brand management.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- Knowledge of positioning and organization of product management</li> <li>- Process of finding new ideas and innovative products</li> <li>- Exercise methods of product management</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Basic of product management</li> <li>- Internal and external tasks of product management</li> <li>- Factors of success in product development</li> <li>- Priorities in marketing mix</li> <li>- Approach and best practice of market leaders</li> <li>- Case studies</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Case study</li> <li>- Final exam</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Cooper, 2011, Winning at new products</li> <li>- Kotler, Armstrong, Wong, Saunders, 2011, Grundlagen des Marketings</li> <li>- Meyer (Hrsg.), 2010, Marken-Management</li> <li>- Pulizzi, 2014, Epic content marketing</li> </ul>
<b>Attendance</b>	Compulsory attendance
<b>Comments</b>	

## Bionics

<b>Degree programme</b>	MST
<b>Semester</b>	3
<b>Course methods</b>	VO
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Recognize natural systems as model for the development of innovative applications in all areas of modern life. Using knowledge based on fundamental understanding of biological systems can enable materials, systems and applications with innovative properties that outperform traditional solutions significantly.
<b>Teaching methods</b>	interactive lectures. Questions and participation are asked for!
<b>Learning outcome</b>	After passing this course successfully students are able to ... - use natural sciences to investigate and understand the fundamental mode of operation of biological systems - discuss the use of bionic for developments in sports technology - create knowledge on the basis of biological systems and transfer it to the development of technical applications
<b>Course contents</b>	- definition and discussion of the term "Bionics" - functions of biological surfaces - possible applications of bionics in the area of Sports Technology
<b>Prerequisites</b>	no special prerequisites necessary
<b>Assessment Methods</b>	- written examination
<b>Recommended Reading and Material</b>	- slides will be shared
<b>Attendance</b>	
<b>Comments</b>	

## Aerodynamics

<b>Degree programme</b>	MST
<b>Semester</b>	3
<b>Course methods</b>	VO
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course aims to develop an understanding of the aerodynamical and hydrodynamical properties of sports equipment and to develop the ability to change those by dedicated construction measures. To this end the basics of hydrodynamics are first introduced which are then applied to specific examples occurring in the development of
---------------------------	--

	sports equipment.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- describe the consequences of the shape of sports equipment on its aerodynamical and/or hydrodynamical behaviour.</li> <li>- purposely influence the aerodynamical and/or hydrodynamical behaviour of sports equipment by measures concerning its design.</li> <li>- perform basic hydrodynamical calculations.</li> <li>- describe motions along stream filaments and streamlines.</li> <li>- apply CFD-methods in the modelling of the aerodynamical and/or hydrodynamical behaviour of sports equipment to better understand the latter and to modify it by design changes.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- hydrostatics</li> <li>- hydrodynamical basics</li> <li>- motions along stream filaments and streamlines</li> <li>- viscous flows</li> <li>- flows with and without vorticity</li> <li>- compressible flows</li> <li>- inviscid flows</li> <li>- CFD - Computational Fluid Dynamics</li> </ul>
<b>Prerequisites</b>	<ul style="list-style-type: none"> <li>- Foundations of technical, natural, and applied sciences- Mathematical foundations</li> </ul>
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Final exam (oral presentation of work done in groups) and written assignment</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Laurien, E., Oertel, H., 2013, Numerische Strömungsmechanik, Springer Vieweg</li> <li>- Oertel, H., Böhle, M., Reviol, T., 2015, Strömungsmechanik für Ingenieure und Naturwissenschaftler, Springer Vieweg</li> <li>- Hucho, W-H., 2012, Aerodynamik der stumpfen Körper, Springer Vieweg</li> </ul>
<b>Attendance</b>	Optional, but especially recommended for the PC lab hours and also because of the written assignment and group work which are assigned during term.
<b>Comments</b>	

## Power Electronics (MLE)

### Presentation Techniques

<b>Degree programme</b>	MLE
<b>Semester</b>	1
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	Seminar on the basics of presentations, with practical exercises
<b>Teaching methods</b>	Discussing tips for presentations Preparing and giving a presentation Discussing and evaluating the presentation by the lecturer and the group
<b>Learning outcome</b>	After passing this course successfully students are able to ... - ....give presentations in English
<b>Course contents</b>	- language of presentations, presentation methods
<b>Prerequisites</b>	Passing the courses of the previous semester
<b>Assessment Methods</b>	
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	Obligatory attendance
<b>Comments</b>	

## Societal Impact Studies

<b>Degree programme</b>	MLE
<b>Semester</b>	3
<b>Course methods</b>	SE
<b>Language</b>	English
<b>ECTS Credits</b>	1.50
<b>Incoming places</b>	Limited

<b>Course description</b>	We aim at assessing problem areas in a society which increasingly depends on electronic communication systems
<b>Teaching methods</b>	Seminar
<b>Learning outcome</b>	After passing this course successfully students are able to ...

	<ul style="list-style-type: none"> <li>- recognize potential sources of error in electronic systems and to evaluate their impacts on safety</li> <li>- analyse the opportunities and limitations of automation</li> <li>- evaluate the loss of privacy in electronic communication systems</li> <li>- propose countermeasures to government surveillance</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Case studies of safety in aviation and public transport systems</li> <li>- Automation of aviation and rail transport</li> <li>- Autonomous vehicles</li> <li>- Smart Homes – Internet of Things</li> <li>- Case studies of government surveillance</li> <li>- Limitation of privacy and citizen's rights</li> </ul>
<b>Prerequisites</b>	Completion of previous semester course
<b>Assessment Methods</b>	- Assessment of quality of the student's in-class participation, and of the presentation of a term paper.
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Maderdonner, O. / et al (2014): Privacy, Skriptum</li> <li>- Additional current handouts and audio-visual support</li> </ul>
<b>Attendance</b>	Attendance is compulsory
<b>Comments</b>	

## Information Systems Management (MWI)

### Artificial Intelligence in Enterprises (Spezialisierung)

<b>Degree programme</b>	MWI
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Introduction and overview of the development of AI (artificial intelligence) and applications in the corporate environment
<b>Teaching methods</b>	Integrated learning:- Basics online- Consolidation in presence- Exercises
<b>Learning outcome</b>	After passing this course successfully students are able to ... - describe the current state of AI science and research

	<ul style="list-style-type: none"> <li>- contextualize questions regarding the application of machine learning</li> <li>- estimate efforts and time to implement productive solutions</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Neural networks</li> <li>- Deep Learning</li> <li>- Natural language processing (NLP)</li> <li>- Transformers, Large Language Models (LLM)</li> <li>- Corporate utilisation</li> </ul>
<b>Prerequisites</b>	Python, statistics, linear algebra and analysis
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Online tests</li> <li>- Students presentations</li> </ul>
<b>Recommended Reading and Material</b>	- will be provided in Moodle
<b>Attendance</b>	in the presence units on site
<b>Comments</b>	

## Systems Engineering (Spezialisierung)

<b>Degree programme</b>	MWI
<b>Semester</b>	1
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>This course provides an introduction to the Systems Engineering (SE) as an interdisciplinary engineering approach that provides solution for complex engineering problems. SE looks at a system as a whole while understanding its internal structure, internal and external interfaces and their interactions with their environment in diverse context. SE forces the Systems Engineers to communicate the issues of the stakeholders, guides them during system requirements analysis life-cycle and supports their decision making procedures at different solution levels until life-cycle activities culminate in a system architecture design covering all functional and non-functional stakeholder requirements. The diversity of the parts of a complex system cannot be engineered independently of one</p>
---------------------------	---

	another, therefore, SE bridges the traditional engineering disciplines and coordinates activities while individual parts of a complex system are designed, implemented, tested, and integrated by different organizations.
<b>Teaching methods</b>	ILV Student-centered teaching utilizing team project and weekly home works to help students to understand the "Systems Engineering" discipline better.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- describe processes, methods, and practices of systems engineering;</li> <li>- use the systems engineering vocabulary/terminology;</li> <li>- recognize systems engineering as a part of project management;</li> <li>- apply requirements analysis techniques for a particular system;</li> <li>- understand the importance of a high quality specification and can create specifications;</li> <li>- recognize the distinguished tests for each development stage of the systems life cycle;</li> <li>- understand the risk management and cost estimation in systems engineering;</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Introduction to Systems Engineering</li> <li>- Systems Engineering Viewpoint, Complex systems</li> <li>- Systems Engineering Life cycle</li> <li>- The Systems Engineering method, Stakeholders</li> <li>- Concept development stage of the SE life cycle model</li> <li>- Decision making and Trade-off analysis</li> <li>- Risk management, and Cost Estimation</li> <li>- Systems Modelling with UML - main concepts and overview</li> <li>- Selected aspects of other SE life cycle phases: Testing, Maintenance</li> </ul>
<b>Prerequisites</b>	Software Engineering
<b>Assessment Methods</b>	- home work, team project and final exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Course slides</li> <li>- Textbook: Systems Engineering Principles and Practice, 2nd Edition, Alexander Kossiakoff, William N. Sweet, Samuel J. Seymour, Steven M. Biemer</li> </ul>
<b>Attendance</b>	Attendance is mandatory!
<b>Comments</b>	For detail information see Moodle

## Big Data & Machine Learning (Spezialisierung)

<b>Degree programme</b>	MWI
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	<p>The analysis of large amounts of data is becoming increasingly important for today's organizations. Gaining insight from data is the core business of many organizations, global enterprises like Google or Facebook as well as small tech start-ups. But companies with other business models are increasingly able to generate competitive advances through intelligent use of their data as well. On the other hand, a company like Zalando is often primarily seen as an online clothing business, while Zalando sees itself mainly as a big data-company. There exists a dynamic landscape of free and open source tools and frameworks for data analysis. The goal of this course is to generate an understanding of the main big data topics and an overview of different available tools and frameworks, as well as practical knowledge regarding the steps that are necessary to gain insight from raw data. The course further intends to build a tool-agnostic understanding of the underlying concepts to be able to keep up with future developments. The following topics will be dealt with by this course:- Exploratory data analysis- Data visualization and -sonification- Application of unsupervised and supervised machine learning methods- Communication of analysis results- Implementation of a use case in an analytics platform</p>
<b>Teaching methods</b>	<p>- Lecture- Practical group work (on-site and distance)- Group discussions- Group presentations</p>
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- distinguish between Data Science and Business Intelligence</li> <li>- do an implementation of reproducible data analysis-pipelines</li> <li>- apply methods of exploratory data analysis, both as summary statistics as well as graphical (and auditory) analysis</li> <li>- understand and identify application areas of unsupervised and supervised machine learning methods</li> <li>- discover and identify structural patterns in a data set with unsupervised machine learning tools</li> <li>- create prediction models using supervised machine learning-tools</li> </ul>



	and evaluate their quality - visualize analysis results in an interactive dashboard - create a use case prototype using an analysis platform or python
<b>Course contents</b>	- Exploratory data analysis - Data visualization and –sonification - Application of unsupervised and supervised machine learning methods - Communication of analysis results - Implementation of a use case in an analytics platform
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	- Exam - Practical group project - Peer-Feedback
<b>Recommended Reading and Material</b>	- Data science & big data analytics : discovering, analyzing, visualizing and presenting data; EMC Corporation Indianapolis, Ind. [u.a.] : Wiley 2015 - Analytics in a Big Data World: The Essential Guide to Data Science and its Applications; Bart Baesens; Wiley 2014
<b>Attendance</b>	Yes
<b>Comments</b>	

## IT-Governance (ITIL, Cobit)

<b>Degree programme</b>	MWI
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	Understanding IT organizations as customer-driven service organizations, this course puts the focus on all aspects necessary to provide efficient and effective IT services. And while technical assets are still central to IT service organizations, the focus shifts to non-tangible assets like knowledge, capabilities and processes. The course explains best practices and international standards in IT management/governance like Cobit and ITIL.
---------------------------	--

<b>Teaching methods</b>	Lecturer presentations Student recaps In-course exercises & case studies Group work
<b>Learning outcome</b>	After passing this course successfully students are able to ... - give an overview of the relevant standards and frameworks as well as discuss them regarding their use for an organization - name and apply the parts of ITIL4 - give an overview of COBIT2019 and its key principles - give an overview of the aspects of COBIT implementation and COBIT assessment
<b>Course contents</b>	- IT process management - IT service management - IT governance - Cobit - ITIL
<b>Prerequisites</b>	Foundations of IT management Foundations of process management
<b>Assessment Methods</b>	- Assessment of group work and final exam - Assessment of in-course contribution
<b>Recommended Reading and Material</b>	- see moodle course
<b>Attendance</b>	attendance required
<b>Comments</b>	

## Knowledge and Document Management (Spezialisierung)

<b>Degree programme</b>	MWI
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course starts with a short overview about different knowledge management approaches (as for example the one according to Probst et. al), as well as about the applicable software systems in the different phases/ processes/ blocks of the knowledge management. Afterwards the students learn the different possibilities for the knowledge sharing in companies, while applying different
---------------------------	---

	eLearning systems. Furthermore the targeted application of software systems for the implementation of the document management in companies will be learned by the students.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- describe different knowledge management approaches</li> <li>- apply selected eLearning systems for the implementation of eLearning scenarios for the dissemination of knowledge</li> <li>- apply different software systems for the implementation of the document management in companies</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Overview about knowledge management approaches</li> <li>- Overview about software systems for the knowledge and document management</li> <li>- eLearning systems for the dissemination of knowledge in companies</li> <li>- Software systems for the implementation of document management in companies</li> </ul>
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	- Course immanent assessment method and end exam
<b>Recommended Reading and Material</b>	- see Moodle
<b>Attendance</b>	
<b>Comments</b>	

## IT Operations Management

<b>Degree programme</b>	MWI
<b>Semester</b>	3
<b>Course methods</b>	ILV, FL
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course offers an introduction of operational management of IT Organizations and running operation. Based on theoretical aspects and practical use cases.
---------------------------	---

<b>Teaching methods</b>	Case Studies related to practice, real world examples, group exercises
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- Students learn to name and classify the relevant aspects of operations management construct solutions for the relevant areas of operations management derive and assess the consequences of the developed solutions in advance</li> <li>- construct solutions for the relevant areas of operations management</li> <li>- derive and assess the consequences of the developed of solutions in advance</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- The IT Operations Framework Expectations of Enduser &amp; increasing Complexity</li> <li>- Expectations of Enduser &amp; increasing Complexity</li> <li>- Organizing and construction of your own IT Operation</li> <li>- Organizational View of co-dependent roles for delivering services and maintaining SLA's</li> <li>- Outsourcing – Risks &amp; Chances</li> <li>- Link to ITIL &amp; ISO 27000 in Operations</li> <li>- Plan-Build-Run or the new IT Operating Model aligning to agile Business Needs in a digital World</li> <li>- Operations Management and Cloud Computing</li> <li>- Contract Management &amp; Licensing Models</li> <li>- Influence of EU-DSGVO / GDPR</li> </ul>
<b>Prerequisites</b>	Courses from the previous semesters
<b>Assessment Methods</b>	- Course immanent assessment method and final exam
<b>Recommended Reading and Material</b>	- Look at moodle
<b>Attendance</b>	Required – despite of being an online seminar
<b>Comments</b>	

## Quantum Engineering (MQE)

### Quantum Programming Lab I

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	LAB

<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course complements quantum computing I and focuses on quantum algorithms for optimization problems and their implementation using qiskit.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...
<b>Course contents</b>	
<b>Prerequisites</b>	-fundamental principles of quantum information (QUINF1)-complex valued linear algebra (MAQE)-quantum gates and fundamental subroutines for quantum algorithms (QUCO1)
<b>Assessment Methods</b>	- Course-immanent performance assessment and final presentation
<b>Recommended Reading and Material</b>	- Nielsen & Chuang: Quantum Computation and Quantum Information - Johnston et al: Programming Quantum Computers
<b>Attendance</b>	
<b>Comments</b>	

## Quantum Information Laboratory

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	2.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this lab course the students learn to create and manipulate qubits in hands-on experiments and to apply the theoretical concepts of quantum information.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...

<b>Course contents</b>	
<b>Prerequisites</b>	wave optics, optical instruments (HOPH), qubits and their manipulation, superposition, entanglement, Bell-inequalities (part of QUINF)
<b>Assessment Methods</b>	- LV-immanent performance assessment
<b>Recommended Reading and Material</b>	- manuals, scripts
<b>Attendance</b>	
<b>Comments</b>	

## Homologation Physics

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course is dedicated to students who have a degree in computer science. It conveys fundamental concepts of physics and classical mechanics which are prerequisite for the subsequent course program.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...
<b>Course contents</b>	
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	- Course-immanent performance assessment
<b>Recommended Reading and Material</b>	- Douglas. Giancoli, Physics for Scientists and Engineers, Global Edition, Pearson - Geoffrey Brooker: Modern classical optics, Oxford Univ. Press
<b>Attendance</b>	
<b>Comments</b>	

## Mathematics for Quantum Engineering

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course content comprises concepts and methods of linear algebra as far as necessary for quantum engineering, the bra-ket-formalism, elements of probability theory, some basics of number theory, and the Fourier transform in the infinite dimensional context.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...
<b>Course contents</b>	
<b>Prerequisites</b>	None
<b>Assessment Methods</b>	- Course-immanent performance assessment
<b>Recommended Reading and Material</b>	- Jürgen Audretsch: Entangled Systems (WILEY-VCH, 2007), Chapter 1 and Section 12.6
<b>Attendance</b>	
<b>Comments</b>	

## Quantum Computing I

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The course introduces the basics of quantum computation and exemplifies the principles in terms of the algorithms by Grover and Shor.
<b>Teaching methods</b>	

<b>Learning outcome</b>	After passing this course successfully students are able to ...
<b>Course contents</b>	
<b>Prerequisites</b>	-fundamental principles of quantum information (QUINF1)-complex valued linear algebra (MAQE)
<b>Assessment Methods</b>	- Course-immanent performance assessment and final presentation or final exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Nielsen &amp; Chuang: Quantum Computation and Quantum Information</li> <li>- Johnston et al: Programming Quantum Computers</li> <li>- Wong: Introduction to Classical and Quantum Computing</li> <li>- Aaronson: Quantum Computing since Democritus</li> <li>- Eleanor G. Rieffel and Wolfgang H. Polak: Quantum Computing, A Gentle Introduction</li> </ul>
<b>Attendance</b>	
<b>Comments</b>	

## Quantum Information I

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	3.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course students get acquainted with fundamental concepts of quantum information and the description of quantum states and their manipulation.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...
<b>Course contents</b>	
<b>Prerequisites</b>	-complex valued linear algebra including the Dirac notation (MAQE)-classical mechanics (HOPH)-ray and wave optics (HOPH)
<b>Assessment Methods</b>	- Course-immanent performance assessment and final exam
<b>Recommended Reading</b>	- Stephen Barnett: Quantum Information



<b>and Material</b>	<ul style="list-style-type: none"> <li>- Nielsen &amp; Chuang: Quantum Computation and Quantum Information</li> <li>- Audretsch: Verschränkte Systeme</li> </ul>
<b>Attendance</b>	
<b>Comments</b>	

## Enabling Technologies I

<b>Degree programme</b>	MQE
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course students get acquainted with experimental techniques and devices required for manufacturing physical qubits.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ...
<b>Course contents</b>	
<b>Prerequisites</b>	Basic linear algebra, physics and electronics (MAQE, HOEL, HOPH)
<b>Assessment Methods</b>	- Course-immanent performance assessment and final presentation
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Bluhm, Hendrik. "3. Quantum computing, qubits and decoherence". Electrons in Solids: Mesoscopics, Photonics, Quantum Computing, Correlations, Topology, Berlin, Boston: De Gruyter, 2019, pp. 125-204. <a href="https://doi.org/10.1515/9783110438321-003">https://doi.org/10.1515/9783110438321-003</a></li> <li>- P. Krantz, M. Kjaergaard, F. Yan, T. P. Orlando, S. Gustavsson, W. D. Oliver; A quantum engineer's guide to superconducting qubits. Appl. Phys. Rev. 1 June 2019; 6 (2): 021318. <a href="https://doi.org/10.1063/1.5089550">https://doi.org/10.1063/1.5089550</a></li> <li>- Nanoelectronics and Information Technology, Rainer Waser: Quantum Computing: Fundamentals and Solid-State Realizations, DiVincenzo, Ustinov, Schreiber, Vandersypen, WILEYVCH (2012), ISBN: 978-3-527-40927-3</li> <li>- Physics of Cryogenics 1st Edition, 2017, by Bahman Zohuri, ISBN: 978-0-12-814519-7</li> <li>- Pozar, D. M. (2012). Microwave Engineering. Italy: Wiley.</li> </ul>

Attendance	
Comments	

# Internet of Things and Smart Systems (MIO)

## Innovation- and Technologiemanagement

Degree programme	MIO
Semester	1
Course methods	SE
Language	English
ECTS Credits	5.00
Incoming places	Limited

<b>Course description</b>	The course "Innovation- and Technologiemanagement" offers you on the one hand current theory and practical examples of IT innovations, on the other hand you apply the learned theoretical knowledge practically by working on a problem defined by our corporate partner. This dual teaching approach provides the opportunity to learn practical skills in innovation development, prototyping and iterative work through user research to finally critically discuss solutions. At the end of the course, you will be proud of two outcomes: One, you will have developed and presented a prototype to solve our corporate partner's challenge. The core is the design of an innovation strategy, the creation of an implementation concept including accompanying measures based on a prototype. On the other hand, you will have written an individual knowledge contribution about an innovation or technology application.
<b>Teaching methods</b>	Theory input from the lecturer Group work with a predefined problem of a company Discussion rounds Written elaboration and reflection of contents
<b>Learning outcome</b>	After passing this course successfully students are able to ... - plan and execute innovation strategies and processes - critically discuss IT innovation tools and theories - conduct a design sprint that specifically includes prototyping, user research, and iterative innovation processes - evaluate and develop emerging technologies that induce innovation
<b>Course contents</b>	- Design thinking and design sprints

	<ul style="list-style-type: none"> <li>- Iterative work based on prototyping: from paper to digital prototypes</li> <li>- Innovation organization &amp; processes: Design of innovation processes and their implementation using concrete company examples.</li> <li>- Theories (e.g. innovator's dilemma, open innovation, user lead innovation as well as co-creation approaches)</li> <li>- Technology-induced innovation: models for evaluating technologies, technology radar, uncovering future trends</li> <li>- Tools of IT innovation: playful approaches to IT innovation, innovation games; application of creativity techniques</li> </ul>
<b>Prerequisites</b>	none
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Case Study "Innovation in an incumbent corporate": Application of theoretical knowledge in a practical application case; 50% of the total grade (group assessment)</li> <li>- Creation of a knowledge contribution: 20% of the total grade (individual performance)</li> <li>- Multiple Choice Exam 30% of the grade (individual performance)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Franken, R., &amp; Franken, S. (2020). Wissen, Lernen und Innovation im digitalen Unternehmen (Vol. 2). Mit Fallstudien und Praxisbeispielen. Springer Gabler, Wiesbaden</li> <li>- Bodemann, M., Fellner, W., &amp; Just, V. (2021). Zukunftsfähigkeit durch Innovation, Digitalisierung und Technologien: Geschäftsmodelle und Unternehmenspraxis im Wandel, Springer Gabler, Wiesbaden</li> </ul>
<b>Attendance</b>	The course will be taught at FH Technikum Wien. Collaboration tools will be integrated into the course sessions (e.g. lectures, group work). Moreover, the assessment methods (e.g. presentations, assignment) will be handled via Moodle. The current attendance rules are in effect.
<b>Comments</b>	-

## Data Management

<b>Degree programme</b>	MIO
<b>Semester</b>	1
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00

<b>Incoming places</b>	Limited
<b>Course description</b>	This course provides an introduction to data storage in the backend/cloud. In addition to classic file formats for structured data, SQL-based and non-SQL-based database systems are discussed.
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain database terms and technologies and install or configure selected database systems.</li> <li>- create logical data models, map them to a database system and record sensor data with them.</li> <li>- apply queries on single and compound tables and perform simple arithmetic operations using SQL.</li> <li>- create XML and JSON-based data and import it into or retrieve it from databases.</li> <li>- create a cloud service to persist and deliver Internet-of-Things data (IoT streams) and explore them with selected web-based tools.</li> <li>- configure a Big Data infrastructure for time series data and use it to record, read, or examine sensor data.</li> <li>- execute ready-made scripts (SQL, Python) or adapt them for given tasks in the field of data management.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Database Basics and Technologies</li> <li>- Data modeling and database creation</li> <li>- Data manipulation</li> <li>- Queries using SQL</li> <li>- XML and JSON</li> <li>- NoSQL databases for time series data</li> <li>- Big Data Infrastructures</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Intermediate test (30%)</li> <li>- Final test (70%)</li> </ul>
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Mobile and Wireless Systems

<b>Degree programme</b>	MIO
<b>Semester</b>	1
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The scope of this lecture are the basics, necessary for wireless data transmission and communication
<b>Teaching methods</b>	Presentation Exercises   SimulationStudy of provided material and references
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- understand the basics of wave propagation</li> <li>- understand the elements a transmission path or circuit</li> <li>- understand the implementation of cellular communication networks, the related procedures like connection Setup, Authentication, Authorization, Handover and the associated signaling between the involved network elements</li> <li>- calculate the coverage and the capacity of the air interface</li> <li>- understand technologies like, digital modulation-, multiple access-, duplex-schemas, antenna technologies, MIMO and the associated mathematical basics in this context</li> <li>- understand the concepts of NFV, SDN, and Network Slicing as applied in 5G</li> <li>- understand the concepts of Low Power Wide Area Networks, their applicability and the aspects necessary to be considered in context of application development</li> <li>- understand the necessity of a standardized software middle layer, in respect of scalability and interoperability in context of application development</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Network- architectures and elements as well as the associated protocols as used in (GSM, GPRS, 3G, LTE, 5G..)</li> <li>- Cellular technologies for IoT devices (NB-IoT, LTE Cat-M, Lora)</li> <li>- Procedures and signaling of cellular communication systems</li> <li>- Physical aspects of the Air interface and related technologies for the data transmission over a wireless channel (CDMA, OFDMA, MIMO etc..)</li> <li>- NFV, SDN and Network Slicing</li> </ul>

	- Standardized Software components (oneM2M, LwM2M) to ensure interoperability of applications
<b>Prerequisites</b>	Basic mathematical skills in: x.) Fourier series x.) Fourier transform x.) Trigonometric functions
<b>Assessment Methods</b>	- two written exams
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## IoT Operating Systems

<b>Degree programme</b>	MIO
<b>Semester</b>	1
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	In this course IoT operating systems will be discussed. We start with a short review of bare-metal microcontroller programming in C (STM32), followed by the programming of FreeRTOS based sensor nodes (STM32), ending with Linux as operating system for gateways and servers.
<b>Teaching methods</b>	This course is based on theory (lecture), practical demonstrations and practical exercises.
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- explain basic operating system functions, such as the process model and virtual memory management.</li> <li>- Linux systems via the command line, as well as automate more complex tasks with shell scripts.</li> <li>- configure the network stack of Linux systems.</li> <li>- configure persistent mass storage (e.g. HDDs, SSDs) on Linux systems.</li> <li>- implement container virtualization on Linux.</li> <li>- explain the similarities and differences between General Purpose Operating System (GPOS) and Real Time Operating System</li> </ul>

	<p>(RTOS).</p> <ul style="list-style-type: none"> <li>- be able to select the appropriate RTOS services, task models, scheduling methods and design patterns for embedded software applications</li> <li>- be able to apply debugging strategies for embedded real-time operating systems.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Operating systems basics (processes, memory management)</li> <li>- Shell and system programs</li> <li>- GNU/Linux installation (boot process on ARM and x86 architectures, block devices, file systems)</li> <li>- GNU/Linux configuration (user management, network stack)</li> <li>- Basics of virtualization (virtual machines, containers, virtual networks)</li> <li>- GPOS vs. RTOS, RTOS characteristics</li> <li>- Tasks and scheduling in RTOS</li> <li>- Intertask Communication and Synchronization</li> <li>- Exception processing (exceptions, interrupts)</li> <li>- Timer and Timer Services</li> <li>- Task models, cycle-based scheduling</li> </ul>
<b>Prerequisites</b>	Microcontroller programming in C/User knowledge in Linux
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Weekly homework</li> <li>- Two tests</li> </ul>
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	optional
<b>Comments</b>	

## IoT System Models

<b>Degree programme</b>	MIO
<b>Semester</b>	1
<b>Course methods</b>	ILV
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	The IoT System Models course covers the processing of the theoretical basis for the analysis and development of IoT systems.
---------------------------	--

<b>Teaching methods</b>	<p>This ILV has been developed according to the "Constructive Alignment" principle. Each topic is processed in a distance learning and in a presence phase. These two phases complete each other and the main method in this ILV is "learning by doing". The distance learning is worked out by the students in self-study. Questions and open points are discussed in regular forums and meetings with the lecturer. In the attendance phase, the results of the distance learning are to be presented and the following topic is to be conveyed in the form of an impulse lecture.</p>
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- explain basic concepts and terms of IoT systems,</li> <li>- categorize and define IoT systems,</li> <li>- define common basic elements, properties and interfaces of IoT systems,</li> <li>- describe basics of Operation Technologies (OT) such as automation pyramid architecture as a basis for IIoT architectures,</li> <li>- understand and interpret key IoT standards and norms,</li> <li>- explain essential technologies on which IoT architectures are built (e.g. sensors, gateway, IT server, database),</li> <li>- specify requirements for the real-time capability (Real Time Operation) reliability, availability and safety (Security and Functional Safety) of IoT systems,</li> <li>- Specify elementary application-specific system architecture, define its interfaces, and implement it in the lab.</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Introduction to IoT systems (definition, history, application areas, ...)</li> <li>- Categorization of IoT systems (Industrial IoT, Home Automation, ...)</li> <li>- Architecture of IoT systems (general and application-specific)</li> <li>- Infrastructure fundamentals</li> <li>- Standardization</li> <li>- Real-time capability</li> <li>- Fail-safe</li> <li>- Team project</li> </ul>
<b>Prerequisites</b>	<p>Basic knowledge according to acceptance criteria</p>
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Immanent performance review (active participation/intermediate tests, 20%)</li> <li>- Team project, 40% (e.g., specify system architecture, define its interfaces, and present it as a team).</li> <li>- Final exam (theory, practical tasks, 40%)</li> </ul>
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Prof. Dr. rer. nat. Felix Hüning (2018), Embedded Systems für IoT, Springer Vieweg, © Springer-Verlag GmbH Deutschland</li> </ul>



	- Prof. Dr. Steffen Wendzel (2018), IT-Sicherheit für TCP/IP- und IoT-Netzwerke, Springer Vieweg, © Springer-Verlag GmbH Deutschland - David Hanes, Gonzalo Salgueiro et. al., IoT Fundamentals, Cisco Press, ISBN-13: 978-1-58714-456-1, 2017 Cisco Systems
<b>Attendance</b>	Optional (with full attendance + 20% from active participation).
<b>Comments</b>	

## Networking

<b>Degree programme</b>	MIO
<b>Semester</b>	1
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	This course discusses network technologies that form the basis for data communication in IoT systems.
<b>Teaching methods</b>	
<b>Learning outcome</b>	After passing this course successfully students are able to ... <ul style="list-style-type: none"> <li>- plan, describe and apply architecture, protocol stacks, interfaces, addresses, routing, ... of IPv4 networks.</li> <li>- describe the basic network architectures and communication protocols used in LANs and WANs, reference models, and their message flows.</li> <li>- name and explain routing concepts, DNS, DHCP, firewalls, ACLs.</li> <li>- simulate/emulate IP networks and protocols in a simulation environment.</li> <li>- explain the operation of internetworking devices (hub, switch, router)</li> <li>- explain the concepts of NFV, SDN, and the "cloudification" of communication networks.</li> <li>- configure network elements in a simulator or in practice</li> <li>- configure and operate server infrastructure for network services</li> <li>- analyze protocol headers</li> <li>- apply network standard tools such as Wireshark and PuTTY</li> </ul>
<b>Course contents</b>	- Reference models (OSI, TCP/IP), network architectures and communication protocols in LANs and WANs

	<ul style="list-style-type: none"> <li>- Message flows in communication networks</li> <li>- Configuration of network elements and server infrastructures</li> <li>- Planning of LANs and IP networks (TCP/IP)</li> <li>- Configure and manage DNS and DHCP servers</li> <li>- Configuration of Firewalls and ACLs</li> <li>- Routing, Internetworking</li> <li>- Simulation of LANs and IP networks</li> <li>- Functional analysis and troubleshooting in LANs</li> <li>- NFV and SDN</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	<ul style="list-style-type: none"> <li>- Assessment of laboratory exercises/simulation exercises documented by students in laboratory protocols.</li> <li>- Presentation of a relevant topic</li> <li>- Moodle-Quiz</li> <li>- Oral examination</li> </ul>
<b>Recommended Reading and Material</b>	
<b>Attendance</b>	
<b>Comments</b>	

## Automation

<b>Degree programme</b>	MIO
<b>Semester</b>	3
<b>Course methods</b>	LAB
<b>Language</b>	English
<b>ECTS Credits</b>	5.00
<b>Incoming places</b>	Limited

<b>Course description</b>	
<b>Teaching methods</b>	
<b>Learning outcome</b>	<p>After passing this course successfully students are able to ...</p> <ul style="list-style-type: none"> <li>- interpret function charts, ladder diagrams, and instruction list</li> <li>- identify individual components of an automated system</li> <li>- apply planning tools of automation technology</li> <li>- network control technology components</li> <li>- apply basic control engineering circuits.</li> </ul>

	<ul style="list-style-type: none"> <li>- explain basic building technology circuits and functions:                         <ul style="list-style-type: none"> <li>o Blind, shutter, awning, sunshade controls</li> <li>o Automatic window and door controls (locking technology)</li> </ul> </li> <li>- apply lighting components</li> <li>- recognize limitations, problems and dangers of automation systems</li> </ul>
<b>Course contents</b>	<ul style="list-style-type: none"> <li>- Switch-on delay, switch-off delay, staircase automat, comfort switching</li> <li>- Circuits and components from practice (e.g. counter for wind measurement, anti-ice function for roller shutters, temperature sensors, motion detectors, humidity sensor)</li> <li>- Control of ventilation technology, dehumidification technology</li> <li>- Linking of individual elements and the problems behind it</li> <li>- Automatic doors and gate controls</li> <li>- Plant engineering in the industry</li> <li>- Autonomous driving with guidance systems in / on the ground or with AI</li> <li>- Basics of engine control units - characteristics and control of the individual types</li> <li>- Problems of instability of controls in large plants</li> <li>- Manipulated variable and its significance in building services engineering</li> <li>- Manipulated variable and its significance in building technology</li> <li>Maintenance and repair, troubleshooting and analysis</li> </ul>
<b>Prerequisites</b>	
<b>Assessment Methods</b>	- Ongoing practical examples and final theoretical exam
<b>Recommended Reading and Material</b>	<ul style="list-style-type: none"> <li>- Heinrich, Linke, Glöckler (2020): Grundlagen Automatisierung, Springer Verlag.</li> <li>- V. Plenk, Grundlagen der Automatisierungstechnik kompakt, Springer Verlag Vieweg, 2019.</li> <li>- Wellenreuther, Zastrow (2015): Automatisieren mit SPS, Springer Vieweg.</li> <li>- Tapken (2020): SPS – Theorie und Praxis, Europa-Lehrmittel.</li> <li>- C. Karaali, Grundlagen der Steuerungstechnik, Springer Verlag Vieweg, 2018.</li> </ul>
<b>Attendance</b>	
<b>Comments</b>	