Module Handbook

Biomedical Engineering

Master of Science Date of Information: 05.05.26

Master Data Biomedical Engineering

Name
Biomedical Engineering
Short Form
BMED2
Degree
Master of Science
Faculty
Faculty of Engineering
Semesters
3
Credit Points (CP)
90
Specification
Framework Examination Regulations
2024-RPO
Examination Regulations
2026
Accredited by
intern
Accredited Until
2034-09-30
Note
Hours per CP
30
Degree Program Head
Prof. Dr. Bernd Schweizer

Degree Program Objectives

Professional Competencies

Medical Technology Requirements

Graduates are able to analyze medical and biological processes and their connections with technical systems and to identify requirements for medical technology innovations from these in a user-oriented way.

Developing and Optimizing Medical Technology Systems

Graduates are able to design, implement, and optimize medical technology systems in compliance with international standards and regulatory requirements.

Data Skills

Graduates are able to assess the opportunities and risks of the digital transformation in their own field and to select digital tools and methods and use these for handling large quantities of data.

Methodological Competencies

Problem Solving

Graduates are able to independently identify complex problems, even in unfamiliar and multidisciplinary situations, and to select and implement appropriate solutions based on the latest scientific findings.

Scientific Research and Development

Graduates are able to formulate research questions, select appropriate research methods, present their research findings, and interpret them, including to improve technical products and processes.

Social Competencies

Leadership Skills

Graduates are able to assume increasing responsibility within a team and as a leader, to involve team members in tasks in a goal-oriented manner while taking the group's situation into account, and to reflect on their own role.

Communication

Graduates are able to present complex subject-related problems, solutions, ideas, and concepts in an argumentatively sound manner to both experts and non-experts, and to further develop them by incorporating their perspectives.

Teamwork Abilities

Graduates are able to work in a goal-oriented manner within a team, to reflect on their own and other's perspectives, to identify potential conflicts in collaboration, and to find solution-oriented, constructive ways of dealing with conflicts.

Personal Competencies

Self-Awareness

Graduates are able to critically assess their own abilities and to reflect on and further develop their professional practice.

Time Management and Self-Management

Graduates are able to plan and prioritize tasks efficiently, to carry them out with motivation and discipline, and to complete them within the given timeframe.

Intercultural Competencies

Graduates are able to reflect on professional communications with regard to different intercultural perspectives and discussion cultures, and to act appropriately in intercultural encounters.

Curriculum

Biomedical Engineering (M.Sc.), PO 2026

The modules are listed in the recommended order of study.

Modules and Courses	CP	SWS	Rec. Semester	Course Format(s)	Course Comp. Type	Examination Formats	vV
Selection from Medical Physics (1st semester): 5 CP	**5**		**1.**				
Selection from Medical Technology (1st semester): 5 CP	**5**		**1.**				
Selection from Professional Skills: 5 CP	**5**		**1.**				
Advanced Mathematics	**5**	**4**	**1.**		**PL**: K o. MP		
Advanced Mathematics		4	1.	SU			
Radiation Therapy and AI in Medicine	**5**	**4**	**1. - 2.**		**PL**: K o. A		
Advanced Radiation Therapy		2	1. - 2.	SU			
Medical Informatics		2	1. - 2.	SU			
Bioanalytics and Cell Biology	**5**	**3**	**1. - 2.**		**PL**: K o. A		
Bioanalytics and Cell Biology		3	1. - 2.	SU			
Advanced Medical Imaging	**5**	**3**	**1. - 2.**		**PL**: K		
Advanced Medical Imaging		3	1. - 2.	SU			
Medical Device Compliance, Industries and Markets	**5**	**4**	**1. - 2.**		**PL**: A		
International Markets and Industries		2	1. - 2.	Proj			
Medical Device Regulation and Compliance		2	1. - 2.	SU			
Selection from Medical Physics (2nd semester): 5 CP	**5**		**2.**				
Selection from Medical Technology (2nd semester): 5 CP	**5**		**2.**				
Research Project	**10**	**0**	**2.**		**SL**: A [MET]		
Research Project		0	2.	Proj			
Master's Thesis	**30**	**0**	**3.**		**PL**: KOL **PL**: TH		true
Master's Thesis		0	3.	MA			
Electives: Medical Physics			~				
Radiation Biophysics	**5**	**3**	**1. - 2.**		**PL**: K o. POR		
Radiation Biophysics		3	1. - 2.	SU			
Radiation Detectors and Applications	**5**	**3**	**1. - 2.**		**PL**: K o. K u. PT o. POR		
Radiation Detectors and Applications		3	1. - 2.	SU			
Radiation Protection (Section 74(1) Radiation Protection Act)	**5**	**5**	**1. - 2.**		**PL**: K o. FG		
Radiation Protection in Teletherapy		1	1. - 2.	SU			
Radiation Protection		2	1. - 2.	SU			
Radiation Therapy		2	1. - 2.	SU			
Biomechanics	**5**	**4**	**1. - 2.**		**PL**: POR		
Biomechanics		4	1. - 2.	P + Proj			
Electives: Medical Technology			~				
Organ Replacement Therapy	**5**	**3**	**1. - 2.**		**PL**: K		
Organ Replacement Therapy		3	1. - 2.	SU			
Signal Processing: Theory and Applications	**5**	**4**	**1. - 2.**		**PL**: K		
Signal Processing: Theory and Applications		4	1. - 2.	SU			
Simulation Tools for Engineers	**5**	**3**	**1. - 2.**		**PL**: K u. PT		
Simulation Tools for Engineers		3	1. - 2.	SU + P			
Microfluidics and Microfabrication	**5**	**4**	**1. - 2.**		**PL**: MP		
Microfluidics		2	1. - 2.	SU			
Microfabrication		2	1. - 2.	SU			
Electives: Professional Skills – Students must select one 5CP-module. Note: All students must take a German proficiency test during the introductory week. For students who do not achieve level B1 in the test, the module German as a Foreign Language is compulsory. Students will be placed in an appropriate course to enable them to make progress towards the next language level. Students with a German language university degree or entrance qualification are exempt from the level test and module.			~				
German as a Foreign Language 1 ***(see footnote 1)***	**5**	**4**	**1.**		**PL**: F		
German as a Foreign Language 1		3	1.	S			
Language of Technology		1	1.	S			
Comprehensive Competencies	**5**	**4**	**1.**		**PL**: K o. K u. POR o. POR		
Advanced Project Management		2	1.	SU			
Leadership		2	1.	SU + S			

Modules might be offered annually, so your actual study schedule depends on whether you start in the winter or summer semester.

Courses in the format of a Practical Course (P) require mandatory attendance. The attendance requirement is fulfilled when at least 80% of class sessions are attended in full. Certain sessions may be declared mandatory at the beginning of the course. If more than 80% of class sessions require mandatory attendance, make-up sessions will be offered for excused absences, as far as organizationally possible. Group assignments and session dates, if applicable, will be announced at the start of the course.

Modules and Courses	CP	SWS	Rec. Semester	Course Format(s)	Course Comp. Type	Examination Formats	vV
Advanced Deep Learning	**5**	**3**	**1. - 2.**		**PL**: K o. POR o. K u. KT		
Advanced Deep Learning		3	1. - 2.	V + P			
Innovation Management & Entrepreneurship	**5**	**4**	**1. - 2.**		**PL**: POR o. H o. PR		
Innovation Management		2	1. - 2.	SU			
Entrepreneurship		2	1. - 2.	SU			

Table Abbreviations:

CP: Credit Points According to ECTS, **MET:** Successfully Completed, **PL:** Graded Course Component, **SL:** Pass/fail Course Component, **SWS:** Contact Hours per Week, **SoSe** Summer Semester, **vV:** Formal Requirements **WiSe** Winter Semester, ∼**:** Dependending on Selection, ("true": For details, see the examination regulations)

Course Format(s):

V: Lecture , **SU:** Seminar-style , **P:** Laboratory , **MA:** Master's Thesis , **S:** Seminar , **Proj:** Project

Examination Format(s):

A: Written Assignment , **F:** Foreign Language Examination , **FG:** Expert Discussion , **H:** Term Paper , **K:** Written Examination , **KOL:** Thesis Defense , **KT:** Revision Test , **MP:** Oral Exam , **POR:** Portfolio , **PR:** Presentation , **PT:** Practical/Artistic Work , **TH:** Thesis

[1] The module Deutsch als Fremdsprache (German as a Foreign Language) requires mandatory attendance. The attendance requirement is fulfilled when at least 75% of class sessions are attended in full. Certain sessions may be declared mandatory at the beginning of the course.

Contents

Modul

Advanced Mathematics

Module Code
Y-M30

Short Form
AMath

Module Requirement
Compulsory

Credits
5 CP

Duration
1 Semester

Frequency
Every semester

Language(s)
English

Scheduled Semester
1.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Friedhelm Schönfeld

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- explain and apply the basic concepts and properties of vector spaces and linear operators,
- classify and apply transformation laws of tensors of different order,
- analyze real-world data by applying statistical and optimization methods,
- evaluate integrals over vector fields applying the theorems of Gauss and Stokes,
- identify and interpret the significant partial differential equations in physics,
- adapt solution methods for partial differential equations, effectively applying these techniques to practical scenarios.

This module contributes to the following degree program objectives
Medical Technology Requirements, Data Skills, Developing and Optimizing Medical Technology Systems, Scientific Research and Development, Problem Solving

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Oral Exam

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses

Required Course(s)

- Advanced Mathematics (SU, 1. Sem., 4 SWS)

Related Course

Advanced Mathematics

Course Code	Short Form	Workload	Semester
Y-M30V		CP	1.

Course Types	Frequency	Language(s)
Seminar-style	Every semester	English

Also included in

- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

- Profound knowledge of linear algebra and analysis

Course Contents

1. Basics of Vector Spaces
   Definition and properties of vector spaces
2. Linear Operators and Matrices
   Definition and examples of linear operators
   Matrix representation and transformation behavior
   Eigenvalues and eigenvectors
3. Fundamentals of Data Analysis and Optimization
   Gradient descent method
   Linear and logistic regression
   Selected methods for dimensional reduction
4. Vector Analysis
   Integral theorems of Gauss and Stokes
   Applications in potential theory
5. Partial Differential Equations
   Overview of key PDEs: wave, diffusion, heat conduction, Navier-Stokes equations
   Physical interpretations and derivation
   Solution Methods for PDEs

Teaching Methods and Media

Short lectures are combined with interactive parts. Use of multimedia resources, such as videos and software demonstrations, enriches the lecture presentations. The time between the lectures is dedicated to discussions, problem-solving sessions, and collaborative work. Students are encouraged to present their solutions at the board. By placing students at the center of the learning process, this approach not only enhances their understanding of applied mathematics but also equips them with essential skills for their academic and professional futures.

References

Christian Lang u. Norbert Pucker, Mathematische Methoden der Physik, Elsevier Spektrum Akademischer Verlag, ISBN 3-8274-158-6
George B. Arfken u. Hans J. Weber, Mathematical Methods for Physicists, Elsevier Academic Press, ISBN 978-0-12-088584-8
Tilo Arens et al., Mathematik, Spektrum Akademischer Verlag, ISBN 978-3-8274-1758-9

Notes

Modul

Radiation Therapy and AI in Medicine

Module Code
BMED2-40

Short Form

Module Requirement
Compulsory

Credits
5 CP

Duration
1 Semester

Frequency
Winter semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Bernd Schweizer, Dr. rer. nat. Sonja Wegener

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- draw on a deepened understanding of external beam irradiation concepts.
- formulate research questions combining imaging and irradiation, both with respect to hardware and algorithmic challenges.
- set up and improve concepts for internal dose calculation for radionuclide therapies.
- understand the high innovation potential of artificial intelligence in the medical domain.
- formulate a medical data analysis and processing problem in the context of machine learning and select suitable algorithmic approaches.
- differentiate the limits of "classical" machine learning from those of the more recent deep-learning based approaches.
- communicate biophysical radiation interaction mechanisms, irradiation strategies and application scenarios of artificial intelligence effectively within interdisciplinary teams.

This module contributes to the following degree program objectives
Medical Technology Requirements, Scientific Research and Development, Communication

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Written Assignment

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses

Required Course(s)

- Advanced Radiation Therapy (SU, 1., 2. Sem., 2 SWS)
- Medical Informatics (SU, 1., 2. Sem., 2 SWS)

Related Course

Advanced Radiation Therapy

Course Code	Short Form	Workload	Semester
BMED2-40V1		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

- Accelerator equipment for optimizing patient positioning.
- Technical solutions for the management of patient movements.
- Advanced forms of external beam irradiation (e.g. arc therapy, integrated MR linac)
- Dose calculation in targeted radionuclide therapy approaches (e.g. Lu-PSMA-therapy)
- Role of multimodal images in treatment planning
- Therapy planning: algorithms and tools

Teaching Methods and Media

The course will combine elements of a seminar, discussions, joint exercises and talks from external experts or a visit to a radiation therapy department. Course videos will be made available to students for flexible review and self-directed learning.

References

Technical Basis of Radiation Therapy: Practical Clinical Applications. Springer Berlin Heidelberg (2008).

Notes

Related Course

Medical Informatics

Course Code	Short Form	Workload	Semester
BMED2-40V2		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites
None

Course Contents
- Overview of artificial intelligence and machine learning for medicine.
- Selected ML algorithms (e.g. logistic regression, SVM, k-means-clustering, ...)
- Introduction to artificial neural networks
- Introduction to generative AI
- Applications in medical image and data processing using machine learning
- Ethical and regulatory boundary conditions for AI in medicine

Teaching Methods and Media
The course will employ a mix of classical lecture, software experiments, case demonstrations and practical exercises using a high-level programming language like MATLAB or Python.

References
A. Géron: “Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems”, O’Reilly Media

Notes

Modul

Bioanalytics and Cell Biology

Module Code
BMED2-41

Short Form

Module Requirement
Compulsory

Credits
5 CP

Duration
1 Semester

Frequency
Winter semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Dipl.-Phys. Prof. Dr. Wolfgang Kleinekofort

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- discuss new developments of physiological and biochemical analysis devices in a group.
- describe the function of biomolecules and larger biological structures and show connections (enzymes, regulation, metabolism)
- apply the knowledge imparted in lectures to problems and tasks that go beyond the content of the lecture
- combine analytical methods, electrophoresis (SDS-PAGE, IEF, CE), spectroscopy (UV/VIS, IR/Raman, fluorimetry), chromatographic separation methods (HPLC) and mass spectrometry (MALDI-TOF, ESI, EI).
- apply different research approaches from the field of applied physiology with the help of medical device technology.
- understand and consider systematic differences in molecular biology between patients of different sex, ethnicity or genetic pre-condition.
- reflect on the ethical, safety-related, and societal implications of engineering decisions in molecular biotechnical applications.

This module contributes to the following degree program objectives
Medical Technology Requirements, Developing and Optimizing Medical Technology Systems, Problem Solving, Scientific Research and Development, Communication, Self-Awareness

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Written Assignment

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam

preparation

Remarks

Related Courses

Required Course(s)

- Bioanalytics and Cell Biology (SU, 1., 2. Sem., 3 SWS)

Related Course

Bioanalytics and Cell Biology

Course Code	Short Form	Workload	Semester
BMED2-41V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible
Dipl.-Phys. Prof. Dr. Wolfgang Kleinekofort

Recommended Prerequisites
None

Course Contents
Content and objectives include deep knowledge of various analytical methods and method validation according to current guidelines. Analytical methods covered include:
- immunological methods
- electrophoresis (SDS-PAGE, IEF, CE)
- spectroscopy (UV/VIS, IR/Raman, fluorimetry)
- chromatographic separation methods (HPLC)
- mass spectrometry (MALDI-TOF, ESI)

Teaching Methods and Media
Students apply different research approaches from the field of applied physiology with the help of medical device technology in small groups. They describe, analyze and interpret specific topics and present them in a scientific seminar at the end of the semester.

References

1. Berg, Tymoczko, Gatto, Stryer: Stryer Biochemie. Springer Spektrum
2. Horton, Moran, Scimgeour, Perry, Rawn.: Biochemie. Pearson.
3. Holčapek, Michal: Handbook of Advanced Chromatography/Mass Spectrometry Techniques. ISBN 978-0-12-811732-3

Notes

Modul

Advanced Medical Imaging

Module Code
BMED2-42

Short Form

Module Requirement
Compulsory

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Bernd Schweizer

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- make use of a qualitative and quantitative understanding of the possibilities and limitations of various imaging modalities.
- identify modality-specific or use-case-specific challenges in the application of medical imaging.
- to develop and/or optimize novel concepts of imaging in combination with laboratory diagnostics or therapy.
- understand the requirements of clinical users of imaging equipment and be able to translate them into new technical solutions.
- analyze and critically reflect sex- and gender-specific differences in medical imaging data and its interpretation.

This module contributes to the following degree program objectives
Medical Technology Requirements, Developing and Optimizing Medical Technology Systems, Scientific Research and Development

Type of Course Component: Graded Course Component

Examination Format: Written Examination

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam preparation

Remarks

Related Courses

Required Course(s)

- Advanced Medical Imaging (SU, 1., 2. Sem., 3 SWS)

Related Course

Advanced Medical Imaging

Course Code	Short Form	Workload	Semester
BMED2-42V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

- Quantitative quality parameters of medical images such as signal-to-noise ratio, spatial and contrast resolution and others.
- Methods of dynamic imaging, in particular contrast agent dynamics and treatment of patient movement in tomographic images.
- Methods of functional imaging using MRI and nuclear medicine imaging.
- Multi-modality imaging (SPECT-CT, PET-CT, PET-MR).
- Imaging requirements for use in different stages of patient care such as differential diagnosis, therapy management or outcome monitoring.
- Software methods and tools for diagnosis and post-processing of images.

Teaching Methods and Media

The course follows a blended didactic approach that combines theoretical input with interactive and media-supported learning. Core concepts are introduced through structured lectures, complemented by videos and computer-based simulations to illustrate complex imaging techniques and clinical applications. Exercises will be offered in course. Course videos will be made available to students for flexible review and self-directed learning.

References

Willi A. Kalender: Computertomographie: Grundlagen, Gerätetechnologie, Bildqualität, Anwendungen. Publicis Verlag (2006).
Victor I. Mikla, Victor V. Mikla: Medical Imaging Technology. Elsevier Verlag (2013).

Notes

Modul

Medical Device Compliance, Industries and Markets

Module Code
BMED2-43

Short Form

Module Requirement
Compulsory

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Bernd Schweizer

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- describe the regulatory frameworks for medical device approval in Germany, the European Union, and selected international markets (e.g., USA, Asia);
- analyze the legal requirements for medical device classification, risk management, and conformity assessment procedures;
- compare international healthcare systems and medical device markets and evaluate their impact on product development and commercialization strategies;
- apply fundamental principles of quality management and regulatory compliance, including ISO 13485 and ISO 14971, in the context of medical device development;
- explain and model typical industrial development processes (e.g., V-model) and integrate regulatory and design control aspects into development workflows;
- critically assess current trends and challenges in global medical device regulation and market access;
- collaborate effectively in intercultural teams, using different team roles and leadership principles.

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Problem Solving, Communication, Intercultural Competencies

Type of Course Component: Graded Course Component

Examination Format: Written Assignment

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses

Required Course(s)

- International Markets and Industries (Proj, 1., 2. Sem., 2 SWS)
- Medical Device Regulation and Compliance (SU, 1., 2. Sem., 2 SWS)

Related Course

International Markets and Industries

Course Code	Short Form	Workload	Semester
BMED2-43V1		CP	1., 2.

Course Types	Frequency	Language(s)
Project	Summer semester only	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

- Market access and reimbursement pathways in different healthcare systems
- Economic and structural differences between international medical device markets
- Development models in the medical device industry (e.g., V-model, stage-gate model)
- Industry case studies from Europe, the U.S., and emerging markets
- Trends in global medical technology regulation and standardization
- Group projects on regional analyses (e.g., EU, U.S., Asia-Pacific, MENA) with joint presentations

Teaching Methods and Media

Project-oriented work in multinational student teams, with changing leadership during the practical phase. Regional focus groups will analyze selected global regions regarding market access, reimbursement systems, and industry structure. Moderated discussions and presentations ensure continuous feedback. Real-world examples and supplementary materials include market reports, case studies, and industry data. Intercultural teamwork is emphasized to strengthen collaborative and communication skills.

References

- Market intelligence reports (e.g., MedTech Europe, EvaluateMedTech, WHO resources)
- Selected journal articles on medical device industry and market development

Notes

Related Course

Medical Device Regulation and Compliance

Course Code	Short Form	Workload	Semester
BMED2-43V2		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

- Introduction to medical device classification and regulatory pathways
- European regulatory framework (MDR, IVDR, notified bodies, CE marking)
- National requirements in Germany (e.g., MPDG, DIMDI/BfArM)
- U.S. regulatory landscape (FDA, 510(k), PMA)
- Selected international regulations (e.g., China NMPA, Japan PMDA)
- Quality management systems (ISO 13485, risk management according to ISO 14971)
- Product lifecycle and technical documentation requirements
- Integration of design controls and regulatory requirements in development processes

Teaching Methods and Media

Lectures with integrated exercises, case studies, and moderated group discussions. Supplementary materials include regulatory documents, industry standards, and real-world examples from medical device companies. Interactive elements like group tasks support the development of analytical and application-oriented competencies in regulatory affairs.

References

- Aakash Deep: Medical Device Regulations: A Complete Guide. Elsevier Science (2022).
- Additional current MDR/IVDR and FDA guidance documents.

Notes

Modul

Research Project

Module Code
BMED2-74

Short Form

Module Requirement
Compulsory

Credits
10 CP

Duration
1 Semester

Frequency
Every semester

Language(s)
English

Scheduled Semester
2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Bernd Schweizer

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- apply their acquired knowledge and skills in a practical and application-oriented setting.
- gain in-depth insight into an industrial and/or clinical environment.
- plan, organize, and manage their own work effectively within a project framework.
- assess social structures and interactions between managers and employees in a professional setting.
- enhance their ability to transfer theoretical knowledge into practical applications.

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Medical Technology Requirements, Scientific Research and Development, Problem Solving, Teamwork Abilities, Time Management and Self-Management

Type of Course Component: Pass/Fail Course Component

Examination Format: Written Assignment

Grading Type: Pass/Fail

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
300, including 0 hours of class attendance (0 contact hours per week) and 300 hours of self-study, including exam preparation

Remarks

Related Courses

Required Course(s)

- Research Project (Proj, 2. Sem., 0 SWS)

Related Course

Research Project

Course Code	Short Form	Workload	Semester
BMED2-74V		CP	2.

Course Types	Frequency	Language(s)
Project	Every semester	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

The research project complements the course of studies with an opportunity to apply the knowledge and skills acquired and learn their practical relevance. Participants get to know an individual industrial and/or clinical area in detail. By being involved in a project with defined independent research or development tasks, the transfer of knowledge and skills, their independent application of these skills and the organization and planning of work are deepened and consolidated. Another aspect is learning about the sociological aspects of business operations. The participants learn about the social structure between managers and employees, to be able to assess their position and potential impact in a later career.

Teaching Methods and Media

The students participate in a research project, usually in the form of an internship in an industrial and/or clinical business.

References

Relevant literature is individual and will be discussed at the start of the each project.

Notes

Modul

Master's Thesis

Module Code
BMED2-44

Short Form

Module Requirement
Compulsory

Credits
30 CP

Duration
1 Semester

Frequency
Every semester

Language(s)
English

Scheduled Semester
3.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Bernd Schweizer

Required Prequisites
- Students with 50+ CP in this program may enter the Master's Thesis module.

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- independently plan, organize, and conduct a research or development project within a defined timeframe, applying scientific methods appropriate to biomedical engineering.
- identify, retrieve, and critically evaluate relevant scientific literature to position their work within the current state of research.
- design and execute experiments or computational studies, analyze data, and interpret results in a scientifically sound manner.
- apply theoretical knowledge, methodological skills, and system-level thinking to solve complex biomedical engineering problems.
- document their research comprehensively in written form and present the results convincingly to both expert and non-expert audiences.
- reflect on their own research process, recognize limitations, and derive implications for further scientific or practical developments.

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Problem Solving, Scientific Research and Development, Communication, Teamwork Abilities, Time Management and Self-Management

Type of Course Component: Graded Course Component | **Examination Format:** Thesis | **Grading Type:** Graded

Type of Course Component: Graded Course Component | **Examination Format:** Thesis Defense | **Grading Type:** Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
900, including 0 hours of class attendance (0 contact hours per week) and 900 hours of self-study, including exam preparation

Remarks

Related Courses
Required Course(s)

- Master's Thesis (MA, 3. Sem., 0 SWS)

Related Course

Master's Thesis

Course Code	Short Form	Workload	Semester
BMED2-44V		CP	3.

Course Types	Frequency	Language(s)
Master's Thesis	Every semester	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Dozent:innen des Fachbereichs Ingenieurwissenschaften

Recommended Prerequisites

None

Course Contents

The Masters thesis is an examination in which students demonstrate that they are able to work independently, under supervision, on a problem from the field of biomedical engineering within a given period of six months, using scientific methods. The thesis should be carried out like a practical project in an industrial company of the biomedical engineering sector, a hospital, or an appropriate research laboratory.
In addition to deepening subject-specific knowledge through a concrete example of experimental and/or simulation work, it also serves to acquire and strengthen the following cross-disciplinary skills:

- Ability for self-directed learning
- Teamwork skills (collaboration with supervisors)
- Application of project management methods
- Communication skills: technical documentation and presentation

Teaching Methods and Media

References

Notes

Modul

Radiation Biophysics

Module Code
BMED2-35

Short Form
RadBP

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Winter semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Daniel Münstermann, Dr. rer. nat. Sonja Wegener

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- explain the fundamental physical concepts of radiation types and the biological mechanisms of radiation at the cellular level (DNA damage types, repair mechanisms, cell cycle effects, radiosensitizers/radioprotectors).
- define the main units and quantities of radiation physics (dose, absorbed dose, equivalent dose) and to calculate the absorbed dose in simple geometries and critically evaluate measurement data.
- assess different radiotherapy or imaging strategies in terms of efficacy, side effects, and radiation protection criteria, including emerging new developments like FLASH or particle radiotherapy.
- plan a research project to investigate a specific question in radiation biophysics/oncology and formulate the associated hypotheses, methods, and analysis strategies.
- present and discuss radiation biophysics concepts and dosimetric results in a clear and scientifically sound manner, adapting their communication to both expert and interdisciplinary audiences.

This module contributes to the following degree program objectives
Medical Technology Requirements, Scientific Research and Development, Self-Awareness

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Portfolio

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Radiation Biophysics (SU, 1., 2. Sem., 3 SWS)

Related Course

Radiation Biophysics

Course Code	Short Form	Workload	Semester
BMED2-35V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites
None

Course Contents
This course deals with the effects of ionising radiation on cells, tissue and living organisms in general and with respect to cancer cells and radiotherapy in particular:

1. Cellular radiobiology
   - Cell cycle and radiosensitivity
   - Mechanisms of cell damage: lethal vs. sublethal damage, biochemical damage
   - Cell survival and clonogenic assays
   - Models of DNA damage and repair
2. Dose-response and modelling fundamentals
   - Dose-response concepts (stochastic vs. deterministic effects)
   - Linear-quadratic (LQ) model and alternative response models
   - ☒/☒ ratio, fractionation effects and time factors
   - BED (Biologically Effective Dose) and EQD2
3. Tumour biology and treatment response
   - Tumour kinetics and repopulation
   - Tumour response pathways
   - Tumour Control Probability (TCP) models
   - Impact of hypoxia and tumour microenvironment on radiosensitivity
   - LET (Linear Energy Transfer) and RBE (Relative Biological Effectiveness)
4. Normal tissue response and toxicity
   - Acute, early and late effects in healthy tissues
   - Serial vs. parallel organ architecture
   - Normal Tissue Complication Probability (NTCP) models
   - QUANTEC principles and quantitative outcome analysis
   - Systems for toxicity scoring (clinical toxicity grading)
5. Biological modifiers and combined modalities
   - Radiosensitizers and radioprotectors
   - Interaction of radiation with the immune system
   - Radiobiology of combined therapies (radiochemotherapy, immunoradiotherapy)
6. Clinical data analysis and applications
   - Dose-response analysis from clinical data and patient series
   - Application and limitations of radiobiological models in radiotherapy planning
   - Relation of radiobiological concepts to radiation protection schemes
7. Advanced and emerging topics (optional)
   - Limitations of existing models and model uncertainty
   - Personalized radiobiology and biomarkers
   - New modalities and high-LET therapies
   - FLASH radiotherapy
   - Simulation of radiation damage to DNA

Teaching Methods and Media
This course is taught in a flipped-classroom format: Based on recorded and/or live impulse lectures introducing the topics, the students will perform their own research using online and offline sources to answer exercise questions. These will be discussed in person in a seminar-like format.

References

C. S. Sureka and Christina Armpilia: Radiation Biology for Medical Physicists
https://en.wikibooks.org/wiki/Radiation_Oncology
Further reading, different scope: Joel Greenberger: Radiation Oncology and Radiation Biology

Notes

Modul

Radiation Detectors and Applications

Module Code
BMED2-36

Short Form
RaDet

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Daniel Münstermann

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- to describe the detector types used in biomedical engineering and medicine (scintillators, semiconductor detectors, gas detectors, photodetectors) and their characteristics.
- to explain basic concepts of detector readout electronics and data analysis (signal formation, amplification, digitization, image processing).
- to select appropriate detectors and electronics for a given task, set up and operate them, perform basic calibrations, process raw detector signals and analyze experimental data to extract quantitative parameters (e.g., spectra, count rates, spatial resolution).
- to evaluate and compare detector technologies for specific biomedical applications (e.g., imaging, dosimetry, radiotherapy monitoring) and justify technology choices.
- to critically appraise experimental outcomes, propose improvements or alternative approaches, and outline potential developments for advancing detector performance in biomedical contexts.
- to plan, organize, and complete experimental or simulation-based tasks involving radiation detection systems within given time frames, demonstrating effective time and self-management in individual and team settings.

This module contributes to the following degree program objectives
Data Skills, Developing and Optimizing Medical Technology Systems, Scientific Research and Development, Problem Solving, Time Management and Self-Management

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Written Examination u. Practical/Artistic Work o. Portfolio

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam

preparation

Remarks

Related Courses
Wahlpflichtveranstaltung/en:

- Radiation Detectors and Applications (SU, 1., 2. Sem., 3 SWS)

Related Course

Radiation Detectors and Applications

Course Code	Short Form	Workload	Semester
BMED2-36V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	English

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible
Prof. Dr. Daniel Münstermann

Recommended Prerequisites
None

Course Contents
1. Fundamentals: radiation types and interactions
   - Ionizing vs non-ionizing radiation; photoelectric effect, Compton, pair production
   - Energy loss (Bethe-Bloch), attenuation, shielding
   - Detection statistics, noise, limits of detection
2. Gas detectors
   - Ionization chambers, proportional counters, GeigerMüller, drift chambers, TPCs
   - Gas gain, electron drift, timing
3. Semiconductor detectors
   - pn junctions, depletion region, charge transport
   - Si, Ge, CdZnTe detectors; pixel/strip segmentation, cooling
4. Scintillation detectors
   - Organic/inorganic scintillators, light yield, timing, energy resolution
   - Photodetectors: PMT, SiPM, PIN diodes; optical coupling
5. Neutron detection
   - n-capture reactions (10B, 6Li, 3He), moderation, detector choices
6. Cherenkov and optical-photon detection
   - Cherenkov principle and detection
7. Readout electronics and signal processing
   - Preamplifiers, shaping, discriminators, ADC/TDC, triggers
   - Noise sources, calibration
8. Performance metrics and calibration
   - Energy/time resolution, efficiency, linearity, dead time, calibration methods
9. Data analysis basics
   - Peak fitting, background subtraction, spectral analysis, basic image reconstruction, uncertainty estimation
10. Medical imaging applications
    - Xray detectors (flat panels), scintillators in SPECT, PET detectors (LYSO, TOF, DOI)
11. Therapy and dosimetry applications
    - Dosimeters (ion chambers, diodes, TLD/OSL), in-vivo monitoring, portal imaging
12. Radiation protection and regulations
    - Personal/environmental dosimetry, standards, lab safety, quality assurance
13. Labs and projects
    - Hands-on: scintillator+SiPM calibration, semiconductor spectra, ADC data acquisition
    - Group project: detector selection (and setup) for a (bio)medical measurement (e.g., PET coincidence test, dosimetry study)
14. Optional/advanced topics
    - Monte Carlo simulation (Geant4/GATE), novel materials, ML for signal/image analysis

Teaching Methods and Media
This course is taught in a flipped-classroom format: Based on recorded and/or live “impulse” lectures introducing the topics, the students will perform their own research using online and offline sources to answer “exercise questions”. These will be discussed in person in a seminar-like format. In addition, the course will contain hands-on lab sessions, allowing the students to gain experience in operating radiation detectors and analyzing the data.

References

- Glenn F. Knoll: Radiation Detection and Measurement
- Indra J. Das: Radiation Detectors and Methods in Medicine
- William R. Leo: Techniques for Nuclear and Particle Physics Experiments

Notes

Modul

Strahlenschutzkurs (§74 Abs.1 StrSchG)

Module Code
BMED2-39

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
German

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Daniel Münstermann, Prof. Dr. Bernd Schweizer, Dr. rer. nat. Sonja Wegener

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- die Grundlagen der Strahlenphysik, strahlenbiologische Grundlagen, physikalisch-technische Grundlagen der Strahlentherapie und Röntgendiagnostik sowie Dosisbegriffe zu erläutern.
- Rechtsvorschriften und Empfehlungen auf dem Gebiet des Strahlenschutzes in der Medizin anzuwenden.
- spezielle Aspekte der Qualitätssicherung, der Dosimetrie und des Strahlenschutzes in der Teletherapie zu bewerten.
- English description: This module corresponds to a radiation protection course required by German legislation. For this reason, the course language is German, even within the English-language masters program.
  The goals are: a) explain the fundamental principles of radiation physics, radiobiology, the physical and technical foundations of radiotherapy and X-ray diagnostics, as well as the key concepts of radiation dose; (b) apply legal regulations and professional recommendations in the field of medical radiation protection; (c) evaluate specific aspects of quality assurance, dosimetry, and radiation protection in external beam therapy.

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Self-Awareness

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Expert Discussion

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 52.5 hours of class attendance (5 contact hours per week) and 97.5 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Radiation Protection in Teletherapy (SU, 1., 2. Sem., 1 SWS)
- Radiation Protection (SU, 1., 2. Sem., 2 SWS)
- Radiation Therapy (SU, 1., 2. Sem., 2 SWS)

Related Course

Spezialkurs Strahlenschutz in der Teletherapie

Course Code	Short Form	Workload	Semester
BMED2-39V1		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	German

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible
Prof. Dr. Daniel Münstermann, Prof. Dr. Bernd Schweizer, Dr. rer. nat. Sonja Wegener

Recommended Prerequisites
None

Course Contents
- Physikalisch-technische Grundlagen der Strahlentherapie
- Prinzipien der Teletherapieplanung
- Spezielle Aspekte der Qualitätssicherung und Dosimetrie
- Spezielle Aspekte des Strahlenschutzes in der Teletherapie
- Aktuelle Entwicklungen in der Teletherapie

Teaching Methods and Media
Der Kurs findet in Präsenz, ggf. mit einzelnen asynchronen Online-Elementen, statt.
Aufgrund der Auflagen der Genehmigungsbehörden findet die Lehrveranstaltung vollständig in deutscher Sprache statt. Eine vollständige Anwesenheit und das Bestehen der Prüfung ist erforderlich, um ein Zertifikat über den Spezialkurs Strahlenschutz in der Teletherapie (ST2) zu erhalten.
Diese Lehrveranstaltung baut inhaltlich auf dem Spezialkurs Basiskurs Strahlentherapie (ST1) auf. Der bestandene Kurs ST1 ist Teilnahmevoraussetzung für die Teilnahme an dieser Lehrveranstaltung.

References
- Schlegel, Wolfgang, Karger, Christian P. und Jäkel, Oliver, Hrsg. (2018): Medizinische Physik, Grundlagen - Bildgebung - Therapie - Technik, Springer Spektrum.
- Strahlenschutzgesetz, Strahlenschutzverordnung, Richtlinie Strahlenschutz in der Medizin
- weitere Literatur wird in der Lehrveranstaltung bekanntgegeben

Notes

Related Course

Grundkurs im Strahlenschutz

Course Code	Short Form	Workload	Semester
BMED2-39V2		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	German

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible
Prof. Dr. Daniel Münstermann, Prof. Dr. Bernd Schweizer, Dr. rer. nat. Sonja Wegener

Recommended Prerequisites
None

Course Contents
- Grundlagen der Strahlenphysik
- Strahlenbiologische Grundlagen
- Dosisbegriffe und Dosimetrie
- Grundlagen und Grundprinzipien des Strahlenschutzes
- Natürliche und zivilisatorische Stahlenexposition des Menschen
- Rechtsvorschrifen und Empfehlungen auf dem Gebiet des Strahlenschutzes
- Übungen

Teaching Methods and Media
Der Kurs findet überwiegend online mit asynchronen Elementen zur selbstständigen Bearbeitung und mit synchronen Phasen statt. Ein 2-stündiges Praktikum zur Strahlungsmessung ist in Präsenz abzuleisten.
Aufgrund der Anforderungen der Genehmigungsbehörden findet der Kurs ausschließlich in deutscher Sprache statt. Es ist die vollständige Bearbeitung der asynchronen Elemente, eine vollständige Anwesenheit bei den synchronen Phasen, die Ableistung des Praktikums und das Bestehen der Prüfung notwendig, um ein Zertifkat über einen absolvierten Grundkurs im Strahlenschutz zu erhalten.

References
- Jens-Holger Grunert (2019): Strahlenschutz für Röntgendiagnostik und Computertomographie, Grundkurs und Spezialkurse, Springer.
- Schlegel, Wolfgang, Karger, Christian P. und Jäkel, Oliver, Hrsg. (2018): Medizinische Physik, Grundlagen - Bildgebung - Therapie - Technik, Springer Spektrum. *Strahlenschutzgesetz, Strahlenschutzverordnung, Richtlinie Strahlenschutz in der Medizin
- weitere Literatur wird in der Lehrveranstaltung bekanntgegeben

Notes

Related Course

Spezialkurs Basiskurs Strahlentherapie

Course Code	Short Form	Workload	Semester
BMED2-39V3		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	German

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible
Prof. Dr. Daniel Münstermann, Prof. Dr. Bernd Schweizer, Dr. rer. nat. Sonja Wegener

Recommended Prerequisites
None

Course Contents
- Physikalisch-technische Grundlagen der Strahlentherapie
- Grundlagen der Strahlenbiologie
- Grundlagen der Strahlentherapie
- Grundlagen der Röntgenbildgebung
- Gesetzliches und untergesetzliches Regelwerk
- Strahlenschutz und Aufzeichnungspflichten
- Qualitätssicherung und Risikomanagement
- Behördliche Verfahren und Überprüfungen, Meldepflichten
- Ethische Aspekte in der Strahlentherapie
- Unterweisung und Einweisung des Personals

Teaching Methods and Media
Der Kurs findet in Präsenz, ggf. mit einzelnen asynchronen Online-Elementen, statt.
Aufgrund der Auflagen der Genehmigungsbehörden findet die Lehrveranstaltung vollständig in deutscher Sprache statt. Eine vollständige Anwesenheit und das Bestehen der Prüfung ist erforderlich, um ein Zertifikat über den Spezialkurs Basiskurs Strahlentherapie (ST1) zu erhalten.
Diese Lehrveranstaltung baut inhaltlich auf dem Grundkurs im Strahlenschutz auf. Der bestandene Grundkurs ist Teilnahmevoraussetzung für die Teilnahme an dieser Lehrveranstaltung.

References
- Schlegel, Wolfgang, Karger, Christian P. und Jäkel, Oliver, Hrsg. (2018): Medizinische Physik, Grundlagen - Bildgebung - Therapie - Technik, Springer Spektrum.
- Strahlenschutzgesetz, Strahlenschutzverordnung, Richtlinie Strahlenschutz in der Medizin
- weitere Literatur wird in der Lehrveranstaltung bekanntgegeben

Notes

Modul

Biomechanics

Module Code
Y-M34

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Winter semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. biol. hom., Dipl.-Ing. Andreas Geck

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- construct and evaluate a physical functional model of an implant for the human body as a group.
- choose materials to use on/in the human body
- analyze technical models
- develop numerical computation models
- organize collaboration within a group and contribute their own share of the work.

This module contributes to the following degree program objectives
Medical Technology Requirements, Developing and Optimizing Medical Technology Systems, Scientific Research and Development, Problem Solving, Teamwork Abilities, Communication, Self-Awareness, Time Management and Self-Management

Type of Course Component: Graded Course Component

Examination Format: Portfolio

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Biomechanics (P, 1., 2. Sem., 1 SWS und Proj, 1., 2. Sem., 3 SWS)

Related Course

Biomechanics

Course Code	Short Form	Workload	Semester
Y-M34V		CP	1., 2.

Course Types	Frequency	Language(s)
Laboratory, Project	Winter semester only	English

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites
None

Course Contents
- Biological-mechanical structure of the human body
- Creation of mechanical models of parts of the human body
- Synthesizing implants for the human body
- Additive manufacturing

Teaching Methods and Media
As part of a group project, students construct a physical model of an implant for the human body. The aspects of advanced biomechanics are developed under the guidance of the teacher. The students develop a mechanical model. The model is then produced and evaluated by the students as a physical functional prototype using additive manufacturing processes. The project is managed via regular project meetings, interim presentations, a project report and a final presentation of the model. Control of the groups via feedback from the teachers and reflection by the students.

References

- Emico Okuno, Luciano Fratin: Biomechanics of the Human Body. Springer
- Stephen, Joseph A. Zeni, David A. Winter: Winter's Biomechanics and Motor Control of Human Movement. Wiley
- Brinckmann, Paul: Orthopädische Biomechanik. Thieme,
- Klein, Paul: Biomechanik der menschlichen Gelenke. Elsevier, Urban & Fischer

Notes

Modul

Organ Replacement Therapy

Module Code
BMED2-34

Short Form
ORT

Module Requirement

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Dipl.-Phys. Prof. Dr. Wolfgang Kleinekofort

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- combine, deepen and critically examine subject-related and interdisciplinary knowledge and apply it in the field of organ replacement therapy.
- apply specialist skills and knowledge in the field of organ replacement procedures, which can be acquired during the course and expanded through self-study.
- evaluate how to support, monitor or replace an organ such as the kidney, lung or liver through the appropriate arrangement of technical components. The module provides an overview of the wide range of problems relating to organ replacement therapy, with a focus on technical applications.
- analyse the relationships between physiology and technology and to design and optimize technical systems.
- communicate complex physiological and technical principles of organ replacement therapies clearly and responsibly within interdisciplinary healthcare teams
- reflect on the ethical and clinical implications of applying such technologies to patients.

This module contributes to the following degree program objectives
Medical Technology Requirements, Developing and Optimizing Medical Technology Systems, Scientific Research and Development, Problem Solving, Communication, Self-Awareness

Type of Course Component: Graded Course Component

Examination Format: Written Examination

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Organ Replacement Therapy (SU, 1., 2. Sem., 3 SWS)

Related Course

Organ Replacement Therapy

Course Code	Short Form	Workload	Semester
BMED2-34V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

The course includes advanced technical components and procedural operations in the field of organ replacement as well as detailed knowledge of the anatomy of organs using the example of the heart, kidneys, lungs and liver. In addition, technical problems and tasks of the practical implementation of organ replacement procedures are dealt with.

Teaching Methods and Media

Short lectures are combined with interactive parts. Use of multimedia resources, such as videos and demonstrations, enriches the lecture presentations. The time between the lectures is dedicated to discussions, problem-solving sessions, and collaborative work. Students are encouraged to present their solutions at the board.

References

Current publications in the field of organ replacement therapy,: Journal: “ESAO Journal”, ISSN 0391-3988 (print version) and 1724-6040 (online). Journal: “Seminars in Dialysis”, Online ISSN:1525-139X Print ISSN:0894-0959

Notes

Modul

Signal Processing: Theory and Applications

Module Code
BMED2-37

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Winter semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Andreas Brensing, Dr. rer. nat. Sonja Wegener

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- classify and describe signals and linear time-invariant (LTI) systems within the framework of signal and system theory.
- calculate fundamental integral transformations of continuous and discrete time deterministic signals.
- describe and analyze deterministic signals and systems in the time and frequency domain.
- analyze and design simple systems with regard to important properties, such as magnitude and phase frequency response, stability, linearity etc.
- apply elementary operations and concepts of signal processing like filter design.
- discuss the overarching principles and properties of various physical and technical systems.
- apply these methods to real-world signals, e.g. biosignals.
- explain the mathematical principles of statistical signal analysis and its application to biosignals.

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Data Skills, Scientific Research and Development

Type of Course Component: Graded Course Component

Examination Format: Written Examination

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Signal Processing: Theory and Applications (SU, 1., 2. Sem., 4 SWS)

Related Course

Signal Processing: Theory and Applications

Course Code	Short Form	Workload	Semester
Y-M20V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites
None

Course Contents
- Classification of signals and systems
- Standard signals
- Modelling of systems based on technical-physical examples
- Mathematical description and calculation of linear-time-invariant systems in the image domain by means of Fourier transform, Laplace transform, z-transform, correlations
- Stability of systems
- Filter design and applications for biomedical signals
- Linearization of nonlinear systems
- Coupled systems
- Methods of continuous and discrete signal processing, filter design and applications
- Signal processing using wavelet transformation
- Analog and digital filters
- Stochastic processes and statistical analysis
- Application examples from the biomedical field, e.g. using ECG, EEG, EMG data

Teaching Methods and Media
The course will combine seminaristic lectures for a solid theoretical foundation with practical application examples implemented e.g. in MATLAB or LTspice.

References

- Sundararajan, D. (2023): Signals and Systems - A practical Approach, Second Edition, Springer.
- Deergha Rao, K. (2018): Signals and Systems, Birkhäuser.
- Bernhard, Stefan; Brensing, Andreas; Witte, Karl-Heinz (2022): Biosignal Processsing, De Gruyter.
- Bruce, Eugene N. (2000): Biomedical Signal Processing and Signal Modelling, Wiley.

Notes

Modul

Simulation Tools for Engineers

Module Code
BMED2-38

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Bernd Schweizer, Dr. rer. nat. Sonja Wegener

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- describe and understand the fundamentals of important numerical simulation methods in engineering.
- identify which advanced problems in biomedical engineering can be addressed by these methods.
- understand the validity and limitations of these calculation methods.
- demonstrate practical experience in using computer programs for engineering simulation tasks.

This module contributes to the following degree program objectives
Data Skills, Developing and Optimizing Medical Technology Systems, Scientific Research and Development, Problem Solving

Type of Course Component: Graded Course Component

Examination Format: Written Examination u. Practical/Artistic Work

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Simulation Tools for Engineers (SU, 1., 2. Sem., 2 SWS und P, 1., 2. Sem., 1 SWS)

Related Course

Simulation Tools for Engineers

Course Code	Short Form	Workload	Semester
BMED2-38V		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style, Laboratory	Summer semester only	English

Also included in

- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

- Overview of computational modelling in engineering and sciences.
- Finite Element Method (FEM)
- Finite Difference Method (FDM)
- Monte-Carlo Methods
- Introduction to related computer applications (e.g. CST, Comsol, EGSnrc)
- Simulating and solving example biomedical engineering problems with these applications
- Assessing the validity and quality of the solutions

Teaching Methods and Media

The course will start with a lecture part, where required necessary theoretical foundations of the mathematical and computational approaches are given. A strong focus will be put on practical aspects like translating a problem into a simulation model by means of advanced code packages, achieving numerical solutions and interpreting those, e.g. in the form of individual or group assignments.

References

Michael R. King, Nipa A. Mody: Numerical and Statistical Methods for Bioengineering - Applications in MATLAB, Cambridge University Press, 2010

Notes

Modul

Microfluidics and Microfabrication

Module Code
Y-M23

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Winter semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Markus Bender

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- identify applications of microtechnology and microfluidics
- analyze micromechanical and microfluidic designs
- explain the basic principles of microfluidics
- explore and apply fabrication techniques
- create devices, including design, construction, fabrication and eveluation
- critically review literature

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Medical Technology Requirements, Problem Solving

Type of Course Component: Graded Course Component **Examination Format:** Oral Exam **Grading Type:** Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses

Wahlpflichtveranstaltung/en:

- Microfluidics (SU, 1., 2. Sem., 2 SWS)
- Microfabrication (SU, 1., 2. Sem., 2 SWS)

Related Course

Microfluidics

Course Code	Short Form	Workload	Semester
Y-M23V1		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in

- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Prof. Dr. Xiangping Li

Recommended Prerequisites

None

Course Contents

- Introduction to Microfluidics
  - Definition and historical development;
  - Importance and applications of microfluidics;
  - Overview of microfluidic systems and components;
- Fundamentals
  - Fluid Properties
  - Effects & Phenomena
  - Fluid dynamics (Couette flow, Hagen-Poiseuille-law, plug flow, Flow through a tube)
  - Electrical Analogies
  - Paper Microfluidics
  - Droplet Microfluidics
  - Digital Microfluidics
  - Centrifugal Microfluidics
- Materials and Fabrication Techniques
  - Common materials used in microfluidic devices
  - Two Photon-polymerization, photolithography, soft lithography, Laser, milling, 3D printing etc.
  - Cleanroom protocols and safety (can be combined with Lab Micropatterning)
- Applications of Microfluidics
  - Biomedical research (PCR, organ-on-a-chip etc.)
  - Environmental and chemical applications
  - Point-of-care diagnostics and drug delivery
  - Single cell technology
- Literature review

Teaching Methods and Media

Lecture with discussions, Powerpoint, whiteboard, presentation of students. Items for demonstration, Lab visit including demonstrations.

References

- Microfluidics and Lab-On-A-Chip by Andreas Manz, etc. (Royal Society of Chemistry, 2020).
- Microsystems for Pharmatechnology edited by Andreas Ditzel
- Microfluidics, Fundamentals, Devices and Applications edited by Yujun Song, etc.
- Introduction to Microfluidics by Patrick Tabeling.
- Fundamentals of Microfluidics and Lab on a Chip for Biological Analysis and Discovery by Paul C.H. Li.
- Microfluidics and Nanofluidics: Theory and Selected Applications edited by Clement Kleistreuer.

Notes

Related Course

Microfabrication

Course Code	Short Form	Workload	Semester
Y-M23V2		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Winter semester only	English

Also included in

- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026

Course Responsible

Prof. Dr. Markus Bender

Recommended Prerequisites

None

Course Contents

- Definitions and advanced phenomena on the micrometer scale
- Advanced microstructuring
  - Lithographic methods
  - Top down processes such as etching
  - Bottom up methods such as deposition
- Complex analysis and evaluation methods of microstructures
  - Optical microscopy
  - Raster electron or probe microscopy
  - Tactile methods
  - Other methods
- Applications: from design to MEMS sensors or microelectronics using the above methods

Teaching Methods and Media

Lecture with discussions, Powerpoint, whiteboard, presentation of students Items for demonstration, clean room visit including hands-on.

References

Völklein, Zetterer: Einführung in die Mikrosystemtechnik (Springer) Schwesinger, Dehne, Adler: Lehrbuch Mikrosystemtechnik (Oldenbourg) MEMC-Book (online) Sami Franssila: Introduction to Microfabrication, Wiley-Verlag (2011)

Notes

Modul

Deutsch als Fremdsprache 1

Module Code
LLZ_50301M

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Every semester

Language(s)
German

Scheduled Semester
1.(recommended)

Type of Examination
Module Level Assessment

Also Included In
- (Int.), PO
- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Computational Mathematics (B.Sc.), PO2027

Curriculum Notes
The module Deutsch als Fremdsprache (German as a Foreign Language) requires mandatory attendance. The attendance requirement is fulfilled when at least 75% of class sessions are attended in full. Certain sessions may be declared mandatory at the beginning of the course.

Module Coordinator
Louise Klein

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,
- entsprechend ihrem Sprachniveau nach dem Gemeinsamen Europäischen Referenzrahmen: die Hauptinhalte von Lese- und Hörtexten zu verstehen, sich zu bestimmten Themen zu äußern, sich zu verständigen. / corresponding to their respective language level according to the Common European Framework: to understand the main content of written and spoken text; to produce language on specific topics; to communicate.

This module contributes to the following degree program objectives
Communication

Type of Course Component: Graded Course Component

Examination Format: Foreign Language Examination

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks
Teilnehmende werden in einen Kurs auf dem entsprechenden Niveau eingeteilt. Vor der Teilnahme am Deutschkurs absolvieren Teilnehmende mit bestehenden Deutschkenntnissen einen Einstufungstest. / Participants will be placed in a

course at the appropriate level. Before the course, participants with existing German skills will take a placement test.

Related Courses

Wahlpflichtveranstaltung/en:

- German as a Foreign Language 1 (S, 1. Sem., 3 SWS)
- Language of Technology (S, 1. Sem., 1 SWS)

Related Course

Deutsch als Fremdsprache 1

Course Code	Short Form	Workload	Semester
LLZ_50302V		CP	1.

Course Types	Frequency	Language(s)
Seminar	Every semester	German

Also included in

- (Int.), PO
- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Computational Mathematics (B.Sc.), PO2027

Course Responsible

Recommended Prerequisites

None

Course Contents

Entsprechend der Niveaustufe des GER / *According to the relevant CEF level*:

- passende und notwendige grammatikalische Strukturen / *appropriate and necessary grammar structures*
- passendes und notwendiges Vokabular / *appropriate and necessary vocabulary*
- kommunikative Situationen im Hochschul- sowie Berufsleben / *communicative situations in university and professional life*

Teaching Methods and Media

in-person teaching

Die Lehrveranstaltung verfolgt den Ansatz des kommunikativen Fremdsprachenlernens. Folgende didaktische Methoden werden angewandt, um die Sprachfertigkeiten zu erweitern: Einzel-, Partner- und Gruppenarbeiten, Präsentationen, Diskussionen, bewegte Lehre. Blended Learning- und Online-Phasen (Quizzes, Projekte, Online-Aufgaben) werden integriert, um das selbstgesteuerte Lernen zu fördern. / *The course adopts the communicative language learning approach. We will use the following learning methods to increase language competence: individual, pair and group work, presentations, discussions, movement in learning. Blended learning and digital elements (quizzes, projects, online activities) are incorporated to support the development of independent learning skills.*

References

Lehrwerke und authentisches Lehrmaterial auf dem entsprechenden Niveau. Dies wird zu Beginn der Lehrveranstaltung bekannt gegeben. / *Coursebooks and authentic material at the appropriate level. This will be announced at the start of the course.*

Notes

Related Course

Fachsprache Technik

Course Code	Short Form	Workload	Semester
LLZ_50303V		CP	1.

Course Types	Frequency	Language(s)
Seminar	Every semester	German

Also included in

- (Int.), PO
- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Computational Mathematics (B.Sc.), PO2027

Course Responsible

Recommended Prerequisites

None

Course Contents

Entsprechend der Niveaustufe des GER / *According to the relevant CEF level*:

- Wortschatz zur Fachsprache der Technik, passend zum GER / techncial vocabulary appropriate to CEF level
- kommunikative Situationen im technischen Kontext / communicative situations in technical contexts

Teaching Methods and Media

in-person teaching

Die Lehrveranstaltung verfolgt den Ansatz des kommunikativen Fremdsprachenlernens. Folgende didaktische Methoden können angewandt werden, um die Sprachfertigkeiten zu erweitern: Einzel-, Partner- und Gruppenarbeiten, Präsentationen, Diskussionen, bewegte Lehre. Blended Learning- und Online-Phasen (Quizzes, Projekte, Online-Aufgaben) werden integriert, um das selbstgesteuerte Lernen zu fördern. / *The course adopts the communicative language learning approach. The following learning methods may be used to increase language competence: individual, pair and group work, presentations, discussions, movement in learning. Blended learning and digital elements (quizzes, projects, online activities) are incorporated to support the development of independent learning skills.*

References

Lehrwerke und authentisches Lehrmaterial im technischen Bereich auf dem entsprechenden Niveau. Dies wird zu Beginn der Lehrveranstaltung bekannt gegeben. / *Coursebooks and authentic material on technological topics at the appropriate level. This will be announced at the start of the course.*

Notes

Modul

Comprehensive Competencies

Module Code
Y-M4

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Every semester

Language(s)
English

Scheduled Semester
1.(recommended)

Type of Examination
Module Level Assessment

Also Included In

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Innovative Product Development and Manufacturing (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026
- Sustainable and Digital Aviation (part-time) (M.Eng.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr.-Ing. Karlheinz Sossenheimer, Dr. Edgar Thomas

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,

- apply methods and instruments for planning, managing and implementing projects in order to successfully achieve results in interdisciplinary teams.
- evaluate and assess projects economically in order to make well-founded decisions in the context of resource and time management.
- analyse mega and business process reengineering projects and develop change management strategies to effectively transform companies.
- analyze economic, technical, and interdisciplinary contexts and to develop solutions in teams both independently and collaboratively.
- leading groups and recognising and communicating technical and interdisciplinary relationships in order to promote team dynamics and motivation.
- take responsibility in the company and in society and to apply the tools of project management and personnel management in order to use their competences in a targeted manner.
- to think in a goal- and implementation-oriented manner, as well as to analyze and design economic and technical aspects within an overall context. They are capable of developing sustainable solutions that can be assessed based on specific criteria.
- analyse their leadership skills in dealing with gender and diversity and take these into account when managing teams.

This module contributes to the following degree program objectives
Problem Solving, Leadership Skills, Teamwork Abilities, Communication, Time Management and Self-Management, Self-Awareness

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Written Examination u. Portfolio o. Portfolio

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses
Wahlpflichtveranstaltung/en:

- Advanced Project Management (SU, 1. Sem., 2 SWS)
- Leadership (SU, 1. Sem., 1 SWS und S, 1. Sem., 1 SWS)

Related Course

Advanced Project Management

Course Code	Short Form	Workload	Semester
Y-M4V1		CP	1.

Course Types	Frequency	Language(s)
Seminar-style	Every semester	English

Also included in

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Industrial Engineering (part-time) (M.Eng.), PO2026
- Innovative Product Development and Manufacturing (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026
- Sustainable and Digital Aviation (part-time) (M.Eng.), PO2026

Course Responsible

Prof. Dr.-Ing. Karlheinz Sossenheimer

Recommended Prerequisites

None

Course Contents

- Einführung in das Projektmanagement / Introduction to project management
- Berechnung von Netzplan und Aufbau Gantt Diagramm (PM) / Calculation of network plan and structure of Gantt chart (PM)
- Methodik und Grundlagen der Earned Value Analyse zur Überwachung von Projekten / Methodology and basics of earned value analysis for monitoring projects
- Personalmanagement in Projekten / Personnel management in projects
- Aufgabe/Verantwortung/Kompetenz der Projektbeteiligten / Task/responsibility/competence of project participants
- Soziale Kompetenz / Social competence:
  - Projektkultur / Project culture
  - Konfliktmanagement und Teamarbeit / Conflict management and teamwork
  - Umgang mit Gender und Diversität in der Teamarbeit / Dealing with gender and diversity in teamwork
- Multiprojektmanagement und Methoden der wirtschaftlichen Analyse von Projekten / Multi-project management and methods of economic analysis of projects
- Moderne agile Methoden des Projektmanagements z. B. SCRUM / Modern agile methods of project management e.g. SCRUM
- Projektmanagement im Business Process Reengineering / Project management in business process reengineering
- Change Management in Unternehmen / Change management in companies
- Claim Management im Projekt / Claim management in projects
- Risiken von Megaprojekten / Risks of megaprojects
- Methoden der Wirtschaftlichkeitsanalysen in Projekten / Methods of profitability analyses in projects
- Vertragsmanagement und Verhandlungstechniken / Contract management and negotiation techniques
- Nutzung von PM-Software: SAP-R3-PS, MS-Project / Use of PM software: SAP-R3-PS, MS-Project

Teaching Methods and Media

Deutsch

Der Inhalt der Lehrveranstaltung wird vermittelt durch:

- Vorlesungen zur Vermittlung theoretischer Grundlagen
- Praktische Übungen und Fallstudien zur Anwendung des Gelernten und um den Praxisbezug herzustellen
- Diskussionen zur Vertiefung des Verständnisses

Zu allen Vorlesungen werden ggf. Videos der Lehrveranstaltungen angeboten und mit den Studierenden geteilt. Der Stoff der Lehrveranstaltung kann mit blended Learning-Methoden und E-Learning anhand dieser Videos erarbeitet werden. Es wird damit ein effektiveres und abwechslungsreiches Lernumfeld geschaffen.

English

The content of the course is taught through:

- Lectures to convey theoretical principles
- Practical exercises and case studies to apply what has been learnt and to establish practical relevance
- Discussions to deepen understanding

If applicable, videos of the lectures are offered and shared with the students. The course material can be worked through using blended learning methods and e-learning based on these videos. This creates a more effective and varied learning environment.

References

- Vorlesungsskript Advanced Projektmanagement
- J. Kuster, E. Huber, R. Lippmann, A. Schmid, E. Schneider, U. Witschi, R. Wüst (2022): **Handbuch Projektmanagement, 5., erweit. Aufl.** ISBN 978-3-662-65472-9.
- Kompetenzbasiertes Projektmanagement (PM4) Handbuch für Praxis und Weiterbildung im Projektmanagement in zwei Bänden, GPM Deutsche Gesellschaft für Projektmanagement e. V., 2019, ISBN 978-3-924841-78-2 (eBook).
- Kerzner, H. (2022). **Project management: A systems approach to planning, scheduling, and controlling (13th ed.).** Wiley.
- Project Management Institute. (2021). **A guide to the project management body of knowledge (PMBOK guide) (7th ed.).** Project Management Institute.
- Turner, J. R. (2014). **Handbook of project-based management: Leading strategic change in organizations (4th ed.).** McGraw-Hill Education.
- Meredith, J. R., Shafer, S. M., & Mantel, S. J. (2020). **Project management: A managerial approach (10th ed.).** Wiley.
- Pinto, J. K. (2019). **Project management: Achieving competitive advantage (5th ed.).** Pearson.
- Shenhar, A. J., & Dvir, D. (2007). **Reinventing project management: The diamond approach to successful growth and innovation.** Harvard Business School Press.
- Larson, E. W., & Gray, C. F. (2021). **Project management: The managerial process (8th ed.).** McGraw-Hill Education
- In case of an english course, further information about respective literature in english will be provided.*

Notes

Die Lehrveranstaltung Advanced Project Management wird in den Studiengängen Elektrotechnik und Management (berufsbegleitend) (M.Eng.) und Wirtschaftsingenieurwesen (berufsbegleitend) (M.Eng.) nur im Sommersemester sowie auf Deutsch oder Englisch angeboten.

Related Course

Leadership

Course Code	Short Form	Workload	Semester
Y-M4V2		CP	1.

Course Types	Frequency	Language(s)
Seminar-style, Seminar	Every semester	English

Also included in

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Industrial Engineering (part-time) (M.Eng.), PO2026
- Innovative Product Development and Manufacturing (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026
- Sustainable and Digital Aviation (part-time) (M.Eng.), PO2026

Course Responsible

Dr. Edgar Thomas

Recommended Prerequisites

None

Course Contents

Deutsch

1 Die Entwicklung von Führungsbeziehungen markiert einen Paradigmenwechsel, der zwischen hierarchischer Vorgesetztenführung (starre, individuumszentrierte, objektivistische Perspektive) und Menschenführung (dynamische Interaktions- und Beziehungsperspektive) unterscheidet. Die Veranstaltung behandelt in diesem Zusammenhang:

- Relevanz dieses modernen Führungsverständnisses.
- Führungstheorien (z. B. Machtführung, Dyadentheorie der Führung).
- Ausgewählte Führungsstilmodelle wie Reifegradmodell, Full-Range-of-Leadership-Modell (transaktionaler, transformationaler Führungsstil) und Super-Leadership-Modell (Selbstführung).
- Psychologische Aspekte von Führung und Teamdynamik motivationstheoretisch (z. B. BIG 3, Selbstwirksamkeitserwartungen) und kommunikationstheoretisch (z. B. Entscheidung zwischen symmetrischer und asymmetrischer Kommunikation).
- Berücksichtigung von Gender und Diversität in Führungsbeziehungen.

2 Die Gestaltung durch Führungsinstrumente prägt eine professionelle Führungsarbeit in der Praxis und spielt eine entscheidende Rolle bei der Erreichung von Mitarbeitenden- und Unternehmenszielen. Die Veranstaltung behandelt in diesem Zusammenhang:

- Traditionelle Management-by-Konzepte.
- Feedbackorientierte Führung (z. B. strukturierte Gespräche mit Mitarbeitenden führen).
- Potenzialorientierte Führung (z. B. Förderung der individuellen Employability und Performance Management).
- Talentorientierte Führung (z. B. Personalportfolio und Karriereplanung als Förderinstrument der Personalentwicklung 4.0).
- Kooperative Führung.
- Wirksame und nachhaltige Führung mittels Kennzahlensystemen.
- Emotional-Resonante Führung.
- Führung selbstführender Teams.

3 Im Kontext einer professionellen Führung mit **Leadership-Kompetenz** behandelt die Veranstaltung, wie eine Führungskraft beispielsweise lernt, das eigene Verhalten und die eigene Wirkung auf andere zu reflektieren und sich kontinuierlich weiterzubilden, mit Stress und Ambivalenzen umzugehen, um die eigene Leistungsfähigkeit und die der Mitarbeitenden zu erhalten oder auch unter Unsicherheit fundierte und schnelle Entscheidungen zu treffen.

4 Agile und werteorientierte Führung in der digitalen Arbeitswelt stellt besondere Anforderungen an Führungskräfte und den Umgang mit ihren Mitarbeitenden. Die Veranstaltung arbeitet heraus, dass eine offene und wirkungsorientierte Kommunikation Vertrauen fördert und empowerte Mitarbeitende zur Übernahme von Verantwortung ermutigt werden, was die intrinsische Motivation und das Engagement steigert. Es werden zentrale Merkmale agiler Führung identifiziert, wonach erfolgreiche Führung einerseits immer auch Selbstführung (Self Leadership) voraussetzt und andererseits bedeutet, nicht nur aus der Erfahrung, sondern auch “von der Zukunft her (zu) führen” (vgl. C. Otto Scharmer).

English

1 The Development of Leadership Relationships marks a paradigm shift that distinguishes between hierarchical superior leadership (rigid, individual-centered, objectivist perspective) and people-oriented leadership (dynamic interaction and relationship perspective). In this context, the lecture deals with:

- Relevance of this modern understanding of leadership.
- Various leadership theories (e.g., power leadership, dyadic theory of leadership).
- Selected leadership style models such as the maturity model, the Full-Range-of-Leadership model (transactional, transformational leadership style), and the Super-Leadership model (self-leadership).
- Psychological aspects of leadership and team dynamics from motivational theory's perspective (e.g., BIG 3, self-efficacy expectations) and communication theory's perspective (e.g., decision between symmetrical and asymmetrical communication).
- Consideration of gender and diversity in leadership relationships.

2 The Design through Leadership Tools shapes professional leadership work in practice and plays a crucial role in achieving employee and company goals. In this context, the lecture deals with:

- Traditional management-by-concepts.
- Feedback-oriented leadership (e.g., conducting structured conversations with employees).
- Potential-oriented leadership (e.g., promoting individual employability and performance management).
- Talent-oriented leadership (e.g., personnel portfolio and career planning as a development tool for Human Resource Development 4.0).
- Cooperative leadership.
- Effective and sustainable leadership using performance measurement systems.
- Emotionally resonant leadership.
- Leading self-managing teams.

3 In the context of professional leadership with **leadership competence**, the lecture figures out, how a leader learns to reflect on his own behavior and impact on others, continuously educates himselve, manages stress and ambivalence to maintain his own performance and that of his employees, or make informed and swift decisions under uncertainty.

4 Agile and Value-Oriented Leadership in the digital work environment presents special demands on leaders and their interactions with employees. The lecture figures out, that open and impact-oriented communication fosters trust and encourages empowered employees to take on responsibility, which increases intrinsic motivation and engagement. Key characteristics of agile leadership are identified, according to which successful leadership always requires self-leadership and, moreover, to lead not only from experience but also from the future (cf. C. Otto Scharmer).

Teaching Methods and Media

Deutsch

Konzept:

Kompetenzdidaktische Lernsettings antizipieren die Handlungslogik der Kompetenzanwendung (Gestalten und Anwenden) in der Aneignungslogik des Lernprozesses (Aneignung) und üben diese ein (Erleben und Üben).

Aneignung:

Die Studierenden nutzen die ihnen zur Verfügung gestellten Informationen, Zugänge, Impulsreferate und Aufgaben zur Bearbeitung von Lernprojekten (Fallaufgaben), zur Beantwortung eigener Fragen und zum Abgleich der individuellen Lernziele mit den Modulzielen.

Erleben und Üben:

Die Studierenden übernehmen Verantwortung für die Gestaltung ihres individuellen Lernprozesses in realen und konstruierten Schlüsselsituationen. Methoden- und Medienwahl in den Übungsphasen: Selbstlern- und Reflexionstools, Fallarbeiten/Fallstudien mit Praxisbezug, Falldiskussionen und Fallpräsentationen, SWOT-Analysen, Rollenspiel mit Praxisbezug, Expertenteams zur Wissensaneignung und Puzzlegruppen zum Informationsaustausch, eingeschobene Übungsaufgaben, Leittextmethode, Blitzlicht, Hitparade, Videosequenzen, Impulsreferate. Gleichzeitig steht die Stärkung der Selbstlernkompetenz im Mittelpunkt der Übungsphase.

Gestaltung und Anwendung:

Der Grad der Kompetenzausprägung zeigt sich in der Fähigkeit der Studierenden, komplexe Probleme selbstorganisiert zu lösen:
(a) in fallbezogenen Prüfungsaufgaben (Lehre) und
(b) in berufsbezogenen Arbeitsprozessen (Praxis).

Blended Learning:

Kombination von asynchronen, angeleiteten Selbstlernphasen und synchronen, begleiteten Gruppenlernphasen. Die Lernsettings finden in Präsenz, Online oder Hybrid statt. Synchrone und asynchrone Phasen werden sinnvoll miteinander verknüpft (Synchron-Asynchron-Verankerung). Anmerkung: Bei einer Teilnehmerzahl von mehr als 20 Studierenden ist auf eine geeignete Methodenwahl zu achten.

English

Concept:

Competence-didactic learning settings anticipate the action logic of competence application (designing and applying) within the acquisition logic of the learning process (appropriation) and practice it (experiencing and practicing).

Appropriation:

Students utilize the information, resources, impulse presentations, and tasks provided to them for processing learning projects (case tasks), answering their own questions, and aligning their individual learning goals with the module objectives.

Experiencing and Practicing:

Students take responsibility for designing their individual learning process in real and constructed key situations. Method and media choices during the practice phases include: self-learning and reflection tools, case studies with practical relevance, case discussions and presentations, SWOT analyses, role plays with practical relevance, expert teams for knowledge acquisition, and puzzle groups for information exchange, interspersed practice tasks, guided text methods, flashlights, charts, video sequences, and impulse presentations. At the same time, strengthening self-learning competence is the focus during the practice phase.

Design and Application:

The degree of competence manifestation is reflected in the ability of students to solve complex problems in a self-organized manner: (a) in case-related examination tasks (teaching) and (b) in profession-related work processes (practice).

Blended Learning:

This involves a combination of asynchronous, guided self-learning phases and synchronous, facilitated group learning phases. The learning settings take place in-person, online, or hybrid. Synchronous and asynchronous phases are meaningfully interconnected (synchronous-asynchronous anchoring). Note: For a participant number of more than 20 students, an appropriate choice of methods should be considered.

References

- Arnold, R. (2014): **Leadership by Personality. Von der emotionalen zur spirituellen Führung Ein Dialog**, Wiesbaden (Springer Gabler).
- Bass, B. M. (1990): **From transactional to transformational leadership: Learning to share the vision.** Organizational Dynamics, 18(3), 1931. https://doi.org/10.1016/0090-2616(90)90061-S
- Burns, J. M. (1978): **Leadership.** Harper & Row.
- Furtner, M; Baldegger, U. (2014): **Self-Leadership und Führung. Theorien, Modelle und praktische Umsetzung**, Wiesbaden (Springer Gabler).
- Goleman, D. (2000): **Leadership that gets results.** Harvard Business Review, 78(2), 7890.
- Northouse, P. G. (2021): **Leadership: Theory and practice (9th ed.).** Sage.
- Kotter, J. P. (1990): **A force for change: How leadership differs from management.** Free Press.
- Scharmer, C. Otto (2009): **Theorie U. Von der Zukunft her führen**, Heidelberg (Carl-Auer).
- Thomas, E. (2025): **Studientext Personalführung inkl. Personalführung in der Praxis (Fallarbeiten, Fallstudien und Übungsaufgaben)**, Vorlesungsscript.
- Wagner, D.: **Praxishandbuch Personalmanagement**, Freiburg et al. (online) [07.02.2025].
- Weibler, J. (2023): **Personalführung. Personen, Beziehungen, Kontexte**, Wirkungen. 4. Auflage Vahlen.
- Yukl, G. (2013): **Leadership in organizations (8th ed.).** Pearson.
- Leadership-Lexikon: **(Leadership insiders: Was Führung im Innersten zusammenhält Führungswissen für die Führungspraxis)**, unter https://www.leadership-insiders.de/ [07.02.2025].

In case of an english course, further information about respective literature in english will be provided.

Notes

Die Lehrveranstaltung Leadership wird in den Studiengängen Elektrotechnik und Management (berufsbegleitend) (M.Eng.) und Wirtschaftsingenieurwesen (berufsbegleitend) (M.Eng.) nur im Sommersemester sowie auf Deutsch oder Englisch angeboten.

Modul

Advanced Deep Learning

Module Code
Y-M18

Short Form
ADL

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Andreas Zinnen

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,

- precisely explain the basic concepts of deep learning and discuss their relevance in the context of current research and applications.
- differentiate between different types of neural networks and analyze their specific properties and areas of application.
- systematically evaluate training data for deep learning, identify suitable preparation measures and reflect on their influence on the model results.
- design a neural network for a specific problem by selecting and justifying suitable architectures and methods.
- critically analyze hyperparameters of a model, make adjustments and evaluate the impact of these adjustments on model performance.
- compare the advantages and disadvantages of different deep learning algorithms and discuss their suitability for specific use cases in a well-founded manner.
- comprehensively evaluate the performance of a deep learning model, select suitable evaluation methods and develop well-founded suggestions for improvement.
- independently design and implement innovative applications of deep learning in different areas, taking into account current trends and technologies.

This module contributes to the following degree program objectives
Developing and Optimizing Medical Technology Systems, Data Skills, Problem Solving, Scientific Research and Development, Communication, Time Management and Self-Management

Type of Course Component: Graded Course Component

Examination Format: Written Examination o. Portfolio o. Written Examination u. Revision Test

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 31.5 hours of class attendance (3 contact hours per week) and 118.5 hours of self-study, including exam preparation

Remarks

Related Courses
Wahlpflichtveranstaltung/en:

- Advanced Deep Learning (V, 1., 2. Sem., 1 SWS und P, 1., 2. Sem., 2 SWS)

Related Course

Advanced Deep Learning

Course Code	Short Form	Workload	Semester
Y-M18V		CP	1., 2.

Course Types	Frequency	Language(s)
Lecture, Laboratory	Summer semester only	English

Also included in

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026

Course Responsible

Recommended Prerequisites

None

Course Contents

- Technical Fundamentals
  - Neural Networks: Structure and functioning of neural networks, including the concepts of neurons, layers, and activation functions
  - Backpropagation: Explanation of the learning process in neural networks and the role of gradient descent
  - Optimization Algorithms: Introduction to algorithms like Stochastic Gradient Descent (SGD), Adam, -RMSprop, etc.
- Architectures and Models
  - Convolutional Neural Networks (CNNs): Structure and application of CNNs, particularly in image processing
  - Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM): Use of RNNs and LSTMs for sequential data such as text or time series
  - Generative Adversarial Networks (GANs): Basics of GANs and their applications in image and video generation
  - Transformer Models
- Advanced Topics
  - Transfer Learning: Leveraging pre-trained models for new tasks
  - Hyperparameter Tuning: Techniques for optimizing model parameters
  - Regularization Methods: Approaches to avoid overfitting, such as dropout and L2 regularization
- Practical Applications and Tools
  - Frameworks and Libraries: Introduction to tools like TensorFlow, PyTorch, Keras, and their use for implementing deep learning models
  - Data Preparation and Augmentation: Methods for preparing and augmenting training data with a special emphasis on gender-equitable datasets, diverse voices and perspectives, and the identification and mitigation of potential bias. Students are encouraged to critically assess data sources and preparation methods, taking into account ethical considerations, diversity, and fairness in AI systems. These aspects are applied through the analysis and validation of datasets with regard to potential bias.

Teaching Methods and Media

The content of the course is delivered through:

- Lectures to convey theoretical foundations
- Practical exercises and case studies to apply what has been learned and establish practical relevance
- Discussions to deepen understanding

Videos of the lectures may be provided and shared with the students, if necessary. The content of the course can be worked on using blended learning methods and e-learning based on these videos. This creates a more effective and varied learning environment.

References

Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 1st Ed., 2016, MIT Press
François Chollet, Deep Learning with Python, 1st Ed., 2017, Manning Publications
Christopher Bishop, Deep Learning - Foundations and Concepts

Notes

Modul

Innovation Management & Entrepreneurship

Module Code
Y-M7

Short Form

Module Requirement
Core Elective

Credits
5 CP

Duration
1 Semester

Frequency
Summer semester only

Language(s)
English

Scheduled Semester
1., 2.(recommended)

Type of Examination
Module Level Assessment

Also Included In

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Industrial Engineering (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026
- Sustainable and Digital Aviation (part-time) (M.Eng.), PO2026

Curriculum Notes

Module Coordinator
Prof. Dr. Thomas Heimer

Required Prequisites
None

Recommended Prequisites
None

Module Objectives
Upon successful completion of the module, students are able to,

- den Ablauf von Innovationsprozessen, von der Definition der Forschungsfrage bis hin zur Marktdiffusion, sowie die Indikatoren für die strategische Steuerung der einzelnen Phasen zu erklären / to explain the process of innovation, from the definition of the research question to market diffusion, as well as the indicators for the strategic management of the individual phases.
- Kenntnisse aus der Forschung der Innovationstheorie zur Entwicklung von innovativen Geschäftsideen anzuwenden und Faktoren für ein erfolgreiches Unternehmertum im Hinblick auf deren Umsetzung zu analysieren / to apply know-ledge of innovation theory to develop innovative business ideas and to analyze factors for successful entrepreneurship with regard to their implementation.
- ein Konzept für eine eigene Unternehmensgründung zu entwickeln und die unterschiedlichen Themenstellungen des Business-Plans, unter Berücksichtigung auch von Diversitäts- und Genderaspekten, selbständig auszuarbeiten / to develop a concept for one's own business start-up and independently elaborate on the various aspects of the business plan, also taking into account diversity and gender aspects.
- zu erklären, wodurch sich Unternehmer:innen auszeichnen und welche Ziele sie verfolgen / to explain what distinguishes entrepreneurs and what goals they pursue.
- eigene neue Ideen und Lösungen zu entwickeln / to develop new ideas and solutions independently.
- die anfallenden Aufgaben zur Planung einer Gründung ziel- und umsetzungsorientiert sowie im Rahmen eines gegebenen Zeitrahmens zu bewältigen / to handle the tasks involved in planning a start-up in a goal-oriented and implementation-focused manner, within a given timeframe.
- bei einer Bearbeitung im Team Aufgaben zu organisieren und gemeinsam eine Lösung zu erarbeiten, unter Berücksichtigung des Einflusses von Genderaspekten bei Teamzusammensetzungen auf Innovationsprozesse / to organize tasks and collaboratively work towards a solution when working in a team, taking into account the influence of gender aspects in team composition on innovation processes.
- wesentliche Elemente einer Unternehmensgründung professionell zu präsentieren und zu kommunizieren / to professionally present and communicate the essential elements of a business start-up.
- Kernelemente der modernen Innovationstheorie zur gesellschaftlichen Ausgestaltung von Technologien zu beschreiben / to describe the core elements of modern innovation theory for the social shaping of technologies.
- innovative Technologie- und Investitionsentscheidungen (z.B. neue Produktionsanlagen, Automatisierungslösungen, digitale Konzepte...) aus Sicht technischer Führungskräfte im Spannungsfeld von Machbarkeit, Kosten, Risiken und Nachhaltigkeitszielen zu begründen / to justify innovative technology and investment decisions (e.g. new production facilities, automation solutions, digital concepts...) from the perspective of technical managers in the area of feasibility, costs, risks and sustainability goals.

This module contributes to the following degree program objectives
Scientific Research and Development, Problem Solving, Communication, Teamwork Abilities, Leadership Skills, Self-Awareness, Time Management and Self-Management

Type of Course Component: Graded Course Component

Examination Format: Portfolio o. Term Paper o. Presentation

Grading Type: Graded

(If multiple examination formats are available, the exact format of examination and, if appliable, the exact duration of examination is o be determined by the Examination Board at the beginning of the course and publicized within the faculty.)

Contribution to Final Grade
By credit

Total Module Workload in Hours
150, including 42 hours of class attendance (4 contact hours per week) and 108 hours of self-study, including exam preparation

Remarks

Related Courses
Wahlpflichtveranstaltung/en:

- Innovation Management (SU, 1., 2. Sem., 2 SWS)
- Entrepreneurship (SU, 1., 2. Sem., 2 SWS)

Related Course

Innovation Management

Course Code	Short Form	Workload	Semester
Y-M7V1		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	English

Also included in

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Industrial Engineering (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026
- Sustainable and Digital Aviation (part-time) (M.Eng.), PO2026

Course Responsible

Prof. Dr. Thomas Heimer, Martin Schipper

Recommended Prerequisites

None

Course Contents

- Die Rolle von Innovationen in einer Volkswirtschaft / The role of innovations in an economy.
- Sozio-ökonomische Steuerung des Technikgeneseprozesses / Socio-economic management of the technology genesis process.
- Methoden der Diffusionssteuerung / Methods of diffusion management.
- Adoptionsverhalten bei technischen Standards, Probleme und Risiken / Adoption behavior regarding technical standards, problems and risks.
- Strategisches Innovationsmanagement / Strategic innovation management.

Teaching Methods and Media

In Innovation Management ist basierend auf der Vorlesung ein Thema vertiefend auszuarbeiten, zu präsentieren und schriftlich zu fixieren. In innovation management a selected topic based on the teaching in the first part of the course is to be generated and to be presented and finally to be developed as a seminar paper.

References

- Afuah, Allan: Innovation Management: strategies, implementation, and profits / Allan Afuah - 2nd ed. - 2003.
- Drucker, Peter F.: Innovation and Entrepreneurship: practice and principles / Peter F. Drucker - 1993.
- Gerybadze, Alexander, 2004, Technologie- und Innovationsmanagement, Vahlen Verlag.
- Dosi, G., 1982, Technological Paradigms and technological trajectories, in: Research Policy, Vol. 11.

Notes

Related Course

Entrepreneurship

Course Code	Short Form	Workload	Semester
Y-M7V2		CP	1., 2.

Course Types	Frequency	Language(s)
Seminar-style	Summer semester only	English

Also included in

- AI and Advanced Information Technologies (M.Eng.), PO2026
- Applied Physics (M.Sc.), PO2026
- Biomedical Engineering (M.Sc.), PO2026
- Electrical Engineering and Management (part-time) (M.Eng.), PO2026
- Industrial Engineering (part-time) (M.Eng.), PO2026
- Mechanical Engineering (M.Eng.), PO2026
- Sustainable and Digital Aviation (part-time) (M.Eng.), PO2026

Course Responsible

Prof. Dr. Thomas Heimer

Recommended Prerequisites

None

Course Contents

- Die Bedeutung von Unternehmensgründungen für die deutsche Wirtschaft / The importance of start-ups for the German economy.
- Innovation und Entrepreneurship - zwei Seiten der selben Münze / Innovation and entrepreneurship - two sides of the same coin.
- Was ist Entrepreneurship? - Definitionen / What is entrepreneurship? - Definitions.
- Was zeichnet Entrepreneur:innen aus? Von den geborenen Führer:innen zu modernen Ansätzen / What distinguishes entrepreneurs? From born leaders to modern approaches.
- Was macht Unternehmensgründungen erfolgreich? Finanzierung von Unternehmensgründungen / What makes start-ups successful? Financing of start-ups.
- Durchführung einer virtuellen Unternehmensgründung / Implementation of a virtual start-up.

Teaching Methods and Media

In Entrepreneurship ist ein Business Plan zu erstellen, das benötigte Eigenkapital zu pitchen und der Plan schriftlich auszuarbeiten. In entrepreneurship a business plan has to be generated, the required equity has to be pitched and the business plan shall be finalised as a paper at the end.

References

- Christine K. Volkmann, Kim Oliver Tokarski; Entrepreneurship: Gründung und Wachstum von jungen Unternehmen - Lucius & Lucius Verlagsgesellschaft, Stuttgart 2006.
- Empirical Entrepreneurship in Europe: new perspectives/ed. by Michael Dowling - 2007.
- Entrepreneurship Research in Europe: outcomes and perspectives/ed. by Alain Fayolle - 2005.
- Venkataraman, S.; Sarasvathy, Saras D.: Strategy and Entrepreneurship: outlines of an untold story/S. Venkataraman and Saras D. Sarasvathy, in: The Blackwell Handbook of Strategic Management S. 650-668.

Notes