Hochschule Anhalt
Anhalt University of Applied Sciences

Fachbereich
EMW (FB6)

Bernburger Str. 55
06366 Köthen

Köthen, 03.04.2024

Modul Handbook

For the Master Degree Program

Master Biomedical Engineering
June 2024

Content

Foreword

This module handbook complies with the requirements of the Standing Conference of the Ministers of Education and Cultural Affairs of the Federal Republic of Germany for the "Qualification Framework for German University Degrees" as well as the requirements of the module descriptions required by the StAkkrVO of the State of Saxony-Anhalt for the individual courses in the Master's degree programme in Biomedical Engineering.

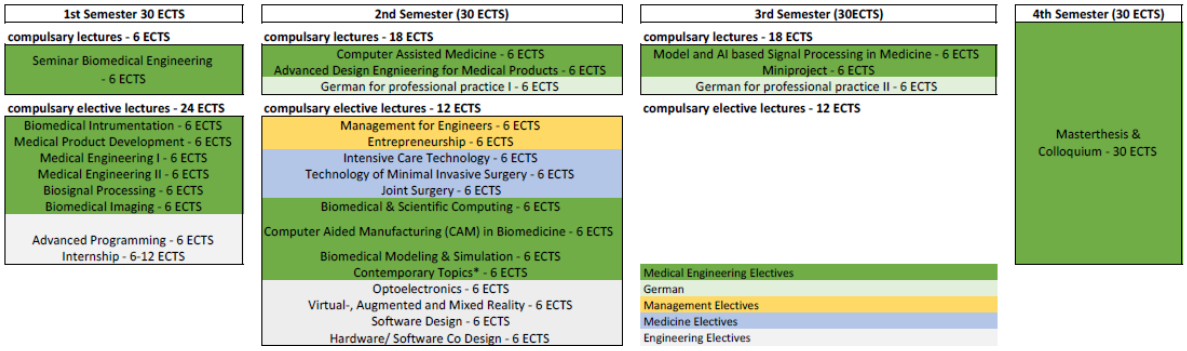
The module handbook is used by students to provide information about the individual modules, including their specific semester planning, as well as for teachers to document the module content and to coordinate with their colleagues.

Information and additions can be obtained from the academic advisor for the degree programme.

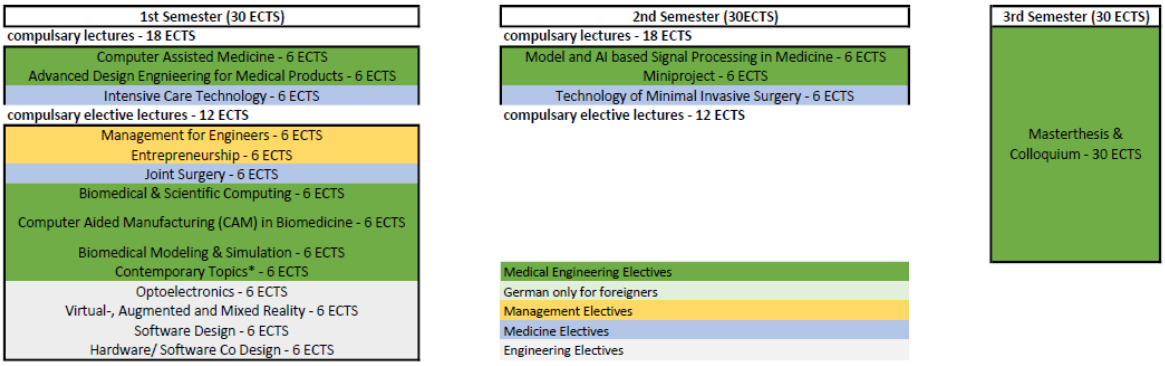
In addition, the following information can be found in the corresponding study and examination regulations:

- Study and examination schedule
- Regular course of study
- Module Catalogue

4 Semester plan



3-Semester plan



1 Computer Assistierte Medizin – Modul-Nr.

1. Modulverantwortliche/r

Prof. Dr. Marianne Maktabi

2. Modultyp

☒ Pflichtmodul ☐ Wahlpflichtmodul

3. ECTS-Leistungspunkte (Credits)

6 Credits

4. Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

5. Teilnahmevoraussetzungen

no

6. Lernziele / Kompetenzen (Learning Outcomes)

At the end of the module students are able to

- know about basic concepts and methods of computer-assisted medicine
- can discuss about technical and structural basics, procedures and implementation in the medical environment
- have a basic methodological understanding of medical-assisting systems

7. Inhalt des Moduls

- Information and Communication Standards
- Telemedicine
- Imaging device technology
- Image Registration and Visualization
- Surgical device technology
- Surgical navigation systems
- Medical robotics
- Rehabilitation Engineering
- AAL
- Medical Software Development

8. Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

lab

9. Prüfungsart und -dauer

Written or oral Exam (90 min/20 min)

10. Medienformen

Tafelerklärungen,

Präsentationen, PC/Laptop

11. Empfohlene Literatur

B. Preim, C. Botha: Visual Computing for Medicine - 2nd Edition, Elsevier, 2013

Several literatures, will be mentioned during the lectures

2 Model and AI based Information Processing in Medicine – Modul-Nr. (Modulbezeichnung)

1. Modulverantwortliche/r

Prof. Dr. Marianne Maktabi

2. Modultyp

☒ Pflichtmodul ☐ Wahlpflichtmodul

3. ECTS-Leistungspunkte (Credits)

6 Credits

4. Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

5. Teilnahmevoraussetzungen

Knowledge about Biomedical Image and Biosignal Processing

6. Lernziele / Kompetenzen (Learning Outcomes)

At the end of the module students are able to

- About advanced medical image processing techniques and how to apply them

7. Inhalt des Moduls

Methods and algorithms for the analysis and visualization of medical image data incorporating current research in the field of medical image processing. In detail, the following methods and algorithms will be presented:

- Basics of Neural Networks in Medical Image Processing/ Signal Processing.
- Convolutional Neural Networks and Deep Learning in medical image processing
- U-Nets for image segmentation
- Autoencoders and Generative Adversarial Networks in medical image processing
- Techniques for data augmentation, transfer learning
- Random Decision Forests for medical image data segmentation
- Statistical shape models: generation and application for image segmentation
- ROI-based segmentation and cluster analysis for multispectral image data segmentation
- Live wire segmentation
- Segmentation with active contour models and deformable models

8. Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

lab

9. Prüfungsart und -dauer

Written or oral Exam (90 min/20 min)

10. Medienformen

Tafelerklärungen,

Präsentationen

11. Empfohlene Literatur

Several literatures, will be mentioned during the lectures

H. Handels: Medizinische Bildverarbeitung - 2. Auflage, Vieweg u. Teubner 2009

T. Lehmann: Handbuch der Medizinischen Informatik - München: Hanser 2005

M. Sonka, V. Hlavac, R. Boyle: Image Processing, Analysis and Machine - Elsevier, 2007

3 Biosignal Processing – Modulnr.

1. Modulverantwortliche/r

Prof. Dr. Marianne Maktabi

2. Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

3. ECTS-Leistungspunkte (Credits)

6 Credits

4. Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

5. Teilnahmevoraussetzungen

Knowledge about Signal Processing

6. Lernziele / Kompetenzen (Learning Outcomes)

The course module aims to provide a basic understanding as well as practical examples on various issues related to biomedical signal analysis.

Students will choose a biosignal application for a course project and will present results at the end of the module.

7. Inhalt des Moduls

- Elementary Signals, LTI-Systems
- Convolution and Correlation
- Fourier Analysis and Transform
- Fourier Transformation
- Time- and Frequency-Domain Filters
- Noise Removal and Signal Compensation
- Stationary and non-stationary Biomedical Signals
- Optimal and Adaptive Filtering
- Event Detection

8. Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

lab

9. Prüfungsart und -dauer

Written or oral Exam (90 min/20 min)

10. Medienformen

Tafelerklärungen,

Präsentationen, PC/Laptop, Video

11. Empfohlene Literatur

Bernhard, Stefan. „Biosignal Processing“. In Biosignal Processing, von Stefan Bernhard, Andreas Brensing, und Karl-Heinz Witte, V–VI. De Gruyter, 2022. https://doi.org/10.1515/9783110736298-202.

Husar, Peter. Biosignalverarbeitung. Berlin, Heidelberg: Springer Berlin Heidelberg, 2010. https://doi.org/10.1007/978-3-642-12657-4.

4 Biomedical Imaging – Modulnr.

1. Modulverantwortliche/r

Prof. Dr. Marianne Maktabi

2. Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

3. ECTS-Leistungspunkte (Credits)

6 Credits

4. Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

5. Teilnahmevoraussetzungen

Knowledge about Signal Processing

6. Lernziele / Kompetenzen (Learning Outcomes)

The course module aims to provide a basic understanding as well as practical examples on various issues related to biomedical image analysis.

The students will know about medical image processing techniques and how to apply them

7. Inhalt des Moduls

- Introduction
- Review of medical imaging technologies
- Data formats in medicine for imaging
- Filter
- Segmentation
- Registration
- Classification

8. Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

lab

9. Prüfungsart und -dauer

Written or oral Exam (90 min/20 min)

10. Medienformen

Tafelerklärungen,

Präsentationen, PC/Laptop, Video

11. Empfohlene Literatur

[1] W. Burger und M. J. Burge, Digital Image Processing: An Algorithmic Introduction Using Java. in Texts in Computer Science. London: Springer London, 2016. doi: 10.1007/978-1-4471-6684-9.

5 Seminar Biomedical Engineering – Modulnr.

1. Modulverantwortliche/r

All Prof. in Biomedical Engineering

2. Modultyp

☒ Pflichtmodul ☐ Wahlpflichtmodul

3. ECTS-Leistungspunkte (Credits)

6 Credits

4. Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

5. Teilnahmevoraussetzungen

no

6. Lernziele / Kompetenzen (Learning Outcomes)

The course module aims to provide a basic about guidelines to write a research paper for publication and learn how to prepare a scientific presentation.

7. Inhalt des Moduls

- Generate ideas and hypotheses: sketching ideas, flowcharts, logical thinking.
- Create the state of the art: literature reviews, online searches, judging the quality of findings, track records and ratings, quick reading, plagiarism/fraud; social media and science.
- Analysis results, plotting graphs and writing: publication´s formats, telling a story with scientific data, tables vs. figures; what to keep in/out; typical language issues; writing style; graphic quality.
- Citation of references according to guidelines.
- Prepare a scientific presentation.
- Analyze and summarize research papers and prepare presentations.

8. Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

lab

9. Prüfungsart und -dauer

oral Exam (20 min)

10. Medienformen

Tafelerklärungen,

Präsentationen

11. Empfohlene Literatur

[1] Lang, T.: How to Write, Publish, and Present in the Health Sciences: A Guide for Physicians and Laboratory Researchers. American College of Physicians.

[2] Zeiger, M.: Essentials of Writing Biomedical Research Papers. Second Edition, McGraw-Hill Professional.

6 Mini Project – Modulnr.

- Modulverantwortliche/r

All Prof. in the Department FMW

- Modultyp

☒ Pflichtmodul ☐ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Interdisciplinary Competencies: Students can

- independently, alone or in small groups, present, structure, and evaluate a scientific or technical topic in writing and orally in a limited amount of time,

- Name and apply rules of care in the preparation of scientific papers and/or presentations,

- Plan and independently perform work steps in the creation of scientific or technical work,

- Conduct literature research independently, critically evaluate literature sources and apply citation methods (also in presentations),

- Use software to create project work and presentations (including literature management programs, if applicable),

- Implement techniques of good scientific presentations,

- Design group work in a goal-oriented manner,

- Apply feedback rules and reflect their own way of working

- Inhalt des Moduls
  - By arrangement: Students demonstrate the ability to independently analyze a scientific/technical issue, develop a solution, and elaborate the solution. They will discuss the results with the supervising university professor and discuss advantages and disadvantages of different approaches.

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

Tafelerklärungen,

Präsentationen

- Empfohlene Literatur

7 Joint Surgery- Modul-Nr. ()

- Modulverantwortliche/r

Prof.Dr. Krüger

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

The student will:

- Learn the structure and function of the joints and cartilages.
- Learn different joint preserving techniques: total knee arthroplasty, total hip arthroplasty and arthroscopy.

- Inhalt des Moduls

- Introduction of arthroplasty, structure and function of joints and cartilages, and the principles and used equipment for Arthroscopy.
- Biomaterials, arthroplasty materials, wear, aseptic loosening, fixation (cemented, uncemented, modular, primary and secondary stability), surfaces (hydroxyapatite), robotics, navigation, design, stress shielding, Wolff`s law, bone density.
- THA and TKA systems (primary and revision) –demonstration.
- Medical devices used for joint preserving surgery: designs, materials and medical procedures.
- Joint replacement materials for joint preserving surgery: characteristics, mechanical properties and biocompatibility.
- Patient demonstration – visit the orthopedic ward.
- Total knee arthroplasty and total hip arthroplasty; cementing technique (Practical laboratory).
- Arthroscopy and arthroplasty (Live surgery).

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

Seminar, practical laboratory (cementing technique) and live surgery (arthroscopy, arthroplasty).

- Empfohlene Literatur

[1] Scuderi, G: Techniques in Revision Hip and Knee Arthroplasty, Saunders.

[2] Scuderi, G.,Tria A.: Knee Arthroplasty Handbook, Springer-Verlag New York.

8 Technologies in Minimal Invasive Surgery !!!- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Kipfmüller

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

9 Intensive Care Technology !!!- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Trommler

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

10 Computer Aided Manufacturing (CAM) in Biomedicine-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Landenberger

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

  - Basic Skills in Manufacturing Technology
  - Basic Skills in CAD

- Lernziele / Kompetenzen (Learning Outcomes)

In the first part of the course the students will get an overview of current state of CAD/CAM-technology and an overview of software-modules and applications. Furthermore typical terms, processes and related manufacturing technologies are explained.

In the beginning of the practical courses fundamental sketching and modelling techniques are shown. The following theme is the preparation of the NC programming. This includes the analysis of geometry and tolerances plus generation of sketches for the NC path.

In the main part of the practical courses the challenges and limitations of NC programming are in the focus. For that purpose typical workpieces for mechanical and medical applications are programmed. Every workpiece is manufactured on the machine tool of the department.

The following skills are acquired:

- Estimation of programming time
- Choosing the right technology (tools, machine tools…)
- Assessment of CAM systems
- Optimization of CAM processes

- Inhalt des Moduls

  - Market Overview
  - Trends
  - Basics and Nomenclature
  - CAD/CAM Process Chain
  - Tools and Tool Management
  - Tool Path Generation
  - Postprocessing

- Manufacturing/Machining

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

written Exam (20 min)

- Medienformen

Presentation (PowerPoint), lecture notes

- Empfohlene Literatur

- Weck, M., Eversheim, W., König, W., Pfeifer, T.: Production Engineering. The Competitive Edge. Butterworth-Heinemann Ltd, Oxford 1991
- Kief, H., Roschiwal, H.: CNC-Handbook. Mc Graw Hill, New York, 2011

11 Optoelectronics- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Hannes Kurtze

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

  - Physics (optics, oscillations and waves), mathematics I-III. Physical technology, material sciences and microsystems desirable, but not required

- Lernziele / Kompetenzen (Learning Outcomes)

The course provides principles of optoelectronic devices and relevant methods. Students can explain basic relations in semiconductor optics as well as selected methods of quantum optical phenomena (e.g. stimulated and spontaneous emission). They can describe technical solutions and have a clear idea of optical components in technical applications.

- Inhalt des Moduls

  - Semiconductor materials (e.g. Si, GaAs, InSb)
  - pn-junction
  - Sensors (photodiode, CCD)
  - Surface emitting devices (RCLED, SLED, VCSEL)
  - Semiconductor devices of reduced dimensions (e.g. quantum well, quantum dot)
  - Efficiency and temperature behavior
  - Emission properties of lasers vs. thermal light sources
  - Application in different spectral regions
  - Application in information and communications technology as well as biomedical technology (e.g. optical data transmission, pulse oximetry)
  - Selected advanced methods
  - Manufacturing, epitaxy

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

Lab

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

Tafel, Folien, Skript, Praktikumshandbücher

- Empfohlene Literatur
  - Eichler, Eichler: Laser. Springer
  - Thuselt: Physik der Halbleiterbauelemente. Springer
  - Rainer Dohlus: Lasertechnik. De Gruyter
  - Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, Wiley 2007
  - Demtröder, W., Laser Spectroscopy: Basic Concepts and Instrumentation, Springer, 2002
  - Kasap, S.O., Optoelectronics and Photonics: Principles and Practices, Prentice Hall, 2001

12 Biomedical Instrumentation- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Bracio

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

The student will:

 Gain an in depth applicable knowledge of the technical components required to convert physiological signals into digital data

 Able to design and implement an electronic system to measure physiological signals

- Inhalt des Moduls

  - Introduction and application
  - Review of electronic key terms
  - Biosignals
  - Biomedical sensors
  - Analog filters
  - Bioamplifiers
  - Analog to digital conversion

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

13 Biomedical Modelling and Simulation- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Bracio

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

The student will:

 Learn the basics of procedural programming in Matlab/Simulink.

 Analyze given problems, develop them on the basis of the analysis algorithms, and implement these algorithms in Matlab/Simulink.

 Be able to simulate and solve biomechanical systems in Matlab/Simulink.

- Inhalt des Moduls

  - Introduction to Matlab/Simulink: Familiarization with Matlab/Simulink, mathematical modelling, structure block diagrams, generation of various types of waveforms, solving calculations, generation of different functions, implementing differential equations.
  - Simulating dynamic systems: simple, discrete, continuous, and hybrid systems; advanced simulation concepts: zero crossings, algebraic loops, control structures and loops, advanced integrator, simulation parameters, debugging.
  - Subsystems: conditionally executed subsystems, atomic subsystems, masking, libraries, configurable subsystems; command line operation.
  - S-functions: simulation procedures, S-functions with no states, S-functions with discrete and continuous states; simulation of biological systems.

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

[1] Sheare, J.: Dynamic modeling and Control of Engineering Systems, Prentice Hall.

[2] Tyagi, K. A..: MATLAB and Simulink for Engineers, Oxford University Press.

14 Biomedical Engineering I- Modul-Nr. ()

- Modulverantwortliche/r

Dr. Aganoglu

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

15 Biomedical Engineering II- Modul-Nr. ()

- Modulverantwortliche/r

Dr. Aganoglu

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

16 Virtual-, Augmented and Mixed Reality - Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Tümler

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Professional Competencies: Students gain insight into hardware and software fundamentals, human perceptual processes, and standard tools for virtual and augmented reality. They will learn to identify AR/VR technologies and tools and to select suitable AR/VR tools and methods depending on the use case. Students will be able to implement their own low-function AR/VR demos and evaluate the suitability of these demos for the application scenario.

Interdisciplinary Competencies: - Combined teaching of methodological/technical/economic correlations reinforces analytical ability and deduction - Increase of own creativity and media competence by designing and presenting lectures in modern presentation forms (e.g. Pecha Kucha) - Promotion of social skills through regular cooperative work in small groups - Strengthening of own conflict and communication skills through joint assessment of lecture and practical training performances - Self-responsible work at individual (group dynamic) speeds in the processing of practical tasks results in strengthened decision competence - Collaboration with students from other degree programs

- Inhalt des Moduls
  - Fundamentals of AR/VR (presence, immersion, interactivity, visualization techniques, tracking, displays, software, etc.)
  - Application areas of AR/VR technologies (application domains, advantages/disadvantages, challenges for users and companies)
  - Build a basic virtual reality application (Unity, Windows Mixed Reality, SteamVR, OpenVR, Visual Studio)
  - Create a basic augmented reality application (Unity, HoloLens 2, Android, Vuforia, Visual Studio)
  - Interaction with virtual elements in AR/VR (Collider, Physics)
  -

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

written Exam (120 min)

- Medienformen

- Empfohlene Literatur

- Lecture notes and videos for lectures and practical training

- Pangilinan et al: Creating Augmented and Virtual Realities: Theory & Practice for Next-Generation Spatial Computing. O'Reilly, 2019

- Schmalstieg, Hollerer: Augmented Reality: Principles and Practice. Addisson-Wesley, 2016

17 Software Design- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Trommler

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Students have become familiar with the content and structure of model-based software development and know how to apply the principles of

the various models to the analysis, design, implementation, testing, and subsequent maintenance of software systems. In particular, objectoriented problem analysis and the design of a solution path are explained to the students by means of practical case studies. The programs to be

created are written using the Python or C++ programming language.

- Inhalt des Moduls

  - Introduction object orientation: Advantages ↔ disadvantages on practical example
  - Structure of the model-based software design from analysis to design
  - Visual modeling with UML
  - UML interaction diagrams as a communication tool in software design
  - From UML diagram to program code
  - Test strategies of software systems
  - Practical training with the PC/laptop

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

written Exam (120 min) or term paper

- Medienformen

- Empfohlene Literatur

• Larman, C., UML 2 and Pattern applied - object-oriented software development, mitp-Verlag, Frechen, 2005

• Gamma, E. ; Helm, R. ; Johnson, R. ; Vlissides, J.: Design Patterns: Entwurfsmuster als Elemente wiederverwendbarer objektorientierter So\ware. 1.Aufl. mitp-Verlag, 2015

• Vijayakumaran, S. Versionsverwaltung mit Git, mitp-verlag, Frechen, 2016

18 Hardware/ Software Co-Design- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Chmielewskie und Prof. Dr. Brutscheck

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Professional competencies: Students have an overview of the design, differences and use of simple programmable logics up to complex FPGA (Field Programmable Gate Array). They know the evaluation board to be used from e.g. Intel in the basic features of the design, the configuration as well as the interfaces. The "Tool Chain" has been discussed and an introduction to the Quartus development environment has been given. The students have learned all the essential structural elements of VHDL (Very High Speed Integrated Circuit Hardware Description Language) in the form of a compact tutorial and are able to formulate simple algorithmic problems in VHDL. They have understood the basic principle of a software CPU and are able to configure it as well as to implement simple problems both in VHDL as a hardware solution and in software using the software CPU (Nios II) and the C programming language. Based on the contents and experiences, the students can implement, for example, an MP3 player that receives its data as an IP stream from a "remote computer".

- Inhalt des Moduls
  - Programmable logic elements
  - Low Cost FPGA series e.g. Cyclone (Intel)
  - Basics of the programming language VHDL
  - System On Programmable Chip (SOPC)
  - Practical training (e.g. MP3 streaming via Ethernet with Intel FPGA Cyclone IV)
- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

report

- Medienformen

- Empfohlene Literatur

- Gessler, Mahr: Hardware-So\ware-Codesign. Vieweg Verlag

- Hwang: Digital Logic and Microprocessor Design with VHDL. Thomson Verlag - Chu: Embedded SoPC Design with Nios II Processor and VHDL Examples. Wiley Verlag

19 Advanced Design Engineering for Medical Products - Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Trommler

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

The student will:

 Basic concepts and methods of computer-assisted medicine: technical and structural basics discussed, procedures and methods of simulation, planning and intraoperative implementation in the medical environment, concrete systems.

 Teaching of a basic methodological understanding of surgery-assisting systems, development of the ability to design one's own systems.

- Inhalt des Moduls

- 1. Introduction to Engineering in Vision and Ophthalmology: Overview of the module, objectives, and expectations. Importance of biomedical engineering in addressing clinical needs in ophthalmology. Historical context and evolution of tools for vision impairment.
- 2. Ocular Anatomy and Physiology: In-depth study of ocular anatomy. Understanding the physiological aspects of the eye. Significance of anatomical knowledge in tool development.
- 3. Ophthalmic Imaging Technologies: Overview of various imaging technologies used in ophthalmology. In-depth study of optical coherence tomography and other advanced imaging methods.
- 4. Diagnostic Techniques in Ophthalmology: Understanding cutting-edge diagnostic techniques. Application of diagnostic tools in clinical settings. Case studies on successful diagnostic approaches.
- 5. Therapeutic Techniques in Ophthalmology: Overview of advanced therapeutic techniques. Integration of biomedical engineering principles in treatment methods. Case studies.
- 6. Lasers in Ophthalmology: Application of various lasers in ophthalmic pathologies. Laser safety and laser safety regulations.
- 7. Basics of Fiber Optics and Fiber Sensors: Fundamentals of fiber optics and their applications in medical imaging. Introduction to fiber sensors and their role in Ophthalmological devices.
- 8. Industrial Trends in Ophthalmological Devices: Exploration of current trends in industrially used Ophthalmological devices. Guest lectures from industry experts. Discussion on emerging technologies, including virtual reality.

- 9. Optional: Wet-lab in Halle University Hospital if possible.

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

Written exam (120 min) or oral Exam (20 min)

- Medienformen

Seminar based teaching, assignments comprising building mock-ups, visual prototypes or similar in groups and peer reviewing the outputs.

- Empfohlene Literatur

Clinical Anatomy of the Eye, Richard S. Snell and Michael A. Lemp

Ophthalmic Medical Devices: Diagnostic Equipment and Surgical Instruments, Ashok Garg and Jorge L. Alió.

20 Medical Product Development!!! Modul-Nr. ()

- Modulverantwortliche/r

Dr. Aganoglu

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Students have knowledge of the content of the Biomedical Engineering degree program. You have basic skills in dealing with subject-specific literature, measuring instruments and software. The aim is to provide students with a guideline on the interrelationships between the individual subjects of the programme. In joint events with students of the BME master's program, an outlook on current research topics in biomedical engineering is given. Planning and implementation of development work and development processes in various medical technology industries.

- Inhalt des Moduls

  - Introduction to the general development processes of biomedical engineering (planning/development/manufacturing/testing/approval)
  - Regularization, laws, regulations, etc. for the development of MP • Familiarization with and application of selected technical standards for MP development
  - Development of functional and requirement specifications for MP (incl. exercises) "Reverse" engineering technologies their meaning, application and implementation (incl. pract. Exercises) Contents
  - Exemplary development of a biomedical device from idea to realization
  - Information, selection, special requirements and the design of special BE and BG for the development of MP from different technological fields (sensors, actuators, electronics, classical electrical engineering, control technology, pneumatics, hydraulics, etc.)
  - Dealing with literature (reference books, data sheets, application notes)

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

21 Internship !!!- Modul-Nr. ()

- Modulverantwortliche/r

All Prof. in Biomedical Engineering

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits for 4 weeks consecutively, 12 credits for 8 weeks (4 weeks consecutively)

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

The purpose of the internship is to improve vocational preparation by acquiring practical skills (preferably) in a company or in an institution corresponding to the study objective. As part of the internship, students gain practical experience, achieve results in translating theory into practice and gain motivation and orientation for the subsequent stages of study. As a rule, the internship is not completed at the university. Supervision by the university (mentor) is ensured. The students apply the knowledge they have acquired so far to a specific work task, discuss different possible solutions and consolidate independent working methods and social skills. As part of the term paper for the internship, students practice how to design and structure scientific papers. The students provide proof that they can independently work on and defend a given task. This includes both content-related (theoretical) aspects and practical (analytical) skills.

- Inhalt des Moduls
  - In the course of the internship, students apply the competencies (knowledge, skills, skills) they have acquired so far during their studies to a specific problem to be agreed with the company supervisor and the university supervisor. For this purpose, a project-like task has to be worked on using engineering methods. The topics for the term paper for the internship are issued by the supervising company or, in individual cases, can also be asked and worked on internally in the department. The supervising professor accompanies the students during the processing time. The internship module is concluded with a written elaboration (term paper on the internship) as well as a presentation to the university.

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

- Medienformen

- Empfohlene Literatur

22 Entrepreneurship- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Fussan

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Course participants obtain:

An understanding about the importance of entrepreneurship and the small business sector in a broad economic and social perspective and to analyse the environment in which entrepreneurs operate.

Investigate the relevance of strategic management in the creation and planning of the entrepreneurial small business.

Furthermore the diversity of small business types is explored, including start-ups, franchises, buying a business and the legal forms. This analysis is undertaken from an international perspective.

Evaluate how entrepreneurial businesses work in practice, focusing on the development, growth and exit stages through key functions of managing people, resources, marketing and capital and evaluate the business opportunities, analyse the feasibility and develop business plans in an international business environment.

- Inhalt des Moduls

- 1. Understanding small business and entrepreneurship
- 1.1 Small business in the economy
- 1.2 Entrepreneurshp, the entrepreneur and the owner-manager

- 1.3 The small business and entrepreneurial environment
- 1.4 Innovation and the marketplace
- 1.5 Information and support
- 2 Creating the entrepreneurial small business
- 2.1 Business planning
- 2.2 Successful small business strategies
- 2.3 Start-ups and franchises
- 2.4 Buying an existing business
- 2.5 Forming and protecting a business
- 3 Managing the entrepreneurial small business
- 3.1 Management of people and resources
- 3.2 Marketing
- 3.3 Money
- 3.4 Business exists and realizing value

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

written Exam (120 min)

- Medienformen

 Lecture

 Practice/exercises

 Discussions with entrepreneurs

 Group work

 Application of modern media

 Self-study

- Empfohlene Literatur

Bygrave, W., Zacharakis, A., Entrepreneurship, Wiley & Sons,

2010, 2nd Edition,

Chaston I. 'Entrepreneurial Management in Small Firms'. Sage

Publications, 2009.

Drucker, P., Innovation & Entrepreneurship, Harper Business,

Reprint 2006.

Morris M., Kuratko D., Cavin G. 'Corporate Entrepreneurship

and Innovation'. Cengage Learning, 2010, 3rd ed.

Ramirez R., Selsky J., der Heijden K., Cable V. 'Business

Planning for Turbulent Times'. Routledge, 2010, 2nd ed.

Stoke, D., Wilson, N.: Small business management

entrepreneurship, 5th Edition, Thomson, 2006.

23 Management for Engineers !!!!- Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Fussan

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

24 German for professional practice 1!!!- Modul-Nr. ()

- Modulverantwortliche/r

- Modultyp

☒ Pflichtmodul ☐ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

25 German for professional practice 2!!!- Modul-Nr. ()

- Modulverantwortliche/r

- Modultyp

☒ Pflichtmodul ☐ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur

26 Contemporary Topics !!!- Modul-Nr. ()

- Modulverantwortliche/r

All Prof. in Biomedical Engineering

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation

Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

Appreciation of some of the major biomedical engineering problems facing the world today.

Understanding the major factors contributing to a particular biomedical engineering issue.

Understanding of research in selected areas of biomedical engineering to the limits of current knowledge.

- Inhalt des Moduls

Aim:

- To expose students to a range of topics in contemporary research across biomedical engineering.
- To develop skills in analysis of problems in contemporary areas of biomedical engineering, including drawing conclusions and making recommendations on how to best to tackle these problems.
- To communicate findings and conclusions through various media.

Introduction to the task; workshops in identifying the problem, and acquiring relevant information.

Seminars in topics related to analysing the problem and making recommendations for possible solutions.

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min) or written exam (120 min)

- Medienformen

Presentation, blackboard

- Empfohlene Literatur

27 Biomedical & Scientific Computing !!!! - Modul-Nr. ()

- Modulverantwortliche/r

Prof. Dr. Bracio

- Modultyp

☐ Pflichtmodul ☒ Wahlpflichtmodul

- ECTS-Leistungspunkte (Credits)

6 Credits

- Lehr- / Lernformen und Workload

140 hours in total, of which 45 in presence and 75 self-study and 20 h Exam preparation
Autonomous work: Literature research, scientific work on the topic, slides and presentation.

- Teilnahmevoraussetzungen

no

- Lernziele / Kompetenzen (Learning Outcomes)

- Inhalt des Moduls

-

- Voraussetzung für die Zulassung zur Modulprüfung (Prüfungsvorleistung)

no

- Prüfungsart und -dauer

oral Exam (20 min)

- Medienformen

- Empfohlene Literatur