TECHNISCHE HOCHSCHULE LÜBECK

Module Catalog

Medical Microtechnology, Master

State: 17.06.2025

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TECHNISCHE HOCHSCHULE LÜBECK

Medical Microtechnology, Master

1st Semester of Studies

Module: Medical Technology

Level	Master	**Short Name**	MT
Responsible Lecturers	Prof. Dr.-Ing. Stefan Müller		
Department, Facility	Applied Natural Sciences		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	8
Semester of Studies	1	**Semester Hours per Week**	6
Length (semesters)	1	**Workload (hours)**	240
Frequency	WiSe	**Presence Hours**	90
Teaching Language	English	**Self-Study Hours**	150

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Written Exam	**Exam Language**	English
Exam Length (minutes)	90	**Exam Grading System**	One-third Grades

Learning Outcomes	• Students have basic knowledge in medicine • They are able to communicate with physicians adequately • They have an overview about the most important physiological parameters and the according sensor principles to measure them • They are able to describe and analyze physiological systems in form of electrical equivalent circuits • They know the function and application of modern medical devices for diagnosis and therapy • Knowing of the function and practice of the main medical devices.
Participation Prerequisites	Basic knowledge in physics, mathematics and engineering sciences is advisable

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering, Medical Microtechnology, Mechanical Engineering
Remarks	None

Module Course: Medical Technology

(of Module: Medical Technology)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	6
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	180
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	120
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Medical Terminology, major organ systems, generation of bioelectrical potentials, a generalized medical instrument, system-transfer function • Measurement of flow, flow sensors, examples • Measurements of the respiratory system, physiology, instruments • Body temperature and temperature sensors • Bioelectrodes and biopotential • ECG (Eindhoven, Goldberger, Wilson), 3D Projection • Bioinstrumentation amplifiers, noise, electrical field, shielding, driven right leg concept • Pumps: Infusion, perfusion, insulin pumps, safety concepts • Cardiac pacemakers and defibrillators • Use of models and equivalent circuits • Exercises for the examination
Literature	John G. Webster, *„Medical Instrumentation"*, 3rd edition, Wiley and Sons, ISBN 978-0471153689, 1997.
Remarks	None

Module Course: Medical Technology - Lab

(of Module: Medical Technology)

Course Type	Practical Training	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	2
Participation Limit	25	**Semester Hours per Week**	2
Group Size	2	**Workload (hours)**	60
Teaching Language	English	**Presence Hours**	30
Study Achievements ("Studienleistung", SL)	Practical Training	**Self-Study Hours**	30
SL Length (minutes)	90	**SL Grading System**	One-third Grades

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Compulsory experiments • Lung function • ECG • Infusion and Perfusion
Literature	Hand-out, lab descriptions
Remarks	Two lab reports have to be handed in

Module: Medicine

Level	Master	**Short Name**	
Responsible Lecturers	Prof. Dr. rer. nat. Dagmar Willkomm Prof. Dr. med. Dipl.-Ing. (FH) Hans-Jürgen Grein		
Department, Facility	Applied Natural Sciences		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	8
Semester of Studies	1	**Semester Hours per Week**	8
Length (semesters)	1	**Workload (hours)**	240
Frequency	WiSe	**Presence Hours**	120
Teaching Language	English	**Self-Study Hours**	120
The following section is filled only if there is **exactly one** module-concluding exam.			
Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			
The previous section is filled only if there is **exactly one** module-concluding exam.			
Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)		
Applicability	Biomedical Engineering, Medical Microtechnology		
Remarks	None		

Module Course: Anatomy and Physiology

(of Module: Medicine)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	4
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	120
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	60
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type	Written Exam	**Exam Language**	English
Exam Length (minutes)	90	**Exam Grading System**	One-third Grades

Learning Outcomes	The students shall acquire a basic understanding of all tissues and organs structures and functions. They should get to know the commonly used terms, the basic principles of medical thinking, diagnostics and therapy. They shall be able to relate to the single tissues and organs productivities and to under what circumstances these can be limited. In addition, they shall learn about the principles to support and replace damaged tissues and organs. The students also acquire knowledge of the physiological regulation of the most important functions within the human body as well as the application of current technical diagnostic and therapy methods in clinical medicine
Participation Prerequisites	None

The previous section is filled only if there is a course-specific exam.

Contents	Basic knowledge in anatomy, cytology and histology
	
	Overview on the main organ systems: Skeletal and muscle systems, respiratory tract, gastrointestinal tract, urogenital tract, central and peripheral nervous systems, blood and defense system
	
	Examples are given concerning wide-spread diseases like infections, diabetes, malfunctions of heart, lungs and kidney and mechanical injuries:
	
	1. The cardiovascular system
	  1. Heart
	  2. Circulation system
	2. General neurophysiology and sensory system
	  1. General neurophysiology
	  2. Sensory system

	3. Brain function and regulation of hormonal feedback control systems
	   1. Brain function
	   2. Hormonal feedback control systems
	4. Motor system
	5. Respiration
	6. Kidneys
	7. Gastrointestinal tract and digestion
	8. Energy metabolism and nutrition

Literature	Waugh, A. Grant, *„Anatomy and Physiology in Health and Illness”*, Elsevier, 2018. R. Drake, A. Wayne Vogl, A. Mitchell, *„Gray's Anatomy for students”*, Churchill Livingstone, 2009.
Remarks	None

Module Course: Microbiology and Hygiene

(of Module: Medicine)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	4
Participation Limit		**Semester Hours per Week**	4
Group Size	25	**Workload (hours)**	120
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)	Presentation	**Self-Study Hours**	60
SL Length (minutes)	20	**SL Grading System**	One-third Grades

The following section is filled only if there is a course-specific exam.

Exam Type	Portfolio Exam	**Exam Language**	English
Exam Length (minutes)		**Exam Grading System**	One-third Grades
Learning Outcomes	The students get acquainted with basic knowledge of microbiology and hygiene. A major focus is on medical microbiology and infections, which can occur when using medical technology products. In addition, students learn basics about sampling techniques, about the hygienically correct handling of potentially contaminated materials and about the avoidance of contamination by technical staff.		
Participation Prerequisites	None		

The previous section is filled only if there is a course-specific exam.

Contents	Basic knowledge of bacteriology, mycology, virology and immunology with an insight into diagnostics in medical microbiology and test systems used. A further focus is on transmission of disease, especially with regard to pathogens in hospitalized patients. In this context, also hygiene of air and water as well as methods of disinfection and sterilization are covered and experimentally explored.
Literature	Goering et al., *„Mims' Medical Microbiology"*, 5th ed. Elsevier, 2012.
Remarks	A presentation has to be held

Module: Natural Science

Level	Master	**Short Name**	
Responsible Lecturers	Dr.-Ing. Robert Wendlandt (UKSH) Prof. Dr. sc. nat. Max Urban		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	4
Semester of Studies	1	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	120
Frequency	WiSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	60

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Portfolio Exam	**Exam Language**	English
Exam Length (minutes)		**Exam Grading System**	One-third Grades
Learning Outcomes	• The students are able to analyze simplified models of the human musculoskeletal system for static joint loads. • The students are able to characterize different tissue types in the scope of orthopedic biomechanics. • The students are able to characterize the most important biomaterials used in joint arthroplasty for tissue reaction and wear properties. • Students are able to discuss the basics of the application of physical models and methods to biological/medical systems. • Students are able to explain how oxygen for metabolism comes to the cells, blood flow, lungs, alveoli's, gas law • Students understand concepts of electrical signals in nerve cells of human body • Students understand how to measure and use magnetic fields in the context of the human body		
Participation Prerequisites	None		

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering, Medical Microtechnology, Mechanical Engineering
Remarks	

Module Course: Biomechanics

(of Module: Natural Science)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	2
Participation Limit		**Semester Hours per Week**	2
Group Size		**Workload (hours)**	60
Teaching Language	English	**Presence Hours**	30
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	30
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Basic static mechanics and elasto-statics • Biomechanics of the human locomotive system • Properties of biomaterials in orthopedics • Artificial joints
Literature	Paul Brinckmann, W. Frobin, G. Leivseth (Hrsg.), „Orthopedic biomechanics", Thieme, 2015.
Remarks	None

Module Course: Biophysics

(of Module: Natural Science)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	2
Participation Limit	60	**Semester Hours per Week**	2
Group Size	10+	**Workload (hours)**	60
Teaching Language	English	**Presence Hours**	30
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	30
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Application of physical models and methods to/for • Liquid and gas flow in the human body (e.g. transport of Oxygen to Mitochondria for ATP production) • Electrical and magnetic interactions in/with biological systems (concept of ATP to enable action potential in cells) • Diagnostic medical devices/ application as ECG, EMG, MEG and MRI
Literature	William C. Parke, „Biophysics: A Student's Guide to the Physics of Life Sciences and Medicine ", ISBN 978-3-030-44145-6, Springer, 2020. Paul A. Tipler, „Physics for Scientists and Engineers", ISBN 978-1-4292-0265-7, 2007.
Remarks	None

Module: Programming Workshop

Level	Master	**Short Name**	PRO
Responsible Lecturers	Prof. Dr. rer. nat. Tim Jürgens		
Department, Facility	Applied Natural Sciences		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	4
Semester of Studies	1	**Semester Hours per Week**	2
Length (semesters)	1	**Workload (hours)**	120
Frequency	WiSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	60
The following section is filled only if there is **exactly one** module-concluding exam.			
Exam Type	Written Exam	**Exam Language**	English
Exam Length (minutes)	90	**Exam Grading System**	One-third Grades
Learning Outcomes	• The students are able to solve basic programming exercises using MATLAB • The students know the syntax of the script language MATLAB • The students can apply a research-oriented task towards digital implementation with MATLAB • The students are able to use multiple ways of data visualization using MATLAB • The students understand basic concepts of signal processing with MATLAB-realized algorithms		
Participation Prerequisites	None		
The previous section is filled only if there is **exactly one** module-concluding exam.			
Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)		
Applicability	Biomedical Engineering, Medical Microtechnology		
Remarks	None		

Module Course: Programming Workshop

(of Module: Programming Workshop)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	4
Participation Limit	25	**Semester Hours per Week**	2
Group Size	2	**Workload (hours)**	120
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	60
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Datatypes • Basic built-in MATLAB functions • Matrices and vectors • Basic and advanced plotting tools • Switch- and if-statements, for- and while-loops • Boolean operators • Cell and struct arrays
Literature	S. Eshkabilov, *„Beginning MATLAB and Simulink: From Novice to Professional “*, Apress publishing, 2019. T. Lyche, *„Exercises in Computational Mathematics with MATLAB (Problem Books in Mathematics)”*, Springer publishing, 2014. E. Tzvi, S. Oung, *„MATLAB introduction“*, electronic lecture manuscript, 2017.
Remarks	None

Module: System Theory

Level	Master	**Short Name**	SYSTHEO
Responsible Lecturers	Prof. Dr. rer. nat. Thorsten M. Buzug (UzL) Prof. Henrik Botterweck		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	6
Semester of Studies	1	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	180
Frequency	WiSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	120
The following section is filled only if there is **exactly one** module-concluding exam.			
Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			
The previous section is filled only if there is **exactly one** module-concluding exam.			
Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)		
Applicability	Biomedical Engineering, Medical Microtechnology		
Remarks	None		

Module Course: Signals and Systems

(of Module: System Theory)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	3
Participation Limit	120	**Semester Hours per Week**	2
Group Size		**Workload (hours)**	90
Teaching Language	English	**Presence Hours**	30
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	60
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes	• Students can create an overview of the signal processing chain for medical imaging. • They can explain the mathematical background of the reconstruction of CT images. • They can explain the basics of the physical relationships regarding X-rays. • They can enumerate the different generations of computer tomographs and explain differences. • They can apply the Fourier transform. • They can reproduce and explain the mathematical principles of two-dimensional reconstruction of CT images. • They can apply the algebraic approach to solving a reconstruction problem. • They can apply the static approach to solving a reconstruction problem. • They can highlight the differences between two-dimensional reconstruction and three-dimensional reconstruction. • They can sketch the transition from two-dimensional reconstruction to three-dimensional reconstruction.
Participation Prerequisites	None

The previous section is filled only if there is a course-specific exam.

Contents	• Signal processing (recapitulation of fundamental principles in signal processing) • Mathematical methods in image reconstruction and signal processing • X-Ray (fundamental principles, quantum statistics)

	• Computed Tomography (devices, current and past technology, signal processing, Fourier-based 2D and 3D image reconstruction, algebraic and statistical image reconstruction, image artifacts, technical and clinical applications, dose)
Literature	T. M. Buzug, *„Computed Tomography, From Photon Statistics to Modern Cone Beam CT“*, Springer-Verlag, Berlin/Heidelberg, 2008. T. M. Buzug, *„Einführung in die Computertomographie - Mathematisch-physikalische Grundlagen der Bildrekonstruktion“*, Springer-Verlag, Berlin/ Heidelberg, 2004.
Remarks	None

Module Course: Numerical Methods

(of Module: System Theory)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	3
Participation Limit		**Semester Hours per Week**	2
Group Size		**Workload (hours)**	90
Teaching Language	English	**Presence Hours**	30
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	60
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type	Written Exam	**Exam Language**	English
Exam Length (minutes)	90	**Exam Grading System**	One-third Grades
Learning Outcomes	The students are aware of typical numerical effects when solving engineering problems. They can map reasonable complex real-world situations to a mathematical model. They know of typical approaches toward a solution. They may use basic mathematical techniques as working tools.		
Participation Prerequisites	None		

The previous section is filled only if there is a course-specific exam.

Contents	Numerical error propagation. Stability and condition. Linear systems. Basic differential equations. Eigenvector decomposition. Ill-posed problems. Basic statistical distributions. Maximum likelihood approaches.
Literature	*„Introduction to numerical methods“*, MIT OpenCourseWare 2019: Frank C. Hoppensteadt and Charles Peskin, *„Modeling and simulation in medicine and the life sciences“*, Springer, 1992.
Remarks	None

TECHNISCHE HOCHSCHULE LÜBECK

Medical Microtechnology, Master

2nd Semester of Studies

Module: Cleanroom Microfabrication

Level	Master	**Short Name**	CMF
Responsible Lecturers	Associate Professor PhD Jakob Kjelstrup-Hansen (SDU)		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	5
Semester of Studies	2	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes

Knowledge

- The knowledge of the basics of a cleanroom, the working procedures, and the safety aspects.
- The knowledge of the structure and properties of silicon and the reason for its large prevalence.
- The knowledge of photolithography and of the steps in the photolithographic process.
- The understanding of the process of formation of silicon dioxide by thermal oxidation.
- The knowledge of the most commonly used chemical and physical vapor deposition techniques incl. their operation principles and of which types of materials that can be deposited.
- The knowledge of the most commonly used wet and dry etching methods and their pros and cons.

Skills

- The ability to use a theoretical model to predict the resulting layer thickness of a silicon dioxide layer made by thermal oxidation.

The ability to experimentally carry out a simple process recipe using the most common microfabrication techniques.

Participation Prerequisites: None

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues

✔ Use of gender-neutral language (THL standard)

✘ Target group specific adjustment of didactic methods

✘ Making subject diversity visible (female researchers, cultures etc.)

Applicability	Biomedical Engineering, Medical Microtechnology
Remarks	None

Module Course: Cleanroom Microfabrication

(of Module: Cleanroom Microfabrication)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	5
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	150
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	90
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	The objective of this course is to make the students familiar with the concepts, materials and methods typically used in a microfabrication process. The specific topics are: • Cleanroom technology • Silicon Crystal structure • Wafer types and properties (sizes, crystal orientations, doping type and concentration)
Literature	• J. D. Plummer et al., *„Silicon VLSI Technology - Fundamentals, Practice, and Modeling “*, Prentice-Hall (Pearson), 2000. S. Franssila, *„Introduction to Microfabrication“*, 2nd edition, Wiley, 2010.
Remarks	None

Module: Clinical Application and Regulatory Affairs

Level	Master	**Short Name**	CARA
Responsible Lecturers	Associate Professor PhD Till Leissner (SDU) Prof. Dr. sc. hum. Folker Spitzenberger		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	5
Semester of Studies	2	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	90
Teaching Language	English	**Self-Study Hours**	60
The following section is filled only if there is **exactly one** module-concluding exam.			
Exam Type	Portfolio Exam	**Exam Language**	English
Exam Length (minutes)		**Exam Grading System**	One-third Grades
Learning Outcomes	Knowledge • The students understand the basic principles of imaging techniques and image analysis methods relevant for clinical applications. • The students have knowledge about the regulatory guidelines for medical devices. Skills • The students are able to write a project formulation. • The students are able to develop a work plan to solve the given problem. • The students are able to choose relevant experimental techniques. • The students are able to plan, to setup an experiment. • The students can conduct experimental work and data analysis. • The students are able to document their work. • The students are able to present the results to a clinical/industrial partner. • The students are able to conduct project work in teams. • The students are able to reflect on regulatory limitations in project development. Competences • The students are able to work in teams. • The students are able to communicate with a client / external partner • The students are able to present their project work and the results.		

Participation Prerequisites	Basic knowledge in medical technology, application of medical products and quality management.
The previous section is filled only if there is **exactly one** module-concluding exam.	
Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering, Medical Microtechnology, Mechanical Engineering
Remarks	None

Module Course: Clinical Application

(of Module: Clinical Application and Regulatory Affairs)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	3
Participation Limit		**Semester Hours per Week**	2
Group Size		**Workload (hours)**	90
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)	(Flexible)	**Self-Study Hours**	30
SL Length (minutes)		**SL Grading System**	One-third Grades

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Clinical sample preparation methods • Basic principles of image analysis, computational imaging and artificial intelligence for image analysis. • Lab-based imaging of biological samples with optical and non-optical methods. Clinical imaging of biological samples
Literature	Will be provided during the lectures.
Remarks	None

Module Course: Regulatory Affairs

(of Module: Clinical Application and Regulatory Affairs)

Course Type	Lecture	**Form of Learning**	Online supported
Mandatory Attendance	no	**ECTS Credit Points**	2
Participation Limit	60	**Semester Hours per Week**	2
Group Size	10+	**Workload (hours)**	60
Teaching Language	English	**Presence Hours**	30
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	30
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Requirements and procedures concerning CE-marking and quality management system certification according to the EU-Legislation based on New Approach 100a-directives. • Relevant directives addressing Medical Devices and comparison with US approval schemes. • Third party inspection/surveillance in EU and corresponding requirements in the USA and other markets. • Essential Requirements for safety and effectiveness, classification and conformity assessment procedures for medical devices. • Clinical evaluation and investigation • Application of risk management requirements and procedures to medical devices. • Implementing adverse event reporting, recalls and corrective/ preventive actions in post market surveillance systems in the EU and in the USA. Technical files and the role and use of Harmonized European standards for the certification and CE-marking. Requirements regarding Instructions for use and marking on the device.
Literature	Hand-out, RL 93/42/EG, 21 CFR 803, 806 und 820
Remarks	None

Module: Computational Multi-Physics

Level	Master	**Short Name**	CMP
Responsible Lecturers	Associate Professor PhD Jost Adam (SDU)		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	10
Semester of Studies	2	**Semester Hours per Week**	8
Length (semesters)	1	**Workload (hours)**	300
Frequency	SuSe	**Presence Hours**	120
Teaching Language	English	**Self-Study Hours**	180

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes

Knowledge - The students can

- account for the governing equations for the most common physical phenomena encountered in mechatronic systems.
- account for different methods for the numerical solution of the governing equations,
- critically discuss the main advantages and drawbacks of the methods
- verify the results and evaluate convergence (i.e. consistency and stability) for the different methods.

Skills - The students can

- derive governing equations for mechatronic systems based on basic principles.
- implement different methods for the numerical solution of standard partial differential equations.
- check for convergence of the solutions, using standard mathematical tools such as Matlab® and Comsol®.
- Competences - The students can
- work independently acquiring necessary skills to solve a given problem
- convey the acquired knowledge and skills to an appropriate audience.

describe the mathematical model for a specific problem and document the implementation and numerical solution of the problem.

Participation Prerequisites

Physics and mathematics at a bachelor degree level, basic numerical analysis and programming skills

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering, Medical Microtechnology
Remarks	None

Module Course: Computational Multi-Physics

(of Module: Computational Multi-Physics)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	10
Participation Limit		**Semester Hours per Week**	8
Group Size		**Workload (hours)**	300
Teaching Language	English	**Presence Hours**	120
Study Achievements ("Studienleistung", SL)	Presentation	**Self-Study Hours**	180
SL Length (minutes)	20	**SL Grading System**	Participation

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	• Description of selected physical problems within mechatronics by partial differential equations (PDEs). • Implementation and application of various numerical methods (e.g. finite-difference time-domain and finite-element methods) to general problems described by partial differential equations. • Verification, accuracy and feasibility analysis of the developed numerical solutions. • Application of commercial finite element software (Comsol Multiphysics®) to general one to three dimensional problems. • Appropriate result communication and presentation
Literature	• M. G. Larson and F. Bengzon, *"The Finite Element Method: Theory, Implementation and Application"*, Springer (2013). Material provided in class
Remarks	None

Module: Experimental Optical Spectroscopy

Level	Master	**Short Name**	EOS
Responsible Lecturers	Associate Professor PhD Jakob Kjelstrup-Hansen (SDU)		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory elective	**ECTS Credit Points**	5
Semester of Studies	2	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes

Profound knowledge of the basis of the field of optics and physics of lasers and their unique properties and potential for applications in optical spectroscopy and material analysis.

The knowledge of the fundamentals of physical optics and optical high-resolution optical microscopy.

The ability to:

- design and construct simple optical systems
- estimate diffraction-limited imaging performance
- explain optical diagrams
- explain the main factors of laser beams: monochromaticity, collimation, and propagation.
- explain and use the most basic principles of laser physics and laser spectroscopy
- apply laser light in spectroscopic experiments

Competences:

- in solving realistic optical problems
- in developing applications using basic and advanced optical components
- critically discuss the strengths and weaknesses of various types of spectroscopy and their application to real-world analytical challenges

critically analyse spectroscopic literature, understand experimental data and report their findings to their peers.

Participation Prerequisites	None

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering, Medical Microtechnology
Remarks	None

Module Course: Experimental Optical Spectroscopy

(of Module: Experimental Optical Spectroscopy)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	5
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	150
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	90
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites	None		

The previous section is filled only if there is a course-specific exam.

Contents	• Geometrical, Instrumental and Wave Optics • Light-mater interaction • Optical Spectroscopy • Linear and Nonlinear Optics • Optical Microscopy and Sensing Explains the fundamentals of physical and geometrical optics as well as optical spectroscopy, in sufficient depth to enable students to solve realistic problems. Finally, it addresses the importance of the measurement and quantification of light in optical systems, covering radiometry, photometry and optical detection. It also introduces basic concepts of nonlinear optics.
Literature	• Hecht, E: Optics, Addison-Wesley. Modern Spectroscopy 4th edition, J. Michael Hollas, John Wiley & Sons
Remarks	None

Module: Microtechnology and Device Fabrication

Level	Master	**Short Name**	MDF
Responsible Lecturers	Associate Professor PhD Jakob Kjelstrup-Hansen (SDU)		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory elective	**ECTS Credit Points**	5
Semester of Studies	2	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes	The student will acquire knowledge on: • The basic components in MEMS/NEMS, their design and operational principles, as well as potential MEMS/NEMS applications. • The basic components in microfluidics, their operational principles, as well as potential applications of microfluidic systems. • The basic back-end processing and electrical characterization techniques. • The operational principles of electron beam lithography, nanoimprint lithography and focused ion beam. The student will be able to: • Select relevant process parameters based on underlying theory and/or process simulation tools. • Design a set of photolithography masks based on desired design specifications. • Use device simulation (finite element modeling) software to aid in the design process.Calculate the behavior of simple mechanical structures, e.g. cantilevers and membranes. Design a dose pattern for EBL that includes proximity effect correction.
Participation Prerequisites	Knowledge of basic microfabrication technologies

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)

Applicability	Biomedical Engineering, Medical Microtechnology
Remarks	None

Module Course: Microtechnology and Device Fabrication

(of Module: Microtechnology and Device Fabrication)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	5
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	150
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	90
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Microsystems are small systems built from a number of functional parts, for example: electronics, mechanics, optics, and/or microfluidics. All or most parts are fabricated partly or fully using microfabrication technology and they form a single entity. A hearing aid and a lab-on-a-chip are examples of such systems. In every modern car you will find a number of microsystems, for instance the air-bag accelerometer for the air bag control. The aim of this course is to make the students able to design, fabricate, and characterize microsystems. The specific topics are: • Introduction to microsystems. • Microfabrication techniques incl. process simulation. • Process integration. • Lithography mask lay-out (exercise using lay-out CAD software). • Nanolithography techniques. • MEMS and NEMS. • Microfluidics. • Back-end processing. • Characterization techniques
Literature	Scripts
Remarks	None

Module: Optics for Engineers

Level	Master	**Short Name**	OE
Responsible Lecturers	Associate Professor PhD Jacek Fiutowski SDU)		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	5
Semester of Studies	2	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes	Knowledge • Profound knowledge of the basis of the field of optics • The knowledge of the fundamentals of physical and geometrical optics Skills • The ability to design and construct simple optical systems • The ability to compute the image properties: size, location, fidelity, brightness • The ability to estimate diffraction-limited imaging performance • The ability to explain optical diagrams • The ability to compute the spectral distribution of a source • The ability to describe the difference between photon and thermal detectors The ability to explain the main factors of laser beams: monochromaticity, collimation, and propagation. Competences • The ability to solve realistic optical problems The ability to developed applications using basic optical components
Participation Prerequisites	None

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)

Applicability	Biomedical Engineering, Medical Microtechnology
Remarks	None

Module Course: Optics for Engineers

(of Module: Optics for Engineers)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	5
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	150
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)	(Flexible)	**Self-Study Hours**	90
SL Length (minutes)		**SL Grading System**	One-third Grades

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Geometrical and instrumental optics
Literature	• Charles A. DiMarzio, *"Optics for Engineers"*, 2011 by CRC Press • F. L. Pedrotti, S. J. Pedrotti, L. M. Pedrotti, L. S. Pedrotti: *"Introdution to Optics"*, Pearson, 1987. • M. V. Klein and T. E. Furtak: *"Optics"*, John Wiley and Sons, 1986. E. Hecht, *"Optics"*, Addison-Wesley, 2002.
Remarks	None

Module: Summer School

Level	Master	**Short Name**	SS
Responsible Lecturers	Associate Professor PhD Jacek Fiutowski (SDU)		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory elective	**ECTS Credit Points**	5
Semester of Studies	2	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Oral Exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	One-third Grades

Learning Outcomes

The main objective is to learn the principles and applications of various medical device types and imaging techniques. This includes the design, modelling, fabrication and characterization of microfluidic chips, the development of optical analysis systems, as well as different imaging techniques with applications within the medical field.

Knowledge - The students should have

- An understanding of the basic physics of fluids
- An understanding how to run a simulation and apply results in practice
- A comprehension of the fundamentals of microfluidic sensing
- An understanding of fabrication process steps for microfluidic systems
- An understanding of proper microfluidic chip layout and functions
- An understanding basics of 3D scanning and 3D model metrology
- An understanding of the most common optical and non-optical imaging techniques for medical applications
- An understanding of spectroscopy techniques and instrumentation and awareness of the challenges in optical analysis of biological tissue
- An understanding the principles of magnetic particle imaging
- An understanding the realistic aspect of working in a team to fulfil a common goal.

Skills - The students should have the

- Ability to design and manufacture microfluidic chips
- Ability to analyse and interpret simulation output
- Ability to setup and test microfluidic systems

Participation Prerequisites	None

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering, Medical Microtechnology
Remarks	None

Module Course: Summer School

(of Module: Summer School)

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	5
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	150
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	90
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Microfluidics • Theory • Simulations • Protype design, realization and testing Medical devices • Optical blood analysis • Spectroscopic techniques and instrumentations • Data analysis incl. machine learning approaches Imaging techniques for medical applications • Optical and non-optical methods • Magnetic particle imaging
Literature	Will be provided during the lectures.
Remarks	None

TECHNISCHE HOCHSCHULE LÜBECK

Medical Microtechnology, Master

3rd Semester of Studies

Module: Forschungspraktikum (Research Internship)

Level	Master	**Short Name**	FPSK
Responsible Lecturers	Prof. Dr.-Ing. Stefan Müller and others		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	30
Semester of Studies	3	**Semester Hours per Week**	
Length (semesters)	1	**Workload (hours)**	900
Frequency	SuSe and WiSe	**Presence Hours**	700
Teaching Language	English	**Self-Study Hours**	200

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type		**Exam Language**	English
Exam Length (minutes)		**Exam Grading System**	Pass
Learning Outcomes	The students shall learn about the application of medical products in diagnosis as well as in therapy. The students shall experience the independent and self-reliant work on an own project. The students shall apply the methods taught in "scientific writing" Students learn how to write and submit a scientific paper. They also learn to be part of a review process.		
Participation Prerequisites	Completed Internship is necessary		

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Biomedical Engineering
Remarks	None

Module Course: Forschungspraktikum (Research Internship)

(of Module: Forschungspraktikum (Research Internship))

Course Type	Practical Training	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	24
Participation Limit		**Semester Hours per Week**	
Group Size		**Workload (hours)**	720
Teaching Language	English	**Presence Hours**	640
Study Achievements ("Studienleistung", SL)	(Flexible)	**Self-Study Hours**	80
SL Length (minutes)		**SL Grading System**	Pass

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Students are working on their project. See detailed internship regulations.
Literature	None
Remarks	Minimum 16 weeks' internship at university or in industry. A 20 to 30 page report has to be handed in.

Module Course: Studierendenkonferenz (Student Conference)

(of Module: Forschungspraktikum (Research Internship))

Course Type	Seminar	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	6
Participation Limit		**Semester Hours per Week**	
Group Size		**Workload (hours)**	180
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)	Presentation	**Self-Study Hours**	120
SL Length (minutes)		**SL Grading System**	Pass

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Students have to contribute the following to the conference: • Submission of a research paper • Submission of a poster • take part in the review-process At the conference they are supposed to • give a short presentation at the poster • present their paper in a talk
Literature	
Remarks	Presentation of internship results at the annual student conference in March on campus. There will be a paper published and a poster and talk presented. Attendance is obligatory on all three days.

TECHNISCHE HOCHSCHULE LÜBECK

Medical Microtechnology, Master

4th Semester of Studies

Module: Abschluss (Master)

Level	Master	**Short Name**	A
Responsible Lecturers	Prof. Dr.-Ing. Stefan Müller and others		
Department, Facility	(Unspecified)		
Course of Studies	Medical Microtechnology, Master		
Compulsory/elective	Compulsory	**ECTS Credit Points**	30
Semester of Studies	4	**Semester Hours per Week**	2
Length (semesters)	1	**Workload (hours)**	900
Frequency	SuSe and WiSe	**Presence Hours**	2
Teaching Language	English	**Self-Study Hours**	898
The following section is filled only if there is **exactly one** module-concluding exam.			
Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			
The previous section is filled only if there is **exactly one** module-concluding exam.			
Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✘ Target group specific adjustment of didactic methods ✘ Making subject diversity visible (female researchers, cultures etc.)		
Applicability	Biomedical Engineering		
Remarks	None		

Module Course: Abschlussarbeit (Master Thesis)

(of Module: Abschluss (Master))

Course Type	Project Work	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	26
Participation Limit		**Semester Hours per Week**	
Group Size		**Workload (hours)**	780
Teaching Language	English	**Presence Hours**	
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	780
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type	Thesis	**Exam Language**	English
Exam Length (minutes)		**Exam Grading System**	One-third Grades

Learning Outcomes	• The students shall know about the application of current medical products in diagnosis and therapy and be able to critically evaluate data and draw conclusions. • The students shall acquire consolidated knowledge of physical, electrical, and mechanical principles applied in medical products. • The students shall independently cope with a defined problem in medical technology and be able to use creativity to develop new and original ideas and methods. • The students shall be enabled to independently develop medical products according to relevant standards. • The students shall be able to present results of their work and should have a knowledge of the non-technical implications of engineering practice. • The students shall be prepared for the international labour market and should have the ability to work and communicate effectively in national and international contexts. • The students shall apply research methods.
Participation Prerequisites	All credits from 1st semester and at least 20 credits from 2nd semester.

The previous section is filled only if there is a course-specific exam.

Contents	The students work on a defined task independently and present their work in writing.
Literature	None
Remarks	None

Module Course: Abschlusskolloquium (Final oral exam)

(of Module: Abschluss (Master))

Course Type	Seminar	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	4
Participation Limit		**Semester Hours per Week**	2
Group Size		**Workload (hours)**	120
Teaching Language	English	**Presence Hours**	2
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	118
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type	Colloquium	**Exam Language**	English
Exam Length (minutes)	60	**Exam Grading System**	One-third Grades

Learning Outcomes	• The students shall know about the application of current medical products in diagnosis and therapy and be able to critically evaluate data and draw conclusions. • The students shall acquire consolidated knowledge of physical, electrical, and mechanical principles applied in medical products. • The students shall independently cope with a defined problem in medical technology and be able to use creativity to develop new and original ideas and methods. • The students shall be enabled to independently develop medical products according to relevant standards. • The students shall be able to present results of their work and should have a knowledge of the non-technical implications of engineering practice. • The students shall be prepared for the international labour market and should have the ability to work and communicate effectively in national and international contexts. • The students shall apply research methods.
Participation Prerequisites	None

The previous section is filled only if there is a course-specific exam.

Contents	The students work on a defined task independently and present their work orally.
Literature	None
Remarks	None