



Module Description

Master of Science in Biomedical Technologies

(09_10_2018)

Generated by the AG Biomedical Technologies
Study dean for Biomedical Technologies: Prof. Dr. Katja Schenke-Layland

The program for *Biomedical Technologies* with Specialization in Implantology, Nanoanalytics/Interfaces and Bioimaging consists of the following modules:

Module No.	Module Name	ECTS
	<i>Mandatory courses</i>	
AM1	<i>Biomedical Technologies in Diagnostic and Therapy I and II</i>	6
AM2	<i>Laboratory Techniques and Medical Device Approvals I and II</i>	6
AM3	<i>Clinical cases and Consequences for Medical Devices I and II</i>	6
	<i>Specialization areas (2 out of 3 specializations Implantology, Bioimaging and Nanoanalytics/Interfaces including for each specialization Lecture, Seminar and Labwork (15 ECTS in total) have to be chosen). Practical work experiences and master thesis can also be completed in industry or abroad and have to be performed within the selected specialization areas.</i>	
AS4	<i>Bioimaging</i>	15
AS4.1	<i>Bioimaging – Lecture and Seminar</i>	6
AS4.2	<i>Bioimaging – Labwork</i>	9
AS5	<i>Bioimaging – Practical work experience</i>	15
AS6	<i>Nanoanalytics/Interfaces I</i>	15
AS6.1	<i>Nanoanalytics/Interfaces I – Lecture and Seminar</i>	6
AS6.2	<i>Nanoanalytics/Interfaces I – Labwork</i>	9
AS7	<i>Implantology</i>	15
AS7.1	<i>Implantology – Lecture and Seminar</i>	6
AS7.2	<i>Implantology – Labwork</i>	9
AS8	<i>Implantology – Practical work experience</i>	15
AS9	<i>Nanoanalytics/Interfaces II</i>	15
AS9.1	<i>Nanoanalytics/Interfaces II – Lecture and Seminar</i>	6
AS9.2	<i>Nanoanalytics/Interfaces II – Labwork</i>	9
AS10	<i>Nanoanalytics/Interfaces – Practical work experience</i>	15

	<i>Elective courses (Lectures and Seminars comprising 12 ECTS in total have to be chosen: either from another specialization area, from the Master program Medical Radiation Sciences or from the Master program Medical engineering at the University of Stuttgart.)</i>	
AS4.1	<i>Bioimaging – Lecture and Seminar</i>	6
AS6.1	<i>Nanoanalytics/Interfaces I – Lecture and Seminar</i>	6
AS7.1	<i>Implantology – Lecture and Seminar</i>	6
AS9.1	<i>Nanoanalytics/Interfaces II – Lecture and Seminar</i>	6
	<u><i>Modules University of Stuttgart</i></u>	
AE11	<i>Aktorik in der Gerätetechnik</i>	6
AE12	<i>Technologien der medizinischen Bildgebung und Labordiagnostik</i>	3
AE13	<i>Interface-Design</i>	6
AE14	<i>Grundlagen der Keramik und Verbundwerkstoffe</i>	6
AE15	<i>Nanotechnologie I – Chemie und Physik der Nanomaterialien</i>	3
AE16	<i>Nanotechnologie II – Technische Prozesse und Anwendungen</i>	3
AE17	<i>Optische Systeme in der Medizintechnik</i>	6
	<u><i>Modules University of Tübingen</i></u>	
BM5.1	<i>Physik und Technologie der medizinischen Strahlenanwendung – Vorlesung</i>	3
BM8	<i>Biostatistik/Biostatistics</i>	6
BM12.1	<i>Nuklearmedizin, diagnostische und interventionelle Radiologie, Strahlentherapie – Vorlesung</i>	3
BM 15	<i>NanoBioPhysics and scanning probe microscopy</i>	3
BM17	<i>Ethical Technology Assessment and Sustainable Development</i>	3
BM18	<i>MEDTEC Innovation</i>	9
BM19	<i>Medical Ultrasound – Theory and Application</i>	3
AMT12	<i>Master Thesis</i>	30

module number: AM1 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Biomedical Technologies in Diagnostic and Therapy I and II</i>			nature of the module: compulsory
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 60 h (2 SWS per semester) self study (preparation for exams included): 120 h			
duration of the module	2 semesters			
time schedule (winter/summer term)	The module is offered once per year starting with lecture I in the winter term.			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 60 Minimum: 5			
module structure /teaching methods	lecture (4 SWS)			
contents	<u>Thematic focus:</u> Heart-lung machine, artificial respiration, anaesthetic technique, computer-assisted surgery, electromedical technique, electronic implants, rehabilitation technology, biocompatible prosthesis, biomedical laser applications			
objectives	The course provides important and up-to-date knowledge of different biomedical technologies. After completion of this module, students will be able to understand the state-of-the-art technologies, modern methodologies and open questions in selected fields of biomedical technologies.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Biomedical Technologies in Diagnostic and Therapy I	Written exam	1-5	3 ECTS
	Biomedical Technologies in Diagnostic and Therapy II	Written exam	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (mandatory course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences (elective course)			
recommended semester	1 st and 2 nd semester			
participation requirements	B.Sc. degree			
person responsible for the module	PD Dr. Martin Schenk			
teaching staff	Liese, Jan, Prof. Dr. rer. nat.			

	Gauglitz, Günter, Prof. Dr. rer. nat. Steeg, Martin, Dr. med. Hetzl, Jürgen, PD Dr. med. Braun, Christoph, Prof. Dr. med. Preißl, Hubert, PD Dr. Gummer, Anthony, Prof. Dr. med. Dalhoff, Ernst, Dr. Ing. Leitritz, Martin, Dr. med. Bende, Thomas, Prof. Dr. rer. nat. Hirt, Bernhard, Prof. Dr. med. Maschmann, Jens, Dr. med. Pauluschke-Fröhlich, Jan, Dr. med. Poets, Christian, Prof. Dr. med. Straub, Andreas, Dr. med. Konrad, Franziska, Dr. med. König, Klemens, Dr. med. Straten, Guido, Dr. med. Herkommer, Alois, Prof. Dr. rer. nat. Krause, Bernd, Dr.-Ing. Wendel, Hans-Peter, Prof., Dr. rer. nat. Stenzl, Arnulf, Prof. Dr. med. Kruck, Stephan, Dr. med.
literature / teaching materials	Texts and books will be announced at the beginning of term.

module number: AM2 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Laboratory Techniques and Medical Device Approvals I and II</i>			nature of the module: compulsory
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 60 h (2 SWS per semester) self study (preparation for exams included): 120 h			
duration of the module	2 semesters			
time schedule (winter/summer term)	The module is offered once per year starting with lecture I in the winter term.			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 60 Minimum: 5			
module structure /teaching methods	lecture (4 SWS)			
contents	<u>Thematic focus:</u> - Molecular biology, cell culture, DNA, RNA and protein isolation, molecular interactions, surface refinement, opt. spectroscopy, microsystems engineering, lab-on-a-chip, live cell imaging, FACS, electron microscopy - research methodologies, experimental design - regulatory affairs and patents			
objectives	The course provides important and up-to-date knowledge of different laboratory techniques and medical device approvals in biomedical technologies. After completion of this module, students will be able to understand the state-of-the-art technologies, modern methodologies and open questions in selected fields of regulatory affairs.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Laboratory Techniques and Medical Device Approvals I	Written exam	1-5	3 ECTS
	Laboratory Techniques and Medical Device Approvals II	Written exam	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (mandatory course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences (elective course)			
recommended semester	1 st and 2 nd semester			
participation requirements	B.Sc. degree			

person responsible for the module	Prof. Dr. Katja Schenke-Layland
teaching staff	Gauglitz, Günter, Prof. Dr. rer. nat. Weimar, Udo, Prof. Dr. rer. nat. Huhn, Carolin, Prof. Dr. rer. nat. Zeck, Anne, Dr. rer. nat. Pötz, Oliver, Dr. rer. nat. Autenrieth, Stella, Dr. rer. nat. Schäffer, Tilman, Prof. Dr. rer. nat. Wagner, Samuel, Prof. Dr. rer. nat. Bohn, Erwin, PD Dr. rer. nat. Fallier-Becker, Petra, Dr. rer. nat. Rolaufts, Bernd, PD Dr. med. Hansmann, Jan, Dr. rer. nat. Schenk, Martin, PD Dr. rer. nat. Martin, Norman Schenke-Layland, Katja, Prof., Dr. rer. nat. Wendel, Hans-Peter, Prof., Dr. rer. nat. Schnurr, Marc, Prof. Dr. rer. nat.
literature / teaching materials	Texts and books will be announced at the beginning of term.

module number: AM3 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Clinical cases and Consequences for Medical Devices I and II</i>			nature of the module: compulsory
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 60 h (2 SWS per semester) self study (preparation for exams included): 120 h			
duration of the module	2 semesters			
time schedule (winter/summer term)	The module is offered once per year starting with lecture I in the winter term.			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 60 Minimum: 5			
module structure /teaching methods	lecture (4 SWS)			
contents	<u>Thematic focus:</u> One important clinical case (patient) / lecture - necessary therapy, e.g. necessary medical device - consequences for the medical device			
objectives	The course provides important and up-to-date knowledge of different clinical cases, the medical indications and the application of medical devices. After completion of this module, students will be able to understand the most important clinical cases and evaluate the consequences, limitations and chances for medical devices.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	Exam	Grading scheme	weighting
	Clinical Cases and Consequences for Medical Devices I	Written exam	1-5	3 ECTS
	Clinical Cases and Consequences for Medical Devices II	Written exam	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (mandatory course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences (elective course)			
recommended semester	1 st and 2 nd semester			
participation requirements	B.Sc. degree			
person responsible for the module	Kirschniak, Andreas, Dr. med.			
teaching staff	Kirschniak, Andreas, Dr. med.			

	Kirschniak, Andreas, Dr. med. Enderle, Markus, Prof., Dr. med. Müller, Sven, Dr. med. Falch, Claudius, Dr. med Johannink, Jonas Wilhelm, Peter Axt, Steffen Amend, Bastian, Dr. med. Müller, Martin, Dr. med., Dr. rer. nat.
literature / teaching materials	Texts and books will be announced at the beginning of term. There is no general script.

module number: AS4.1 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Bioimaging – Lecture and Seminar</i>			nature of the module: specialization
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 56 h self study (preparation for exams included): 124 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the first half of the winter term as block course			
language (English/German)	English			
maximum/minimum number of participants	Lecture: max.: 50 Seminar: max.: 20			
module structure /teaching methods	lecture and seminar (4 SWS)			
contents	<u>Thematic focus:</u> - Image Correction - Functional MRI - Hyperpolarized MRI - Principles of Combined PET/MR Imaging - Basics of Image Reconstruction - Imaging and Metabolomics (MRI, NMR) - Advanced Tracer development and production - MR Angiography - Research in Radiochemistry - Pharmacological Modelling			
objectives	Students - get functional and methodical based competences - get theoretical knowledge about setup of experiments concerning special topics in Neurology, oncology, immunology and other diseases - learn about preparation of patients and rodents before the measurements, setup of measurements for certain needs and topics - gain insights into the image analysis tools in preclinical and clinical implementation			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	Exam	Grading scheme	weighting
	Lecture	Written/oral exam	70-100%, <70% failed	3 ECTS
	Seminar	Oral presentation (30 min presentation + 15 min discussion)	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization and elective course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences			

	(elective course) and elective course for students of M.Sc. Medical Engineering Univ. of Stuttgart), required for modules AS4.2 and AS5
recommended semester	1 st semester
participation requirements	B.Sc. degree
person responsible for the module	Pichler, Bernd, Prof., Dr. rer. nat. / Dr. Carsten Calaminus
teaching staff	Pichler, Bernd, Prof., Dr. rer. nat. Schick, Fritz, Prof., Dr. med. Dr. rer. nat. Scheffler, Klaus, Prof., Dr. phil. la Fougère, Christian, Prof., Dr. med. Bares, Roland, Prof., Dr. med. Nikolaou, Konstantin, Prof., Dr. med. Ernemann, Ulrike, Prof., Dr. med. Schmidt, Holger, PD Dr. rer. nat. Wiesinger, Benjamin, Dr. med. Angelovski, Goran, Dr. rer. nat. Reischl, Gerald, Dr. rer. nat. Pohmann, Rolf, Dr. rer. nat. Klose, Uwe Prof., Dr. rer. nat. Wehrl, Dr. Disselhorst, Dr. Maurer, Dr. Fischer, Dr. etc.
literature / teaching materials	Texts and books will be announced at the beginning of term.

module number: AS4.2 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Bioimaging – Labwork</i>			nature of the module: specialization
credit points	9 CP			
work load - contact hours (SWS) - self study	Total: 270 h contact hours: 90 h self study (preparation for exams included): 180 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the winter term as block course.			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 16 Minimum: 3			
module structure /teaching methods	Practical Training and Seminar (6 SWS)			
contents	<u>Thematic focus:</u> - Clinical application of PET and MRI, PET/MR application, imaging of special diseases - Clinical application of CT and US, deeper insight into clinical topics - Physics and technologies used in the nuclear medicine - Image acquisition methods in preclinical imaging (MRI, OI, PET, SPECT/CT): design for special experiments in clinic and preclinical setup and scanning of rodents - Clinical and Preclinical Application and Drawbacks of different MRI sequences - Research in Radiochemistry - Advanced Tracer development and production			
objectives	Students - Gain functional and practical competences of the application of the imaging methods - are part of practical demonstrations in preclinical imaging including hands-on experiences - learn animal handling procedures in preclinical imaging according to the animal protection laws - Gain practical competences in detector physics - Learn the analysis of images in clinical and preclinical studies - Gain competences to work on the clinical setup of the scanners			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Labwork	4 Experimental protocols	1-5	9 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), required for module AS5			
recommended semester	1 st semester			
participation	B.Sc. degree and successful completion of module AS4.1			

requirements	
person responsible for the module	Pichler, Bernd, Prof., Dr. rer. nat. / Dr. Carsten Calaminus
teaching staff	Pichler, Bernd, Prof., Dr. rer. nat. Schick, Fritz, Prof., Dr. med. Dr. rer. nat. Scheffler, Klaus, Prof., Dr. phil. Bares, Roland, Prof., Dr. med. Claussen, Claus, Prof., Dr. med. Ernemann, Ulrike, Prof., Dr. med. Honndorf, Valerie, Dr. rer. nat. Schmidt, Holger, PD Dr. rer. nat. Wiesinger, Benjamin, Dr. med. Angelovski, Goran, Dr. rer. nat. Reischl, Gerald, Dr. rer. nat. Pohmann, Rolf, Dr. rer. nat. Klose, Uwe Prof., Dr. rer. nat. Wehrl, Dr. Disselhorst, Dr. Maurer, Dr. Fischer, Dr. etc.
literature / teaching materials	Texts and books will be announced at the beginning of term.

module number: AS5 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Bioimaging – Practical work experience</i>			nature of the module: specialization
credit points	15 CP			
work load - contact hours (SWS) - self study	Total: 450 h contact hours: 300 h self study (preparation for exams included): 150 h			
duration of the module	1 semester, min. 6 weeks full-time and max. 10 weeks full-time			
time schedule (winter/summer term)	The module is offered once per year in the winter term as block course			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 8 Minimum: 1			
module structure /teaching methods	Practical Training			
contents	The Labwork contains a special topic which the student has to work on in theory and practice under the supervision of a scientist or medical doctor.			
objectives	The aim of the labwork is that the student develops his research skills to an independent level. After the student has learned the skills for setting up experiments and analysing the data the student should work on his own under the supervision of the scientist/medical doctor in charge. Based on this research the student should finish his/her project and write a protocol as well as give a talk. The idea of the labwork is to give the student the best preparation he/she can get for his/her master's thesis as well as to provide the student a deeper insight into the bioimaging field.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Practical Training	Written report about the internship (10-15 pages, Arial 12, single-spaced)	1-5	15 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), recommended for master's thesis in bioimaging			
recommended semester	3rd semester			
participation requirements	B.Sc. degree, passed semester 1 and 2, and successful completion of module AS4.1 and AS4.2			
person responsible for the module	Pichler, Bernd, Prof., Dr. rer. nat. / Dr. Carsten Calaminus			
teaching staff	Pichler, Bernd, Prof., Dr. rer. nat. Schick, Fritz, Prof., Dr. med. Dr. rer. nat. Scheffler, Klaus, Prof., Dr. phil. Bares, Roland, Prof., Dr. med. Claussen, Claus, Prof., Dr. med.			

	Ernemann, Ulrike, Prof., Dr. med. Honndorf, Valerie, Dr. rer. nat. Schmidt, Holger, PD Dr. rer. nat. Wiesinger, Benjamin, Dr. med. Angelovski, Goran, Dr. rer. nat. Reischl, Gerald, Dr. rer. nat. Pohmann, Rolf, Dr. rer. nat. Klose, Uwe Prof., Dr. rer. nat. Wehrl, Dr. Disselhorst, Dr. Maurer, Dr. Fischer, Dr. etc.
literature / teaching materials	Texts and books will be announced at the beginning of term.

module number: AS6.1 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanoanalytics/Interfaces I – Lecture and Seminar</i>			nature of the module: specialization
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 60 h self study (preparation for exams included): 120 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the winter term			
language (English/German)	English			
maximum/minimum number of participants	Lecture: Maximum: 24; Minimum: 3 Seminar : Maximum: 8; Minimum: 3			
module structure /teaching methods	Lecture: Nanoanalytics and Biophysics (2 SWS) and Seminar: Nanotechnology for Medical Application (2 SWS)			
contents	<u>Thematic focus:</u> - Introduction to statistical physics, soft matter and polymer physics, mechanics of cells and tissues, physics of the cytoskeleton, cellular forces, motor proteins, methods in nanobiophysics, high resolution microscopy techniques, micro- and nanofluidics, lab-on-a-chip technology - Discussion of current research topics in the field of nanotechnology for medical applications			
objectives	Students - are familiar with the basics of nanoanalytics and biophysics. - Independently study a scientific research topic and present it in the form of an oral seminar talk.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Nanoanalytics and Biophysics	Written/oral exam	1-5	3 ECTS
	Nanotechnology for medical Applications	Oral presentation (30 min presentation + 15 min discussion)	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization and elective course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences (elective course) and elective course for students of M.Sc. Medical Engineering Univ. of Stuttgart), required for module AS10. For elective courses only the lecture is applicable.			
recommended semester	1 st semester			
participation	B.Sc. degree			

requirements	
person responsible for the module	Schäffer, Tilman, Prof., Dr. rer. nat.
teaching staff	Rheinländer, Johannes, Dr. rer. nat. Schäffer, Tilman, Prof., Dr. rer. nat.
literature / teaching materials	Literature will be announced at the beginning of term.

module number: AS6.2 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanoanalytics/Interfaces I – Labwork</i>			nature of the module: specialization
credit points	9 CP			
work load - contact hours (SWS) - self study	Total: 270 h contact hours: 90 h self study (preparation for exams included): 180 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the winter term			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 8 Minimum: 3			
module structure /teaching methods	Practical Training (6 SWS)			
contents	<u>Thematic focus:</u> Planning, execution, analysis and discussion of practical experiments: - optical lithography - light microscopy - electron microscopy - scanning probe microscopy - neurotransmitter detection - scattering techniques - protein crystallization			
objectives	Students - are familiar with independent practical work with selected experimental methods in nanoanalytics / interfaces			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Practical Training	4 Experimental protocols	1-5	9 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), required for module AS10			
recommended semester	1 st semester			
participation requirements	B.Sc. degree			
person responsible for the module	Schäffer, Tilman, Prof., Dr. rer. nat.			
teaching staff	Fleischer, Monika, Prof., Dr. rer. nat. Rheinländer, Johannes, Dr. rer. nat. Schäffer, Tilman, Prof., Dr. rer. nat. Schreiber, Frank, Prof., Dr. rer. nat.			

literature / teaching materials	Literature will be announced at the beginning of term.
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module number: AS7.1 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Implantology – Lecture and Seminar</i>			nature of the module: specialization
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 60 h self study (preparation for exams included): 120 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term as block course			
language (English/German)	English			
maximum/minimum number of participants	Lecture: max.: 50 Seminar: max.: 20			
module structure /teaching methods	lectures and seminars (4 SWS)			
contents	<u>Thematic focus:</u> - Vital implants: Tissue engineering, cell biology, biomaterials, reactor technology - Avital implants: Interface between tissue and man-made materials, signal acquisition and processing, biostability, biocompatibility, operational procedures, design and use in clinical trials			
objectives	Students - Vital implants: Detailed knowledge of extracellular matrix components (focus on collagen and elastic fibres), properties of biomaterials, reading and review of current literature, presentation and documentation of own data - Avital implants: An understanding of the coupling and interaction between technical implants and tissue, material and bio-compatibility, rejection, knowledge about the transmission of electrical signals and the passivation of surfaces and technical body parts of all kinds, principles of sensory and motor function			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Written/oral exam	1-5	3 ECTS
	Seminar	Oral presentation (30 min presentation + 15 min discussion)	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization and elective course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences (elective course) and elective course for students of M.Sc. Medical Engineering Univ. of Stuttgart), required for modules AS7.2 and AS8			

recommended semester	2 nd semester
participation requirements	Successful completion of a Bachelor degree in Medical Technologies, or equivalent
person responsible for the module	Geis-Gerstorfer, Jürgen, Prof., Dr. rer. nat. Schenke-Layland, Katja, Prof., Dr. rer. nat.
teaching staff	Stenzl, Arnulf, Prof., Dr. med. Wendel, Hans-Peter, Prof., Dr. rer. nat. Schenk, Martin, Dr. rer. nat. Alexander-Friedrich, Dorothea, Prof. Dr. rer. nat. Löwenheim, Hubert, Prof., Dr. med. Höntzsch, Dankward, Prof., Dr. med. Gharabaghi, Alireza, Prof., Dr. med. Tatagiba, Marcos, Prof., Dr. med. Bauer, Axel, Prof., Dr. med. Kluba, Torsten, Prof., Dr. med. Gall, Christian, Dr. med. Birbaumer, Niels, Prof., Dr. phil. Zeck, Günther, Dr. rer. nat. Lembert, Nicolas, Dr. rer. nat. Kurtenbach, Anne, Dr. rer. nat and further lecturers.
literature / teaching materials	Texts and books will be announced at the beginning of term.

module number: AS7.2 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Implantology – Labwork</i>			nature of the module: specialization
credit points	9 CP			
work load - contact hours (SWS) - self study	Total: 270 h contact hours: 90 h self study (preparation for exams included): 180 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 16 Minimum: 3			
module structure /teaching methods	Practical Training			
contents	<u>Thematic focus:</u> - Vital implants: Tissue engineering, cell biology, biomaterials, reactor technology - Avital implants: Interface between tissue and man-made materials, signal acquisition and processing, biostability, biocompatibility, operational procedures, design and use in clinical trials			
objectives	Students - Vital implants: Cell and tissue culture techniques, properties of biomaterials, cell and tissue analysis for characterization, bioreactor technology, creating reports - Avital implants: Design and use of electronic implants (e.g. hearing implants, visual implants, brain stimulation) and endoprosthetic construction (e.g. femoral heads) for mechanics and movement, structural substitutes (breast implants, stents), surgical procedures			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Practical Training	4 Experimental protocols	1-5	9 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), required for module AS8			
recommended semester	2 nd semester			
participation requirements	Successful completion of a Bachelor degree in medical technologies, or equivalent and successful completion of module AS7.1			
person responsible for the module	Geis-Gerstorfer, Jürgen, Prof., Dr. rer. nat. Schenke-Layland, Katja, Prof., Dr. rer. nat.			
teaching staff	Stenzl, Arnulf, Prof., Dr. med. Wendel, Hans-Peter, Prof., Dr. rer. nat. Schenk, Martin, Dr. rer. nat			

	Alexander-Friedrich, Dorothea, Prof. Dr. rer. nat. Löwenheim, Hubert, Prof., Dr. med Höntzsch, Dankward, Prof., Dr. med. Gharabaghi, Alireza, Prof., Dr. med. Tatagiba, Marcos, Prof., Dr. med. Bauer, Axel, Prof., Dr. med. Kluba, Torsten, Prof., Dr. med Gall, Christian, Dr. med. Birbaumer, Niels, Prof., Dr. phil. Zeck, Günther, Dr. rer. nat. Lembert, Nicolas, Dr. rer. nat. Kurtenbach, Anne, Dr. rer. nat and further lecturers.
literature / teaching materials	Texts and books will be announced at the beginning of term

module number: AS8 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Implantology – Practical work experience</i>			nature of the module: specialization
credit points	15 CP			
work load - contact hours (SWS) - self study	Total: 450 h contact hours: 300 h self study (preparation for exams included): 150 h			
duration of the module	1 semester, min. 6 weeks full-time and max. 10 weeks full-time			
time schedule (winter/summer term)	The module is offered once per year in the summer and winter term as block course			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 16 Minimum: 1			
module structure /teaching methods	Practical Training (10 SWS)			
contents	Vital implants: Tissue engineering, cell biology, biomaterials, reactor technology Avital implants: Interface between tissue and man-made materials, signal acquisition and processing, biostability, biocompatibility, operational procedures, design and use in clinical trials			
objectives	Vital implants: Cell and tissue culture techniques, properties of biomaterials, cell and tissue analysis for characterization, bioreactor technology, creating reports Avital implants: Design and use of electronic implants (e.g. hearing implants, visual implants, brain stimulation) and endoprosthetic construction (e.g. femoral heads) for mechanics and movement, structural substitutes (breast implants, stents), surgical procedures			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Practical Training	Written report about the internship (10-15 pages, Arial 12, single-spaced)	1-5	15 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), recommended for master's thesis in implantology			
recommended semester	3rd semester			
participation requirements	Successful completion of a Bachelor degree in medical technologies, or equivalent, 2 passed specialization blocks and successful completion of module AS7.1 and AS7.2			
person responsible for the module	Geis-Gerstorfer, Jürgen, Prof., Dr. rer. nat. Schenke-Layland, Katja, Prof., Dr. rer. nat.			
teaching staff	Stenzl, Arnulf, Prof., Dr. med. Sievert, Karl-Dietrich, Prof. Dr. med.			

	Wendel, Hans-Peter, Prof., Dr. rer. nat. Schenk, Martin, Dr. rer. nat Vaegler, Martin, Dr. rer. nat. Alexander-Friedrich, Dorothea, Dr. rer. nat. Löwenheim, Hubert, Prof., Dr. med Höntzsch, Dankward, Prof., Dr. med. Gharabaghi, Alireza, Prof., Dr. med. Tatagiba, Marcos, Prof., Dr. med. Bauer, Axel, Prof., Dr. med. Kluba, Torsten, Prof., Dr. med Gall, Christian, Dr. med. Birbaumer, Niels, Prof., Dr. phil. Zeck, Günther, Dr. rer. nat. Lembert, Nicolas, PD, Dr. rer. nat. Kurtenbach, Anne, PD, Dr. rer. nat and further lecturers.
literature / teaching materials	Texts and books will be announced at the beginning of term

module number: AS9.1 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanoanalytics/Interfaces II – Lecture and Seminar</i>			nature of the module: specialization
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 60 h self study (preparation for exams included): 120 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	English			
maximum/minimum number of participants	Lecture: Maximum: 24; Minimum: 3 Seminar : Maximum: 8; Minimum: 3			
module structure /teaching methods	Lecture: Nanoanalytics and Biophysics (2 SWS) and Seminar: Nanotechnology for Medical Applications (2 SWS)			
contents	<u>Thematic focus:</u> - Introduction to statistical physics, soft matter and polymer physics, mechanics of cells and tissues, physics of the cytoskeleton, cellular forces, motor proteins, methods in nanobiophysics, high resolution microscopy techniques, lab-on-a-chip technology - Discussion of current research topics in the field of nanotechnology for medical applications			
objectives	Students - are familiar with the fundamentals of nanoanalytics and biophysics. - study independently a scientific research topic and present it in the form of an oral seminar talk.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Nanoanalytics and Biophysics	Written/oral exam	1-5	3 ECTS
	Nanoanalytics Nanotechnology for medical Applications	Oral presentation (30 min presentation + 15 min discussion)	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization and elective course) and M.Sc. in Medizinische Strahlenwissenschaften/Medical Radiation Sciences (elective course) and elective course for students of M.Sc. Medical Engineering Univ. of Stuttgart), required for module AS10. For elective courses only the lecture is applicable.			
recommended semester	2 nd semester			
participation requirements	B.Sc. degree			

person responsible for the module	Schäffer, Tilman, Prof., Dr. rer. nat.
teaching staff	Rheinlaender, Johannes, Dr. rer. nat. Schäffer, Tilman, Prof., Dr. rer. nat.
literature / teaching materials	Literature will be announced at the beginning of term.

module number: AS9.2 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanoanalytics/Interfaces II – Labwork</i>			nature of the module: specialization
credit points	9 CP			
work load - contact hours (SWS) - self study	Total: 270 h contact hours: 90 h self study (preparation for exams included): 180 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 8 Minimum: 3			
module structure /teaching methods	Practical Training (6 SWS)			
contents	<u>Thematic focus:</u> Planning, execution, analysis and discussion of practical experiments: - optical lithography - light microscopy - electron microscopy - scanning probe microscopy - neurotransmitter detection			
objectives	Students - Independent practical familiarization with selected experimental methods in nanoanalytics / interfaces			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Practical Training	4 Experimental protocols	1-5	9 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), required for module AS10			
recommended semester	2 nd semester			
participation requirements	B.Sc. degree			
person responsible	Schäffer, Tilman, Prof., Dr. rer. nat.			

for the module	
teaching staff	Fleischer, Monika, Prof., Dr. rer. nat. Rheinlaender, Johannes, Dr. rer. nat. Schäffer, Tilman, Prof., Dr. rer. nat.
literature / teaching materials	Literature will be announced at the beginning of term.

module number: AS10 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanoanalytics/Interfaces – Practical work experience in Nanotechnology for Medical Applications</i>			nature of the module: specialization
credit points	15 CP			
work load - contact hours (SWS) - self study	Total: 450 h contact hours: 300 h self study (preparation for exams included): 150 h			
duration of the module	1 semester, min. 6 weeks full-time and max. 10 weeks full-time			
time schedule (winter/summer term)	The module is offered once per year in the summer and winter term as block course.			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 8 Minimum: 1			
module structure /teaching methods	Practical Training			
contents	The Labwork contains a special topic that the student has to work on in theory and practice under the supervision of a scientist or medical doctor.			
objectives	Independent practical familiarization with experimental methods in the planned area of the Master's thesis.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	Exam	Grading scheme	weighting
	Practical Training	Written report about the internship (10-15 pages, Arial 12, single-spaced)	1-5	15 ECTS
applicability	M.Sc. in Biomedical Technologies (specialization course), recommended for master's thesis in Nanoanalytics/Interfaces			
recommended semester	3rd semester			
participation requirements	B.Sc. degree, 2 passed specialization blocks and successful completion of either modules AS6.1 and AS6.2 or modules AS9.1 and AS9.2			
person responsible for the module	Schäffer, Tilman, Prof., Dr. rer. nat.			
teaching staff	Fleischer, Monika, Prof., Dr. rer. nat.			

	Kirschniak, Andreas, PD, Dr. med. Rheinlaender, Johannes, Dr. rer. nat. Schäffer, Tilman, Prof., Dr. rer. nat.
literature / teaching materials	Literature will be announced at the beginning of term.

module number: AE11 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Aktorik in der Gerätetechnik; Konstruktion, Berechnung und Anwendung mechatronischer Komponenten</i>			nature of the module: elective course
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 42 h self study (preparation for exams included): 138 h			
duration of the module	2 semester			
time schedule (winter/summer term)	The module is offered each semester			
language (English/German)	German			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture, practical training,			
contents	Behandelt werden feinwerktechnische Antriebe unterschiedlicher Wirkprinzipie mit den Schwerpunkten: - Magnettechnik/-technologie (Werkstoffe, Verfahren, konstruktive Auslegung, Magnetisierung) - Elektromagnetische Antriebe (rotatorische und lineare Schrittmotoren; Berechnung, Gestaltung, Anwendung) - Elektrodynamische Antriebe (rotatorische und lineare Gleichstromkleinstmotoren; Berechnung, Gestaltung, Anwendung) - Piezoelektrische, magnetostruktive und andere unkonventionelle Aktorik (neue Werkstoffe in mechatronischen Komponenten, Berechnung, Gestaltung, Anwendung) - Beispiele zur Realisierung mechatronischer Lösungen in der Gerätetechnik. Beispielhafte Vertiefung in zugehörigen Übungen und Praktika (Spezialisierungsfachpraktika und APMB).			
objectives	Die Studierenden kennen die Grundlagen der Magnettechnik und -technologie (Werkstoffe, Verfahren, konstruktive Auslegung, Magnetisierung). Die Studierenden können elektromagnetische Antriebe (rotatorische und lineare Schrittmotoren) vereinfacht berechnen, gestalten und auslegen. Die Studierenden können elektrodynamische Antriebe (rotatorische und lineare Gleichstromkleinstmotoren) vereinfacht berechnen, gestalten und auslegen. Die Studierenden kennen piezoelektrische, magnetostruktive und andere unkonventionelle Aktorik.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Oral exam (ca. 40 min)	1-5	6 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2nd semester			
participation requirements	B.Sc. degree in Medical Technologies			

person responsible for the module	Schinköthe, Wolfgang, Prof., Dr.-Ing.
teaching staff	Schinköthe, Wolfgang, Prof., Dr.-Ing.
literature / teaching materials	Literature will be distributed before start of lecture.

module number: AE 12 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Technologien der medizinischen Bildgebung und Labordiagnostik</i>			nature of the module: elective course
credit points	3 CP			
work load - contact hours (SWS) - self study	Total: 90 h contact hours: 28 h self study (preparation for exams included): 62 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	German			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture			
contents	Bildgebende Diagnostik - Röntgen - Computertomographie - Magnetresonanztomographie - Positronenemissionstomographie - Labordiagnostik - Klinische Chemie - Immunologie - Molekulare Diagnostik (DNA Analyse) Informationstechnologie in der Medizintechnik			
objectives	- Kenntnis bildgebender und labormedizinischer Diagnoseverfahren und deren klinischer Bedeutung und Einsatzfelder. - Grundverständnis der zugrundeliegenden physikalischen und biomolekularen Messprinzipien. - Einblick in die Entwicklung und Herstellung medizintechnischer Geräte und die damit verbundenen technologischen Herausforderungen. - Verständnis grundlegender Zusammenhänge im Gesundheitswesen in Bezug auf Arbeitsabläufe, Kostenentwicklung und Behandlungsqualität.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Oral exam (ca. 30 min)	1-5	3
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2nd semester			
participation requirements	B.Sc. degree in Medical Technologies			
person responsible for the module	Yang, Bin, Prof., Dr.-Ing.			

teaching staff	Lauer, Lars, Dr.
literature / teaching materials	Literature will be distributed before start of lecture.

module number: AE 13 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Interface-Design</i>		nature of the module: elective course	
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 42 h self study (preparation for exams included): 138 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	German			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture, practical training, seminar			
contents	Darstellung des interdisziplinären Interfacedesigns als Vertiefung zum Technischen Design mit Fokussierung auf alle relevanten Mensch-Maschine- Interaktionen. Beschreibung aller notwendigen Begriffe und Grundlagen zur Interfacegestaltung. Ausführliche Vorstellung der Methoden zur Integration der Makro-, Mikro- und Informationsergonomie in den gegenwärtigen Entwicklungsprozess. Darauf aufbauend werden Werkzeuge, wie Usability-Tests und Workflow-Analyse, intensiv beschrieben und deren Bewertungen und Ergebnisse diskutiert. Es werden zahlreiche realisierte Beispiele aus der Praxis als Fallbeispiele vorgestellt und behandelt.			
objectives	Das Modul vermittelt Grundlagen und Vertiefungen zum Interfacedesign. Studierende besitzen nach dem Besuch des Moduls - das Wissen über die wesentlichen Grundlagen des Interfacedesigns als Bestandteil der methodischen Entwicklung und zur Vertiefung des Technischen Designs, - die Kenntnis über wesentliche Interaktionsprinzipien zur Wahrnehmung, Kognition und Betätigung und Benutzung, - die Fähigkeit wichtige Methoden zur Gestaltung der Mensch-Maschine-Schnittstelle anzuwenden, Lösungen zu realisieren und zu präsentieren, - die Fertigkeiten zur Planung und Durchführung von Usability-Tests mit Probanden, - grundlegende Kenntnisse zu Kriterien und Bewertung von Anzeigern und Stellteilen über die XKompatibilitäten, - ein detailliertes Verständnis von Makro-, Mikro- und Informationsergonomie und deren Integration in die Planungs-, Konzept-, Entwurfs- und Ausarbeitungsphase, - die Fähigkeit zur Durchführung und Auswertung einer Workflow-Analyse als Querschnittsfunktion, - die Fähigkeit effiziente Bedienstrategien zu beurteilen, - das Wissen über Auswirkungen und zukünftige Trends der Interfacegestaltung.			
Requirements for	course	exam	Grading scheme	weighting

credit points / exams and grading scheme (where appropriate, weighting)	Lecture	Written exam (ca. 120 min)	1-5	6 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2nd semester			
participation requirements	B.Sc. degree in Medical Technologies			
person responsible for the module	Maier, Thomas, Univ.-Prof., Dr.-Ing.			
teaching staff	Maier, Thomas, Univ.-Prof., Dr.-Ing. Schmid, Markus, Dr.-Ing.			
literature / teaching materials	Literature will be distributed before start of lecture.			

module number: AE 14 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Grundlagen der Keramik und Verbundwerkstoffe</i>	nature of the module: elective course
credit points	6 CP	
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 42 h self study (preparation for exams included): 138 h	
duration of the module	2 semester	
time schedule (winter/summer term)	The module is offered once per year in the winter term	
language (English/German)	German	
maximum/minimum number of participants	Maximum: 20	
module structure /teaching methods	Lecture	
contents	Dieses Modul hat die werkstoff- und fertigungstechnischen Grundlagen keramischer Materialien zum Inhalt. Darüber hinaus werden konstruktive Konzepte und die werkstoffspezifische Bruchmechanik berücksichtigt. Es werden keramische Materialien und deren Eigenschaften erläutert. Keramische werden gegen metallische Werkstoffe abgegrenzt. Anhand von ingenieurstechnischen Beispielen aus der industriellen Praxis werden die Einsatzgebiete und -grenzen von keramischen Werkstoffen aufgezeigt. Den Schwerpunkt bilden die Formgebungsverfahren von Massivkeramiken. Die theoretischen Inhalte werden durch Praktika vertieft und verdeutlicht. Stichpunkte: - Grundlagen von Festkörpern im Allgemeinen und der Keramik. - Einteilung der Keramik nach anwendungstechnischen und stofflichen Kriterien, Trennung in Oxid-/ Nichtoxidkeramiken und Struktur-/ Funktionskeramiken. - Abgrenzung Keramik zu Metallen. - Grundregeln der Strukturmechanik, Bauteilgestaltung und Bauteilprüfung. - Klassische Herstellungsverfahren vom Rohstoff bis zum keramischen Endprodukt. - Formgebungsverfahren, wie das Axialpressen, Heißpressen, Kalt-, Heißisostatpressen, Schlicker-, Spritz-, Foliengießen und Extrudieren keramischer Massen. - Füge- und Verbindungstechnik. - Sintertheorie und Ofentechnik. - Industrielle Anwendungen (Überblick und Fallbeispiele).	
objectives	Die Studenten können: - Merkmale und Eigenheiten keramischer Werkstoffe unterscheiden, beschreiben und beurteilen. - Belastungsfälle und Versagensmechanismen verstehen und analysieren. - werkstoffspezifische Unterschiede zwischen metallischen und keramischen Werkstoffen wiedergeben und erklären. - Technologien zur Verstärkung von Werkstoffen sowie die wirkenden Mechanismen benennen, vergleichen und erklären. - Verfahren und Prozesse zur Herstellung von massivkeramischen Werkstoffen benennen, erklären, bewerten, gegenüberstellen,	

	auswählen und anwenden. - Herstellungsprozesse hinsichtlich der techn. und wirtschaftl. Herausforderungen bewerten und anwendungsbezogen auswählen. - in Produktentwicklung und Konstruktion geeignete Verfahren und Stoffsysteme identifizieren, planen und auswählen. - Werkstoff- und Bauteilcharakterisierung erklären, bewerten, planen und anwenden.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Written exam (ca. 120 min)	1-5	6 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2nd semester			
participation requirements	B.Sc. degree in Medical Technologies			
person responsible for the module	Gadow, Rainer, Univ.-Prof., Dr.Dr.h.c.			
teaching staff	Gadow, Rainer, Univ.-Prof., Dr.Dr.h.c.			
literature / teaching materials	Literature will be distributed before start of lecture.			

module number: AE 15 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanotechnologie I - Chemie und Physik der Nanomaterialien</i>			nature of the module: elective course
credit points	3 CP			
work load - contact hours (SWS) - self study	Total: 90 h contact hours: 28 h self study (preparation for exams included): 62 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered each semester			
language (English/German)	German			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture			
contents	Nanoskaligkeit natürlicher Materie. Definition der Nanotechnologien und Nanomaterialien. Aufbau und Struktur von Nanomaterialien. Dimensionalität von Nanomaterialien (3 D, 2 D, 1 D und 0 D). Methoden zur Analyse von Nanomaterialien und deren Anwendung. Synthese und Verarbeitung von Nanomaterialien. Top down versus bottom up. Synthese aus unterschiedlichen physikalischen Phasen (Gasphase und Flüssigphase). Mechanische, chemische, elektrische, optische, magnetische, biologische und toxikologische Eigenschaften von Nanomaterialien.			
objectives	Die Studierenden - verstehen die Nanoskaligkeit natürlicher Materie und können sie an Beispielen illustrieren. - können die Definition der Nanotechnologien und Nanomaterialien anwenden und die Potenziale und Risiken von Nanomaterialien diskutieren. - können den Aufbau und die Struktur von Nanomaterialien erklären. - können die Dimensionalität von Nanomaterialien (3 D, 2 D, 1 D und 0 D) bestimmen. - können Methoden zur Analyse von Nanomaterialien auswählen und die Vorgehensweise bei deren Anwendung skizzieren. - können unterschiedliche Verfahren zur Synthese aus unterschiedlichen physikalischen Phasen (Gasphase und Flüssigphase) von Nanomaterialien erläutern und deren grundlegende Prinzipien beschreiben. - verstehen die besonderen Attribute von top down- und bottom up-Verfahren zur Synthese und Verarbeitung von Nanomaterialien. - sind in der Lage besondere mechanische, chemische, elektrische, optische, magnetische, biologische und toxikologische Eigenschaften von Nanomaterialien zu bewerten.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Written exam (ca. 90 min)	1-5	3 ECTS

applicability	M.Sc. in Biomedical Technologies (elective course)
recommended semester	1 st or 2nd semester
participation requirements	B.Sc. degree in Medical Technologies
person responsible for the module	Hirth, Thomas, Prof., Dr.
teaching staff	Tovar, Günter, Apl. Prof., Dr. Hirth, Thomas, Prof., Dr.
literature / teaching materials	Literature will be distributed before start of lecture.

module number: AE 16 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Nanotechnologie II - Technische Prozesse und Anwendungen</i>			nature of the module: elective course
credit points	3 CP			
work load - contact hours (SWS) - self study	Total: 90 h contact hours: 28 h self study (preparation for exams included): 62 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the winter term			
language (English/German)	German			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture			
contents	Technische Prozesse zur Synthese und Verarbeitung von Nanomaterialien unterschiedlicher Dimensionalität (3 D, 2 D, 1 D und 0 D) und aus unterschiedlichen physikalischen Phasen (gasförmig, flüssig, fest)			
objectives	Die Studierenden - verstehen technische Prozesse zur Synthese und Verarbeitung von Nanomaterialien unterschiedlicher Dimensionalität (3 D, 2 D, 1 D und 0 D) und aus unterschiedlichen physikalischen Phasen (gasförmig, flüssig, fest) und können Prozessketten illustrieren. - können Anwendungen von Nanomaterialien mit besonderen mechanischen, chemischen, Biochemischen, elektrischen, optischen, magnetischen, biologischen und medizinischen Eigenschaften verstehen und bewerten. - interpretieren die öffentliche Wahrnehmung von Nanotechnologien und Nanomaterialien und können reale Chancen und Risiken von Nanotechnologien und Nanomaterialien bewerten.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Written exam (ca. 90 min)	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2nd semester			
participation requirements	B.Sc. degree in Medical Technologies			
person responsible for the module	Hirth, Thomas, Prof., Dr.			
teaching staff	Hirth, Thomas, Prof., Dr. Tovar, Günter, Apl. Prof., Dr.			
literature / teaching materials	Literature will be distributed before start of lecture.			

module number: AE 17 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>Optische Systeme in der Medizintechnik</i>			nature of the module: elective course
credit points	6 CP			
work load - contact hours (SWS) - self study	Total: 180h contact hours: 42h self study (preparation for exams included): 138h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	German			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture, practical training			
contents	Basic optical system design and optical system parameters. Basic architecture of optical systems used in medicine (microscope, surgical microscope, endoscope, ophthalmic systems) Modern microscopy methods (structured illumination, confocal, fluorescence). Optics of the human eye and ophthalmic systems. Lasers in medical diagnostics and therapy. Spectroscopic and hyperspectral methods and systems. 3-D optical metrology. Basic properties of detectors.			
objectives	The students know how to calculate basic optical quantities within simple optical systems The students are familiar with - the optical setup of microscopes, endoscopes, and ophthalmic systems - spectral systems and their application - the properties of the human eye - properties of laser beams - polarization The students have an overview - over state of the art microscopic methods in order to enhance resolution and/or contrast - laser systems and their application in medicine - important properties of optical detectors			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Written exam	1-5	6 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2nd semester			

participation requirements	B.Sc. degree in Medical Technologies
person responsible for the module	Herkommer, Alois, Univ.-Prof., Dr.
teaching staff	
literature / teaching materials	Literature will be distributed before start of lecture. Additional recommended books: - Gross H.: Handbook of optical systems Vol. 1-4 - Hecht, E.: Optik (Optics) - Kühlke D.: Optik

Modulkennziffer: BM5 .1 (Veranstaltungsnummer wird zugeteilt)	Modultitel: <i>Physik und Technologie der medizinischen Strahlenanwendungen - Vorlesung</i>			Art des Moduls: Wahlfach
Leistungspunkte	3 LP			
Arbeitsaufwand* - Kontaktzeit SWS - Selbststudium	Gesamt: 90 h Kontaktzeit: 3 SWS (32 h) Selbststudium: 58 Stunden			
Moduldauer*	1 Semester			
Turnus*	Das Modul wird in jedem Sommersemester angeboten			
Unterrichtssprache	Deutsch			
Gruppengröße / beschränkte Teilnehmerzahl	Vorlesung: max. 20 Teilnehmer			
Lehrformen*	Vorlesung (3 SWS)			
Modulinhalt*	Technische Umsetzung der Gesetzmäßigkeiten der Atom-, Kern- und Strahlenphysik in Gerätetechnik der radiologischen Diagnostik, Nuklearmedizin und Strahlentherapie: - Beschleuniger für die Strahlentherapie und die Radionukliderzeugung - Bestrahlungsfeld-Verifikationstechniken und Therapie-Bildprozeduren - Gerätetechnik der Brachytherapie - Gerätetechnik der Hyperthermie - Geräte für die Bildgebung (Röntgendiagnostik, Szintigrafie, bildgestützte Radiotherapie) - Nukliderzeugung in Kernreaktor, Generatorsystemen und im Zyklotron - Messverfahren und –protokolle für die Qualitätssicherung und den Strahlenschutz			
Qualifikationsziele*	- Die Studierenden verfügen nach erfolgreichem Abschluss des Moduls über das physikalisch-technische Basiswissen, das für die wissenschaftliche und klinische Arbeit in der medizinischen Strahlenforschung in der Onkologie erforderlich ist. - Sie kennen Funktionsweise und Technik der gängigen in der Nuklearmedizin, Radiologie und Strahlentherapie eingesetzten Geräte.			
Prüfungsform / Benotung (ggf. Gewichtung)*	Veranstaltung	Prüfungsform	Benotung	Leistungspunkte
		Schriftliche Klausur		3 LP
Verwendbarkeit*	Die Vorlesung dieses Moduls ist Teilmodul des Moduls BM5 im Masterstudiengang Medizinische Strahlenwissenschaften. Es kann nur die Vorlesung (3 SWS = 3 ECTS) belegt werden.			
Empfohlenes Semester	2. Fachsemester			
Teilnahme-voraussetzungen*	B.Sc. in Medizintechnik.			

Modul- verantwortlicher	Dohm, Oliver, Dr. rer. nat./ Prof. Dr. Daniela Thorwarth
Dozent	Dohm, Oliver, Dr. rer. nat., Kaulich, Theodor, Dr. rer. nat., Thorwarth, Daniela, Dr. rer. nat., Zeeb, Bastian
Literatur / Lernmaterialien	Wird zu Semesterbeginn bekannt gegeben.

module number: BM8	Title of the module: <i>Biostatistics 1</i>	Nature of the module: Elective course
credit points	6	
work load - contact hours (SWS) - self study	Total: 180 h contact hours: 70 h self study (preparation for exams included): 110 hours	
duration of the module	1 Semester	
time schedule (winter/summer term)	Annual	
language (English/German)	German / English	
maximum/minimum number of participants	Lecture: no limit Tutorial: max. 28 participants	
module structure /teaching methods	Statistics 1: Lecture 1 (2 SWS), Tutorial (1 SWS) (mandatory, English) 3 ECTS Anova: Lecture 1 (2 SWS), Tutorial (1 SWS) (elective, English) 3 ECTS Statistics 2: Lecture 1 (2 SWS), Tutorial (1 SWS) (elective, German) 3 ECTS Clinical Studies: Lecture 1 (2 SWS), Tutorial (1 SWS) (elective, English) 2 ECTS	
contents	Statistics 1: Scales, Descriptive Statistics (Graphics, Tables, Parameters), Correlation and Regression, Diagnostic Tests, Confidence intervals, Kaplan Meier Analysis of Survival Data Examples and Principles of statistical tests, Tests for independent samples, Tests for dependent Samples, Assessment of Normal Distribution, one factorial analysis of variance, Multiple Testing, Principles of sample size estimation Anova: One factorial analysis of variance, analysis of covariance, two factorial analysis of variance without interaction, two factorial analysis of variance with interaction, two factorial analysis of variance with one between and one within factor, multiple comparisons, mixed models and generalized estimating equations Statistics 2: Epidemiological Studies: Target population, Risk factors, sources of bias, adjustment, Exact and Chi-Square Tests, Multiple Logistic Regression, Cluster analysis, Discriminant analysis, Metaanalysis, Surveillance, Registries, Standards (STROBE, MOOSE,...) Biostatistics of Clinical Studies: Statistical methods for clinical studies, sample size estimation, sequential and adaptive designs, diagnostic studies, studies with censored data	
objectives	The students are able to develop statistical modelling and analysis of experiments, interventional and observational clinical studies and of epidemiological studies. They are able to interpret the results. The students have knowledge of statistical analysis (descriptive, confirmatory, regression, multivariate) and they are able to decide which method is the most adequate in a specific study.	

Requirements for credit points / exams and grading scheme (where appropriate, weighting)	Course	Exam	Grading Scheme	Weighting
	Statistics 1	Written exam		3 ECTS
	Analysis of Variance	Mandatory attendance		3 ECTS
	Statistics 2	Mandatory Attendance		3 ECTS
	Clinical Biostatistics	Mandatory Attendance		3 ECTS
applicability	This Module is elective for MSc Biomedical Technology and MSc Medizinische Strahlenwissenschaften			
recommended semester	1st / 2nd Semester			
participation requirements	The knowledge of the Course Statistics 1 is required to attend the other three courses which are independent of each others.			
person responsible for the module	Martus, Peter, Prof. Dr. rer. nat.			
teaching staff	Martus, Peter, Prof. Dr. rer. nat., Sharma, Manu PhD, Wang, Lisa, MSc, PhD Student			
literature / teaching materials	To be announced at the beginning of the term			

Modulkennziffer: BM12.1 (Veranstaltungsnummer wird zugeteilt)	Modultitel: <i>Nuklearmedizin, diagnostische und interventionelle Radiologie, Strahlentherapie - Vorlesung</i>			Art des Moduls: Wahlfach
Leistungspunkte	3 LP			
Arbeitsaufwand* - Kontaktzeit SWS - Selbststudium	Gesamt: 90 h Kontaktzeit: 2 SWS (21 h) Selbststudium: 69 Stunden			
Moduldauer*	1 Semester			
Turnus*	Das Modul wird in jedem Wintersemester angeboten			
Unterrichtssprache	Deutsch			
Gruppengröße / beschränkte Teilnehmerzahl	Vorlesung: max. 20 Teilnehmer			
Lehrformen*	Vorlesung (2SWS)			
Modulinhalt*	Grundlagen der Nuklearmedizin, der diagnostischen und interventionellen Radiologie und der Strahlentherapie aus der Sicht des Mediziners: - Physikalische Grundlagen der Nuklearmedizin - Grundprinzipien nuklearmedizinischer Anwendungen (Radiopharmaka) - Anwendung offener und umschlossener Radionuklide in Diagnostik und Therapie - Nuklearmedizinische Therapie und intratherapeutische Dosismessung - Physikalische Grundlagen der Strahlentherapie - Indikationen für die Anwendung bestimmter diagnostischer und therapeutischer Verfahren - Radiographische Verfahren, Magnetresonanztomografie, Ultraschall			
Qualifikationsziele*	- Die Studierenden kennen nach Abschluss des Moduls alle für die moderne Nuklearmedizin, Radiologie und Strahlentherapie relevanten klinischen Verfahren und Techniken. - Sie können diese hinsichtlich diagnostischer und therapeutischer Effektivität bewerten und das strahlungsbedingte Risiko für Patient und Personal quantifizieren.			
Prüfungsform / Benotung (ggf. Gewichtung)*	Veranstaltung	Prüfungsform	Benotung	Leistungspunkte
		Schriftliche Klausur		3 LP
Verwendbarkeit*	Die Vorlesung dieses Moduls ist Teilmodul des Moduls BM 12 im Masterstudiengang Medizinische Strahlenwissenschaften. Es kann nur die Vorlesung (2 SWS = 3 ECTS) belegt werden.			
Empfohlenes Semester	3. Fachsemester			
Teilnahmevoraussetzungen*	-			
Modulverantwortlicher	Zips, Daniel, Prof., Dr. med.			
Dozent	Zips, Daniel, Prof., Dr. med.,			

	Bares, Roland, Prof., Dr. med., Pfannenberger, Christina, Prof., Dr. med. Weidner, Nicola, Dr. med., Müller, Arndt-Christian, Dr. med., Welz, Stefan, Dr. med., Paulsen, Frank, Dr. med., Heinzelmann, Frank, Dr. med.,
Literatur / Lernmaterialien	Wird zu Semesterbeginn bekannt gegeben.

module number: BM 15 (Veranstaltungsnummer wird zugeteilt)	title of the module: <i>NanoBioPhysics and scanning probe microscopy</i>			nature of the module: elective course
credit points	3 CP			
work load - contact hours (SWS) - self study	Total: 90 h contact hours: 30 h self study (preparation for exams included): 60h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	German or English			
maximum/minimum number of participants	Maximum: 20			
module structure /teaching methods	Lecture (2 SWS)			
contents	<u>Thematic focus:</u> - Introduction, interactions on the nanoscale, measurement of inter- and intramolecular forces, contact models, technology of scanning probe microscopy, biological basics, oscillations of nanostructures, static and dynamic imaging modes, magnetic nanostructures.			
objectives	Students - become familiar with a young field of nanoscience - acquire fundamental knowledge about the area of NanoBioPhysics - learn interdisciplinary methods and applications of scanning probe microscopy			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture	Written exam (ca. 90 min) or oral exam	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st or 2 nd semester			
participation requirements	B.Sc. degree			
person responsible for the module	Schäffer, Tilman, Prof., Dr. rer. nat.			
teaching staff	Schäffer, Tilman, Prof., Dr. rer. nat.			
literature / teaching materials	Literature will be announced at the beginning of term.			

module number: BM17	title of the module: <i>Ethical Technology Assessment and Sustainable Development</i>			nature of the module: elective course
credit points	3 CP			
work load - contact hours (SWS) - self study	Total: 90 h contact hours: 30 h self study (preparation for exams included): 60 h			
duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 20 Minimum: 6			
module structure /teaching methods	Seminar (2 SWS)			
contents	- Introduction to ethical technology assessment and sustainable development - Ethical case study of a certain biomedical technology: Ethical and social dimensions will be explored and discussed exemplarily by focusing a concrete technology - "My carbon footprint": The individuals' contribution and the contribution of biomedical technologies for sustainable development - Life-cycle assessment as a method to assess environmental impacts associated with all the stages of a product's life from cradle to grave			
objectives	- Students get an idea of what ethical questions are. Their awareness for ethical aspects of biomedical technologies is raised and they can exemplarily formulate and discuss them. - Students become familiar with fundamental issues of sustainable development and possible contributions to it. - Students work on criteria for sustainable innovations and the assessment of new technologies. - Students can assess possible benefits and risks from technological innovations and their use for a sustainable development.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Seminar	Presentation during Seminar and writing of a reflection paper	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	2 nd semester			
participation	B.Sc. degree			

requirements	
person responsible for the module	Spindler, Mone, Dr. phil.
teaching staff	Spindler, Mone, Dr. phil.
literature / teaching materials	Literature will be announced at the beginning of term.

module number: BM18	title of the module: <i>MEDTEC Innovation</i>			nature of the module: elective course
creditpoints	9 CP			
work load - contact hours (SWS) - self study	Total: 180 h Contact hours:60 h Self-study: 120h			
Durationofth module	2 semester			
time schedule (winter/summer term)	The module is offered once per year in the winter an summer term			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 12			
module structure /teaching methods	Lecture / Seminar combination (2 SWS)			
contents	<u>Thematic focus:</u> - The module deals with the development process of a medical device from the industry perspective. The students will be undergoing an innovation process from primary identification of clinical unmet needs to concept generation to a functional demonstrator. During this process several steps such as self-assessment, needs finding, idea generation, IP and market analysis, as well as the physical process of drafting a design and building a demonstrator will be included.			
objectives	Students - become familiar with the field of innovation management - acquire fundamental knowledge about the importance of a structured process, challenging situations during the process and the application of ancillary tools - learn important methods and processes along the definition of a project towards feasibility and fabrication of a demonstrator.			
Requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture / Seminar	Presentation/ Concept / Demonstrator	1-5	3 ECTS (WS) 6 ECTS (SS)
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	1 st and 2 nd semester			
participation requirements	B.Sc. degree			
person responsible for the module	Wahl, Siegfried, Prof. Dr. rer. nat. Hofmann, Boris, Prof., Dr. rer. nat.			
teaching staff	Wahl, Siegfried, Prof. Dr. rer. nat. Hofmann, Boris, Prof., Dr. rer. nat.			
literature / teaching materials	Literature will be announced at the beginning of term.			

module number: BM19	title of the module: <i>Medical Ultrasound – Theory and Application</i>			nature of the module: elective course
creditpoints	3 CP			
work load - contact hours (SWS) - self study	Total: 90 h Contact hours: 20 h (1,5 SWS) Self-study: 70 h			
Duration of the module	1 semester			
time schedule (winter/summer term)	The module is offered once per year in the summer term			
language (English/German)	English			
maximum/minimum number of participants	Maximum: 10			
module structure /teaching methods	Lecture / Seminar combination			
contents	- Ultrasonography – Ultrasound technology mainly for imaging (diagnostics). Theoretical part: Technical background, well established and latest features. Practical part: How to run a system, basics in medical sonography for B-mode, Colour imaging and Doppler. Hands on practice and basic pathological findings for most common diseases.			
objectives	-			
requirements for credit points / exams and grading scheme (where appropriate, weighting)	course	exam	Grading scheme	weighting
	Lecture/ Seminar	Written or oral examination	1-5	3 ECTS
applicability	M.Sc. in Biomedical Technologies (elective course)			
recommended semester	2 nd semester			
participation requirements	B.Sc. degree			
person responsible for the module	Enderle, Markus, Prof., Dr. med., Forschungsleiter Firma Erbe Medizintechnik. Tel.: 07071/755255			
teaching staff	And colleagues			
literature / teaching materials	Literature will be announced at the beginning of term.			

