AC Angewandte Chemie

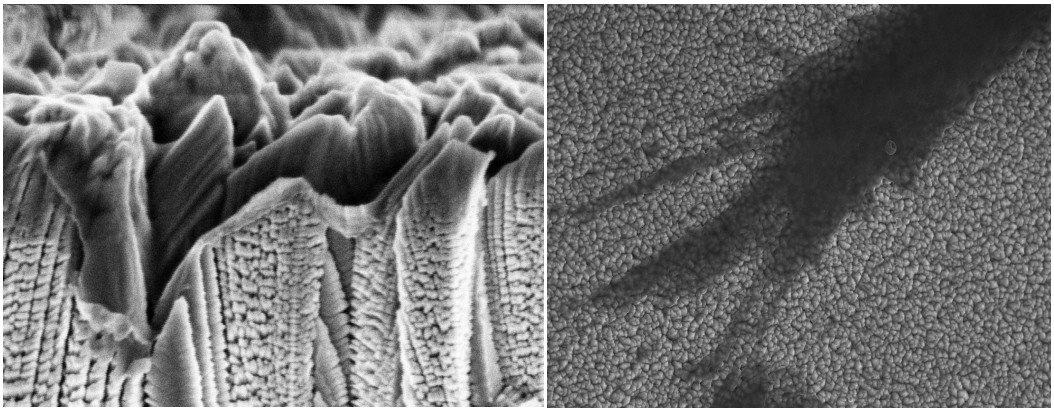
Module Compendium

for the Master's Degree Program

Master of Science

Biomedical Sciences (BMS)

Valid as of October 2020
School of Applied Chemistry



Double layer of TiO_2 and polymer; structuring of the surface and optimization of the chemical composition of the surface for the purpose of cell establishment

Hochschule Reutlingen
Reutlingen University

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Preliminary Remarks

This module compendium serves the purpose of providing students and instructors a detailed and comprehensive description of the curriculum of the degree program Master of Biomedical Sciences.

The module descriptions present the module goals and intended results of study as well as the contents of the individual courses. Furthermore, all information necessary for academic success is given in the module descriptions. They are also included in the diploma supplement to the master's degree program.

If you have any questions regarding several modules or the course of studies, please contact the office of the Dean of the Faculty of Applied Chemistry.

If you have questions regarding a particular module, please contact the responsible module coordinator. You will find a list of the module coordinators in the Internet, where this module compendium can also be found.

If you have questions regarding a particular course, please contact the instructor.

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Introduction

Overview of the course of studies

The curriculum of the master degree program for Biomedical Sciences comprises 3 semesters. The diploma is a professional qualification and enables graduates of biomedicine with a master's degree in natural science to work in industry or in academia.

Important structural elements of the course of studies are

- Two mandatory modules and four out of five elective modules in the winter term
- Project-oriented learning with 20 ECTS in the summer term
- Two out of three elective modules in the summer term
- A master's thesis, to be written within 6 months during the third semester.

The curriculum has been chosen so that graduates will be qualified to work in various fields, in particular in academic and industrial research in pharmaceuticals, medical technology (implants, regenerative medicine), biotechnology and diagnostics. The graduates' qualifications will be based on their education in the modern fields of material and surface sciences with regard to their application in biomedicine, but also on a profound knowledge of bioanalytics, pharmaceutical research and modern biotechnology. Students can start their studies both during winter or summer semester.

Modules in the winter term comprise two mandatory modules "Statistics in Biomedicine" (BMS01) and "Scientific methods (BMS02), which provide fundamental knowledges in the field of biomedical science. In addition five modules covering various fields in biomedical sciences are presented, of which four modules are to be selected. These are „Analytical Methods in Biomedical Sciences" (BMS03), „Materials and Applications in Biomedical Sciences" (BMS04), "Microbiology & Virology (BMS05), „Technology Management" (BMS06) and „Industry-Related Topics" (BMS07).

In the summer term, the main focus is laid on the module "Project-Oriented Learning" (BMS12), which provides 20 ECTS. Objective is the education of the students in setting-up, planning and performing a project aiming at the solution of a specific research question. Additionally, three modules are offered, of which two modules must be selected. These are „Biofabrication & Regenerative Medicine" (BMS08), „Advanced Pharmacology" (BMS09) and "Industry-Related Topics 1".

The master's thesis shall be written in the third semester and can be done internally at Reutlingen University or at an external institute.

European Credit Transfer and Accumulation System (ECTS)

The Ministry for Science, Research and Art BW and the Conference of Ministers of Culture require the curriculum of study to be divided into modules. Students' performance is recorded by means of the „European Credit Transfer and Accumulation System" (ECTS). In order to compare the performance of students at various institutions of higher learning—also foreign institutions—the ECT system is based not on the number of course hours per week, but rather on the time that students are required to invest in learning. In this way, student performance can be more objectively compared throughout Europe.

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Full-time students can achieve 60 ECTS credit points per academic year. This approximates an average workload of 1800 hours of study. A credit point corresponds to 30 hours workload for a student of average intelligence and aptitude, whereby the workload includes the time during which the student attends class and his/her study time outside of class. Class time is given as weekly number of hours (à 60 minutes) per course (WH).

Example:

WH*	Class attendance	Study time	Workload	Credit points
2	30 h	60 h	90 h	3

WH* = 1 WH equals 15 hours per semester, which normally consists of 15 weeks.

Students can only obtain the ECTS points if the required exams have been successfully and verifiably absolved. Credit points are awarded according to the “all or none” principle.

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Overview of the modules in the course of studies

BMS01: Statistics in Biomedicine

Module No.	Module course	Semester	WH	Credit points
BMS01	Medical Statistics	winter	2	5
	Multivariate Data Analysis	winter	2	

BMS02: Scientific Methods

Module No.	Module course	Semester	WH	Credit points
BMS02	Quantitative Biology	winter	2	5
	Research Design	winter	2	

BMS03: Analytical Methods in Biomedical Sciences)

Module No.	Module course	Semester	WH	Credit points
BMS03	Analytical Methods in Biomedical Sciences Drug	winter	2	5
	Diagnostic Technologies	winter	2	

BMS04: Materials and Applications in Biomedical Sciences

Module No.	Module course	Semester	WH	Credit points
BMS04	Functional Implants & Surface Technology	winter	2	5
	Drug Release & Delivery Systems	winter	2	

BMS05: Microbiology & Virology

Module No.	Module course	Semester	WH	Credit points
BMS05	Microscopy and Optics	winter	2	5
	Microbial / Viral Pathogens and Infection	winter	2	

BMS06: Technology Management

Module No.	Module course	Semester	WH	Credit points
BMS6	Innovation Management/ Project Management/ Project Management	winter	4	5

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BMS07: Industry-Related Topics 2 (Drug Discovery & Medical Technology)

Module No.	Module course	Semester	WH	Credit points
BMS07	Drug Discovery and Development	winter	2	5
	Introduction into Medical Technology	winter	2	

BMS08: Biofabrication & Regenerative Medicine

Module No.	Module course	Semester	WH	Credit points
BMS08	Biofabrication & Regenerative Medicine	summer	4	5

BMS09: Advanced Pharmacology

Module No.	Module course	Semester	WH	Credit points
BMS09	Biomedical Pharmacology	summer	2	5
	Advanced Bioanalysis	summer	2	

BMS10: Industry-Related Topics 1 (Regulatory Affairs & IP Management

Module No.	Module course	Semester	WH	Credit points
BMS10	Regulatory Affairs	summer	2	5
	IP Management	summer	2	

BMS11: Modules from other Schools or Universities

Module No.	Module course	Semester	WH	Credit points
BMS11	Modules from other Schools or Universities	summer	4	5

BMS12: Project Oriented Learning

Module No.	Module course	Semester	WH	Credit points
BMS12	Information Retrieval and Evaluation	summer	2	20
	Research Seminar	summer	2	
	Team Project	summer	12	

BMS13: Master‘s Thesis

Module No.	Module course	Semester	WH	Credit points
BMS13	Master’s Thesis Project and Defense (internal/external)	3		30
	Research Seminar for Master’s Thesis	3	2	

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Assignment of Marks / Assessment of Quality

Relative ECTS Marks

The international standard foresees that the best 10% of those students who pass receive the mark „A“, regardless of which mark they may receive according to the German marking system. With this system, the performance of students who have passed can be compared more objectively, taking into account that different courses may have different degrees of difficulty.

Student performance	ECTS mark
the best 10%	A = excellent
the next 25%	B = very good
the next 30%	C = good
the next 25%	D = satisfactory
the next 10%	E = sufficient
	F = failing

Since a large number of students are necessary in order to correctly calculate the relative ECTS marks, the conventional German marking system (1-5) shall be used and adapted as shown in the table below (valid as of February 2011).

ECTS mark	German mark	ECTS definition	German translation
A	1,0 – 1,3	excellent	hervorragend
B	1,4 – 2,0	very good	sehr gut
C	2,1 – 2,7	good	gut
D	2,8 – 3,5	satisfactory	befriedigend
E	3,6 – 4,0	sufficient	ausreichend
FX/F	4,1 – 5,0	failing	nicht bestanden

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Remarks Concerning the Description of Modules

The module descriptions are meant to offer students information regarding the course of studies, curriculum content, qualitative and quantitative requirements, the relationship of the individual modules to other modules and integration of the module into the general concept of the course of studies. The module descriptions are listed in tabular form.

The following remarks will help the reader to understand the terms used in the module descriptions.

Module description / abbreviation:
A module name and abbreviation have been assigned to every module. The module name provides information about the content of the module. The corresponding abbreviation begins with the first letter of the name of the degree program. It ends with a number of a sequence of numbers. Thus, the abbreviation BMS1 stands for the first module in Biomedical Sciences.

Courses:

The courses included in a module are listed separately.

Semester:

The semester in which a module must be absolved is indicated.

Person responsible for the module:

This person is responsible for the editing of the module.

Instructor:

Instructors are responsible for the content and organization of their courses and/or those courses, which are held by an associate instructor.

Language:

The language in which the course is taught is indicated.

Integration with other courses of study:

In the event that a module is also offered in other courses of study, this shall be indicated.

Type of instruction/WH:

The type of instruction as well as the weekly hours of instruction are indicated in tabular form. The abbreviations stand for:
Lecture (L)
Exercise (E)
Lab work (LW)
Seminar (S)

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Workload and credit points:
The workload consists of class attendance and study outside of class. The hours of class attendance are calculated by multiplying the WH (à 60 minutes) x 15, which is the normal number of weeks per semester, excluding the exam week.
The calculation of the time needed for study outside of class presupposes that students will require the time represented by the credit points. Each credit point represents 30 hours workload. The total workload is the sum of the workload resulting from class attendance and the workload resulting from study outside of class.

Requirements according to the examination regulations:
Students must have already completed the listed modules in order to participate in the respective module.

Recommended prerequisites:
Course instructors indicate the knowledge and proficiency that students should have in order to participate in and understand the subject matter of a course.

Goals of the module / desired outcome:
The goals of the module define the academic, technical and, if applicable, professional qualifications that should be achieved with this module. The desired outcome describes which knowledge, skills and competences are to be acquired through study.

Content:
The precise content of the course is described (operative level), with which the desired outcome is to be achieved.

Study and exam requirements:
The type of exam and its duration are indicated.

Media used:
The media (overhead projector, digital projector, flip chart, video, etc.) used in the course are indicated; furthermore, which documents are to be made available to the students when and in which form.

Literature:
A list of literature and, if applicable, information regarding multimedia-supported literature is provided. The literature list includes texts that will prepare students for the upcoming seminar as well as texts to accompany the course work during the semester.

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Module Description

BMS01 – Statistics in Biomedicine

<table>
<tr><td>Course of studies</td><td colspan="6">Biomedical Sciences (MSc)</td></tr>
<tr><td>Module</td><td colspan="6">Statistics in Biomedicine</td></tr>
<tr><td>Abbreviation</td><td colspan="6">BMS01</td></tr>
<tr><td>Course(s)</td><td colspan="6">• Multivariate Data Analysis (MDA)
• Medical Statistics</td></tr>
<tr><td>Semester</td><td colspan="6">Winter</td></tr>
<tr><td>Person responsible for the module</td><td colspan="6">Prof. Dr. Ralf Kemkemer</td></tr>
<tr><td>Instructor</td><td colspan="6">Prof. Dr. Ralf Kemkemer
Prof. Dr. Karsten Rebner</td></tr>
<tr><td>Language</td><td colspan="6">English / German for MDA course</td></tr>
<tr><td>Status within the curriculum</td><td colspan="6">Mandatory</td></tr>
<tr><td rowspan="4">Type of course / WH</td><td colspan="3">Course</td><td>L</td><td>E</td><td>LW</td><td>S</td></tr>
<tr><td colspan="3">Multivariate Data Analysis</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td colspan="3">Medical Statistics</td><td>2</td><td></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Workload in hours</td><td>Course</td><td>Class attendance</td><td>Study outside of class</td><td colspan="2">Total</td><td colspan="2">CP</td></tr>
<tr><td>Quantitative Biology</td><td>30</td><td>45</td><td colspan="2">75</td><td colspan="2"></td></tr>
<tr><td>Medical Statistics</td><td>30</td><td>45</td><td colspan="2">75</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Sum</td><td rowspan="2">60</td><td rowspan="2">90</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">150</td><td colspan="2">5</td></tr>
<tr><td>Credit points</td><td colspan="6">5</td></tr>
<tr><td>Prerequisites for attending this course</td><td colspan="6">See examination regulations</td></tr>
</table>

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Recommended knowledge / course work	Fundamentals of mathematics, IT, biology and medicine
Module goals / desired outcome	General knowledge: - Basic understanding of quantitative modes in cell biology and biomedical studies - Basic knowledge of principles of image processing and analysis in cell biology - Basic knowledge of statistical methods and multivariate data analyses - Basic knowledge of principles of experiment design and statistical learning - Knowledge of data visualization Technical competences: - Ability to use software tools for statistics, data and image analysis and data visualization - Ability to use databases for simple data retrieval - Ability to identify and use appropriate methods in statistics - Ability to develop simple quantitative models in cell biology - Ability to perform and interpret simple statistical methods and tests - Ability to recognize the limitations of statistical tests - Ability to develop linear and non-linear regression methods - Ability to design new multivariate models for a given data set Social competences and skills: - Ability to research, interpret and present scientific results
Content	• Medical and pharmaceutical statistics Statistics in clinical practice: gathering, interpreting and presenting statistical data from medical studies Design of experiments for drug development, optimization and approval procedures Approval of test hypothesis in clinical studies • Multivariate Data Analysis Explorative Data Analysis (EDA); Principal Components Analysis; Statistical Learning and Model Selection ; Linear Regression Methods and Regression Shrinkage Methods

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Study and exam requirements	Written exam (2h), presentation, term paper
Media used	PowerPoint slides, flip charts, board, computer, software tools
Literature	Quantitative Biology: From Molecular to Cellular Systems Michael E. Wall, ISBN 9781439827222, 2012 by CRC Press Research Methods for the Biosciences, 2nd Edition, D. Holmes, P. Moody, and D. Dine, Oxford University Press 2011 Statistical methods in medical research, P Armitage, G Berry, J N S Matthews, Blackwell Scientific Publications (Oxford, Boston) 2002 Esbensen, Kim, et al. *Multivariate Data Analysis: An Introduction to Multivariate Analysis, Process Analytical Technology and Quality by Design*. Camo, 2018. Kessler, W.: Multivariate Datenanalyse für die Pharma-, Bio- und Prozessanalytik, Wiley-VCH, 2007

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BMS02 – Scientific Methods

Course of studies	Biomedical Sciences (MSc)						
Module	Scientific Methods						
Abbreviation	BMS02						
Course(s)	• Quantitative Biology • Research Design						
Semester	Winter						
Person responsible for the module	Prof. Dr. Ralf Kemkemer						
Instructor	Prof. Dr. Ralf Kemkemer						
Language	English						
Status within the curriculum	Mandatory						
Type of course / WH	Course	L	E	LW	S		
	Information Retrieval and Evaluation	1	1				
	Multivariate Data Analysis	1	1				
Workload in hours	Course	Class attendance		Study outside of class	Total	CP	
	Information Retrieval and Evaluation	30		45	75		
	Research Design	30		45	75		
	Total	**60**		**90**	**150**	**5**	
Credit points	5						
Prerequisites for attending this course	See examination regulations (Studien- und Prüfungsordnung)						
Recommended knowledge / coursework	Basic understanding (BSc-level) of biology, biomedical technology and IT						

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Module goals / desired outcome	**General knowledge**: Successful students will obtain • overview of how to use relevant literature data bases with respect to scientific publications, patents, reviews, and monographs • understanding of how search engines and citation management programs function and can be used • Basic understanding of scientific institutions, scientific methods and history of science • Knowledge of principles of good scientific practice • Understanding of important concepts of research, e.g. hypothesis definition, literary research, planning of experiments, evaluation of experiments and data presentation • Understanding of science funding and scientific writing **Skills:** Successful students will be able • to conduct systematic and efficient scientific literature searches (source identification and exploitation) • to efficiently evaluate and document relevant publications and text/content therein • to cite literature correctly according to respective scientific standards and to save citations using citation managers • Understanding of advantages, disadvantages and limitations of scientific methods • Ability to design a basic research project and write a proposal therefore • Ability to plan a research project Social competences: • Ability to work in a self-organized manner and as a member of a team • Ability to do work target-oriented and systematically
Content	**Quantitative Biology** • ..... **Research Design** • Principles of scientific methods and history • Structure and organization of German and international scientific institutions • Principles of science funding • Principles of scientific research and literary research with practical examples • Aspects of a scientific project (hypothesis, planning, research, financing, data evaluation,...)

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	• Scientific writing (proposals, publications), review process
Study and exam requirements	Presentation, assignments, proposal
Media used	Lecture, board, overheads, lecture notes, handouts, exercise sheets, software practicals in CIP-pool
Literature	Research Methods for the Biosciences, 2nd Edition, D. Holmes, P. Moody, and D. Dine, Oxford University Press 2011 Scientific Publications

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BMS03 - Analytical Methods in Biomedical Sciences

Course of studies	Biomedical Sciences (MSc)				
Module	Analytical Methods in Biomedical Sciences				
Abbreviation	BMS03				
Course(s)	• Analytical Methods in Biomedical Sciences • Diagnostic Technologies				
Semester	Winter				
Person responsible for the module	Prof. Dr. Reinhard Kuhn				
Instructor	Prof. Dr. Reinhard Kuhn Prof. Dr. Ralf Kemkemer				
Language	English				
Status within the curriculum	Elective module				
Type of course / WH	Course	L	E	LW	S
	Analytical Methods in Biomedical Sciences	1			1
	Diagnostic Technologies	2			
Workload in hours	Course	Class attendance	Study outside of class	Total	CP
	Analytical Methods in Biomedical Sciences	30	45	75	
	Diagnostic Technologies	30	45	75	
	Total	**60**	**90**	**150**	**5**
Credit points	5				
Prerequisites for attending this course	See examination regulations				
Recommended knowledge / course work	Knowledge of biochemistry, bioanalytics, instrumental analytics, chemistry, material science, biology				

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Module goals / desired outcome	General knowledge Successful students will obtain • Profound overview of current bioanalytical techniques that are significant in biomedical and pharmaceutical research • Profound understanding of materials for diagnostic applications • Profound understanding of technologies and functioning of laboratory diagnostics and applications • Fundamental understanding of principles of cell biology, cell culture techniques and molecular biology Skills: • Understanding of complex relationships in bioanalytics • Understanding of the aspects of material science that are relevant for R&D in biotechnology, pharmaceutical and diagnostics industries • Understanding of principles of interaction of biological systems and molecules with materials • Understanding of principles of structure of diagnostic systems and prerequisites for certain applications • Ability to name limitations of existing technologies • Ability to evaluate various methods of modern cell culture techniques and laboratory diagnostics • Ability to read and understand scientific publications Social competences: • Ability to prepare and deliver a scientific presentation for a seminar • Ability to do scientific research and to present scientific findings

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Content	**Analytical Methods in Biomedical Sciences** The course consists of a lecture and a seminar. Students must choose a research topic on which they will prepare and hold a scientific presentation. The following fields of study will be covered in the lecture and seminar: • Biomarkers • Proteomics and metabolomics • Pharmaceutical analysis • Selected topics of bioanalysis, e.g. blotting techniques, two-hybrid systems, FRET, Patch Clamp, clinical laboratory analysis **Diagnostic Technologies** • Structure, function and application of laboratory diagnostic methods, in particular micro-technologies and microfluidics, lab-on-a-chip technology, cell biology, cell culture technologies, microscopy
Study and exam requirements	Written exam (2h), presentation, term paper
Media used	Lecture, script as download, board, student presentations, digital projector, handouts
Literature	• Rehm, H., Letzel, T.: Der Experimentator – Proteinbiochemie/Proteomics, Spektrum Verlag • Vishal, S.: Biomarkers in Medicine, Drug Discovery and Environmental Health, Wiley • Matson, R.S.: Applying Genomic and Proteomic Microarray Technology in Drug Discovery, CRC Press • Lovric, J.: Introducing Proteomics, Wiley-Blackwell • Russel, S., Meadows, L.A., Russel, R.R.: Microarray Technology in Practice, Academic Press • Mishra N.C., Introduction to Proteomics, Wiley (2010) • Issaq, H.J.: Proteomic and Metabolomic Approaches in Biomarker Discovery, Academic Press • Lämmerhofer, M.: Metabolomics in Practice, Wiley-VCH • Molecular Diagnostics : Fundamentals, Methods and Clinical Applications, 2nd Edition, Lela Buckingham PhD, MB, DLM(ASCP) ISBN-13: 978-0-8036-2677-5, 2012 Paperback, 576 pages • Scientific publications

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BMS04 - Materials and Applications in Biomedical Sciences

Course of studies	Biomedical Sciences (MSc)					
Module	Materials and Applications in Biomedical Sciences					
Abbreviation	BMS04					
Course(s)	• Functional Implants & Surface Technologies • Drug Release and Delivery Systems					
Semester	Winter					
Person responsible for the module	Prof. Dr. Rumen Krastev					
Instructor	Prof. Dr. Ralf Kemkemer Prof. Dr. Rumen Krastev					
Language	English					
Status within the curriculum	Elective module					
Type of course / WH	Course			L	E	LW / S
	Drug Release and Delivery Systems			2		
	Functional Implants & Surface Technologies			2		
Workload in hours	Course	Class attendance	Study outside of class	Total		CP
	Drug Release and Delivery Systems	30	45	75		
	Functional Implants & Surface Technologies	30	45	75		
	Total	**60**	**90**	**150**		**5**
Credit points	5					
Prerequisites for attending this course	See examination regulations					

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Recommended knowledge / course work	Basic understanding (BSc-level) of chemistry, biology and biomedical technology, material sciences
Module goals / desired outcome	Basic knowledge - Knowledge of materials for biomedical application in in-vitro and in-vivo applications - Understanding of technologies for surface modifications for implants and related methods - Knowledge of biomedical implant technologies - application examples and challenges - Understating of drug delivery concepts and application of polymers - Understanding of drug release methods, kinetics and applications Technical competences: - Students will be able to understand surface and polymer chemistry technologies and transfer these to appropriate applications in the biomedical field - Students will be able to identify technical working principles of complex implants - Students will be able to understand the complexity of tissue-material interaction and relate this to material properties - Students will be able to classify the suitability of different materials classes for specific applications - Students will be able to name limitations of current technologies in the field Social competences: - Students develop skills in research, reading and interpretation of scientific texts - Students gain an awareness of ethical aspects in the development of medical products.
Content	• Functional Implants & Surface Technologies Materials and design principles of passive and active implants, examples and applications, surfaces and surface modifications, technical principles of active implants (examples), micro and nanotechnology, surface chemistry, interaction of cells with materials. • Drug Release and Delivery Systems • Medical devices (active and passive) as drug delivery systems examples and applications

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	• Approaches, formulations, technologies, and systems for transporting of active pharmaceutical compounds as needed to achieve the desired therapeutic effect • Immobilization and delivery of “biologicals” e.g. peptides, proteins, antibodies, vaccines and gene based drugs • Release based on diffusion, degradation, swelling, and affinity-based mechanisms • Current approaches – site and time specific targeting, facilitated pharmacokinetics • Example techniques – thin polymer film delivery, acoustic or light targeted delivery, liposomal delivery.
Study and exam requirements	Written exam (2h), presentation /assignments
Media used	PowerPoint slides, flip charts, board
Literature	King M.R.: Principles of Cellular Engineering – Understanding the Biomolecular Interface, Academic Press, 2006 Ritter A.B., et al.: Biomedical Engineering Principles, CRC Press, 2012 Narayan R.: Biomedical Materials, Springer Publisher, 2009 Ratner B.D. et al.: Biomaterial Sciences, Elsevier Oxford, 2012 Wintermantel E., H. Suk-Woo Ha: Medizintechnik: Life Science Engineering, Springer 2009

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BMS05 - Microscopy and Microbial / Viral Pathogens

Course of studies	Biomedical Sciences (MSc)					
Module	Microscopy and Microbial / Viral Pathogens					
Abbreviation	BMS05					
Course(s)	• Microscopy and Optics • Microbial / Viral Pathogens and Infection					
Semester	Winter					
Person responsible for the module	Prof. Dr. Marc Brecht					
Instructor	Prof. Dr. Marc Brecht Dr. Doğan Doruk Demircioğlu					
Language	English and German					
Status within the curriculum	Elective module					
Type of course / WH	Course	L	E			
	Microscopy and Optics	2				
	• Microbial / Viral Pathogens and Infection	2				
Workload in hours	Course	Class attendance		Study outside of class	Total	CP
	Microscopy and Optics	30		45	75	
	• Microbial / Viral Pathogens and Infection	30		45	75	
	Sum	**60**		**90**	**150**	**5**
Credit points	5					
Prerequisites for attending this course	None					
Recommended knowledge / course work	Basic understanding of physics, microbiology, biochemistry (BSc level)					

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Module goals / desired outcome	After successful completion of this module: 1. Microscopy and Optics • Students have a detailed knowledge of geometrical and ray optics (K1) • Students understand the formation of images by mirrors and lenses (K2) • Students understand the difference between geometrical and wave optics (K2) • Students are able to solve problems of intermediate complexity (K3) • Students are able to construct images formed by a simple lens system (e.g. a microscope) (K3) • Students have a profound knowledge of the most relevant microscopic techniques (K1) • Students are able to assign a problem to the most relevant microscopy techniques (K4) • Students are able to analyze a given microscopy technique and find out the most relevant relations (K4) • Students create and give an oral presentation about a microscopic technique for other students (K6) 2. Microbial / Viral Pathogens and Infection • Studierende können Viren und Bakterien in Klassen einteilen • Entsprechend dem zellulären Aufbau von Bakterienzellwänden können sie Bakterien zuordnen • Sie verstehen die Mechanismen der Infektionswege • Die Studierenden sind in der Lage unterschiedliche Toxine zu beschreiben und können deren Einfluss auf den Menschen beschreiben • Sie kennen die Bedeutung von Impfungen zur Verhinderung von Infektionskrankheiten und verstehen die Mechanismen der Immunisierung • Sie haben die Grundlagen der Epidemiologie erlernt. • Sie sind in der Lage, unterschiedliche Techniken die Inaktivierung von Pathogenen einzuordnen und an Beispielen anzuwenden
Content:	1. Microscopy and Optics Optical technologies are a cornerstone of all analytical technologies. The lecture starts with a short repetition of geometric optics. We will discuss wave optics in free space and waveguides, followed by the basic function of lasers including modes in optical resonators and Fourier transformations in the description of

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	optical setups. Then we will consider aberrations of optical elements, lens design and technical optics. In the second part we will focus on microscopy, we will discuss the resolution of a conventional microscope as well as methods of resolution improvement like structured illumination, 4Pi, STED, STROM and FLIM microscopy and single-molecule sensitive detection. In all parts examples for applications will be given. 2. Microbial / Viral Pathogens and Infection • Grundlagen der Virologie und Bakteriologie • Strukturen bakterieller Zellmembranen, Zellwände und –oberflächen, Gram-positive und Gram-negative Bakterien, Mykobakterien, Virulenzfaktoren • State-of-the-Art Techniken der Virologie und Bakteriologie • Mechanismen der Infektiologie • Microbial Toxine (z.B. Hämolysin, Botulinus Toxin, Diphtheria Toxin, Anthraxtoxin, Tetanus Toxin, Pertussis Toxin, Cholera Enterotoxin, Staphylococcus aureus Enterotoxin, Escherichia coli Toxin) • Impfung • Grundlagen der Epidemiologie • Techniken der Inaktivierung von Pathogenen
Study and exam requirements	Written examination (2h), Presentation
Media used	Lecture, board, digital projector, handouts
Literature	• Hecht, E.: Optics, Addison-Wesley, 2001 • Demtröder, W.: Laser spectroscopy I & II, Springer; 5th ed. 2014 • Murphy, D.B.: Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Blackwell; 2nd ed. 2012 • Groß, U., Kurzlehrbuch Medizinische Mikrobiologie und Infektiologie, Thieme, 2013 • Suerbaum, S., Burchard, G.-D., Kaufmann, S.H.E., Schulz, Th.F. (Hrsg.); Medizinische Mikrobiologie und Infektiologie; Springer, 2010 • Modrow, S.; Molekulare Virologie; Spektrum Akademischer Verlag, 2010

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Course of studies	Biomedical Sciences (MSc)					
Module	Technology Management					
Abbreviation	BMS06					
Course(s)	• Project Management • Innovation Management • Quality Management					
Semester	Winter					
Person responsible for the module	Prof. Dr. Alexander Schuhmacher					
Instructor	Prof. Dr. Alexander Schuhmacher					
Language	English					
Status within the curriculum	Elective module					
Type of course / WH	Course			L	E	LW / S
	Project Management			2		
	Innovation Management			2		
Workload in hours	Course	Class attendance	Study outside of class	Total	CP	
	Project Management	30	45	75		
	Innovation Management	30	45	75		
	Total	60	90	150	5	
Credit points	5					
Prerequisites for attending this course	See examination regulations					
Recommended knowledge / course work	Basic understanding of project management					

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Module goals / desired outcome	Project Management: Ability to understand and use the principles of project management principles in managing a research project (time and costs). Ability to successfully lead a team Innovation Management: Understanding of innovation strategies and processes. Understanding of the significance of the context of innovation strategy for the daily business of researchers in an R&D organization. Ability to apply quality and quantitative evaluation methods in projects.
Content	Innovation Management • Economic relevance of innovation • Innovation strategies • Innovation processes • Open innovation Project management • Time and cost planning of projects • Portfolio management • Scientific and financial evaluation of research projects • High-performance teams
Study and exam requirements	Written examination (2h)
Media used	Lecture, group work, interactive discussions, handouts, flipcharts
Literature	Gassmann O. et al. (2004) Leading Pharmaceutical Innovation. Springer Verlag Schein EH (1997) Organizational Culture and Leadership. Jossey-Bass Publishers S. Nokes and S. Kelly. Guide to Project Management. FT Press (2003) PMI (2008) The Standard for Portfolio Management. 2nd edition. Project Management Institute Alexander Schuhmacher, Markus Hinder, Oliver Gassmann (2015) Value Creation in the Pharmaceutical Industry: The Critical Path Towards Innovation, Wiley International

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BMS07 - Industry-Related Topics 2 (Drug Discovery & Medical Technology)

Course of studies	Biomedical Sciences (MSc)					
Module	Industry-Related Topics 1					
Abbreviation	BMS07					
Course(s)	• Drug Discovery & Development • Introduction into Medical Technology					
Semester	Winter					
Person responsible for the module	Prof. Dr. Alexander Schuhmacher					
Instructor	Prof. Dr. Alexander Schuhmacher Prof. Dr. Günter Lorenz					
Language	English					
Status within the curriculum	Mandatory					
Type of course / WH	Course	L	E			
	Drug Discovery & Development	2				
	Introduction into Medical Technology	2				
Workload in hours	Course	Class attendance		Study outside of class	Total	CP
	Drug Discovery & Development	30		45	75	
	Introduction into Medical Technology	30		45	75	
	Sum	**60**		**90**	**150**	**5**
Credit points	5					
Prerequisites for attending this course	See examination regulations					
Recommended knowledge / course work	Basic understanding, knowledge of the principles of pharmaceutical and medical technology industries Basic knowledge of natural sciences					

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Module goals / desired outcome	Basic knowledge of the pharmaceutical and medical technology industries Understanding of strategic and operational topics concerning drug discovery, drug development, medical and biomedical technologies. In “Drug Discovery and Development”, students will receive information on state-of-the-art developments, research, and expert opinions in the pharmaceutical industry. Furthermore, the key success factors in research and development (R&D) as well as value creators in pharmaceutical innovation will be discussed. The topics addressed in the textbook include the innovation process, pharmaceutical R&D, research and innovation strategies. Students will gain an overview of the pharmaceutical industry and how pharmaceutical R&D works operationally. In the “Introduction to Medical Technology”, students will gain a basic understanding of fundamental technologies in bio-medical engineering, focusing on the medical background and basic principles of related methods (MRT, CT, sonography, PET, dialysis, heart-lung machine, artificial lungs, stents, heart valves, pace makers). Students will know: (1) the definition of biomedical engineering and (2) the basic principles and medical background of different technologies. Thus, students will improve their ability to (1) understand and use new vocabulary (2) read, summarize and discuss scientific topics and (3) prepare and present scientific results in the form of short presentations in teams.

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Content:	**Part 1: Drug Discovery and Development** • Global epidemiology • Pharma-economics • Drug costs • Financing of innovation • Drug targets • Preclinical safety • Pharmaceutical development • Translational medicine • Clinical development • Antibodies • Vaccines • Outsourcing • Pharmaceutical strategies **Part 2: Introduction to Medical Technologies** Introduction • Definition • Overview • Short summary of the basics Medical background and technology fundamentals: Medical imaging • MRT • CT • Sonography • PET • etc. Life support systems: • Dialysis • Heart-lung machine • Artificial lung • etc. Implants • Stent • Heart valve • Cochlear • Retinal
Study and exam requirements	Preparation and presentation of at least one scientific topic in the module; written examination (2 hours)
Media used	Lecture, group work, interactive discussions, handouts, flip charts

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Literature	• Wintermantel, E., Ha, S. W.: Medizintechnik: Life Science Engineering. Interdisziplinarität, Biokompatibilität, Technologien, Implantate, Diagnostik, Werkstoffe, Zertifizierung, Business Springer, Berlin; Auflage: 5., überarb. u. erw. A. 2009 • Ratner, B. D., Hoffman A.S. et al. (eds.): Biomaterials Science - An Introduction to Materials in Medicine, Elsevier Academic Press, 2004 • Joseph Bronzino and Donald R. Peterson : The Biomedical Engineering Handbook, Fourth Edition: Four Volume Set, Crc Pr Inc; 2015 • Pierre Morgon (2014) Sustainable Development in the Healthcare System, Springer

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BMS08 - Biofabrication and Regenerative Medicine

Course of studies	Biomedical Sciences (MSc)					
Module	Biofabrication and Regenerative Medicine					
Abbreviation	BMS08					
Course(s)	• Biofabrication • Regenerative Medicine					
Semester	Summer					
Person responsible for the module	Prof. Dr. Petra Kluger					
Instructor	Prof. Dr. Petra Kluger					
Language	English					
Status within the curriculum	Elective module					
Type of course / WH	Course	L	E	LW	S	
	Biofabrication	1	1			
	Regenerative Medicine	2				
Workload in hours	Course	Class attendance		Study outside of class	Total	CP
	Biofabrication	30		45	75	
	Regenerative Medicine	30		45	75	
	Total	**60**		**90**	**150**	**5**
Credit points						
Prerequisites for attending this course	See examination regulations					
Recommended knowledge / course work	Cell biology, physiology, biomaterials, tissue engineering, biomedical engineering					

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Module goals / desired outcome	• *students get insight into biofabrication technologies (including bioinks, CAD, automation, different 3D printing methods) f for future perspectives in biomedical engineering* • *students get an overview of the materials and techniques used in Regenerative Medicine; state of the art in various clinical applications and the global market* *students can:* • *define the term biofabrication* • *explain basic principles for automation, especially for automated cell and tissue culture as well as clinical applications* • *distinguish different biofabrication technologies, their characteristics and their pros & cons* • *analyze materials for their use as bioinks and their limitations* • *create of digital models by Computer aided design programs and the printing of the self-designed models* • *evaluatepotential applications of these biofabrication technologies in biomedical sciences* • *define the term regenerative medicine* • *compare characteristics of stem cells and their clinical use* • *analyze different matrix components and their properties as well as the potential clinical applications of different matrices* • *explain basic contents of the regulatory framework* • *describe key facts concerning the global regenerative medicine market* • *evaluate the state of the art in selected applications and the challenges* *students improve their ability in:* • *understanding and use new vocabulary* • *read, summarize, discuss and evaluate scientific topics* • *prepare and present results and short presentation in teams*

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Content	**Biomedical Technologies - Biofabrication** • Introduction Biofabrication • Overview of different biofabrication technologies • Lab automation for cell and tissue cultures • Bioinks for scaffold and tissue fabrication • CAD of models and the printing of these files **Regenerative Medicine** • Definition and short summary of fundamentals • Stem cells (basics and clinical applications) • Matrix (basics and clinical applications) • State-of-the-art clinical applications • Regulatory affairs and market
Study and exam requirements	One written exam for the module (120 min)
Media used	Lecture, interactive discussions, group work, flip chart, PCs, presentations
Literature	• Gustav Steinhoff, Regenerative Medicine: From Protocol to Patient, Springer 2013 • Anthony Atala, Robert Lanza, James A., Thomson, and Robert M. Nerem, Principles of Regenerative Medicine, Elsevier, 2008 • Ratner, B. D., Hoffman A.S. et al. (eds.): Biomaterials Science - An Introduction to Materials in Medicine, Elsevier Academic Press, 2004 • Joseph Bronzino and Donald R. Peterson : The Biomedical Engineering Handbook, Fourth Edition: Four Volume Set, Crc Pr Inc; 2015

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BMS09 - Advanced Pharmacology

Course of studies	Biomedical Sciences (MSc)				
Module	Advanced Pharmacology				
Abbreviation	BMS09				
Course(s)	• *Biomedical* Pharmacology • Advanced Bioanalysis				
Semester	Summer				
Person responsible for the module	Prof. Dr. Reinhard Kuhn				
Instructor	Prof. Dr. Reinhard Kuhn				
Language	English and German				
Status within the curriculum	Elective module				
Type of course / WH	Course	L	E	LW	S
	Biomedical Pharmacology	2			
	Advanced Bioanalysis	2			
Workload in hours	Course	Class attendance	Study outside of class	Total	CP
	Pharmacology	30	45	75	
	Advanced Bioanalysis	30	45	75	
	Total	**60**	**90**	**150**	**5**
Credit points	5				
Prerequisites for attending this course	See examination regulations				
Recommended knowledge / course work	Knowledge of biochemistry, bioanalytics and instrumental analytics, biology, fundamentals of pharmacology				

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Module goals / desired outcome	General knowledge: • Profound overview of current bioanalytical techniques relevant for biomedical as well as pharmaceutical research • Understanding of mode of action of drugs Skills: • Understanding of drug interaction in the human organism • In-depth knowledge of Pharmaco-kinetics and Pharmaco-dynamics • Understanding of the use of modern analysis systems in personalized medicine • Understanding of the functioning of microarray- and gene-chip-systems • Ability to read and understand scientific publications Social competences: • Preparation and presentation of a scientific presentation for a seminar • Ability to do scientific research and present scientific findings
Content	**Analytical Methods in Biomedical Sciences** • Labeling and detection • DNA structure and isolation • Cloning and sequencing • Advanced polymerase chain reaction • DNA/RNA microarray technology • Karyotype analysis • Personalized medicine • Examples of personalized medicine **Biomedical Pharmacology** • Fundamentals and Nomenclature in Pharmacology • Pharmacokinetics • Pharmacodynamics • Pharmacology of Thrombosis • Pharmacology of Hypertension • Pharmacology of Pain and inflammation
Study and exam requirements	Written exam (2h)
Media used	Lecture, script for download, board, digital projector, handouts

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Literature	• J Licino, ML Wong, *Pharmacogenomics*, Wiley-VCH (2003) • RS Matson, *Applying Genomic and Proteomic Microarray Technology in Drug Discovery*, CRC Press (2013) • C Mühlhardt, *Der Experimentator*: *Molekularbiologie/Genomics*, Spektrum Akad. Verlag (2002) • AM Lesk, *Introduction to Genomics*, Oxford University Press 2nd Ed. (2012) • M Lämmerhofer, W Weckwerth, *Metabolomics in Practice*, Wiley-VCH (2013) • S Russel, LA Meadows, RR Russel, *Microarray Technology in Practice*, Elsevier Academic Press (2009) • H Lüllmann, K Mohr, *Pharmakologie und Toxikologie*, Thieme (14. Aufl.) • E Mutschler, G Geisslinger, HK Kroemer, M Schäfer-Korting, *Arzneimittelwirkungen*, Wiss. Verlagsges. Stuttgart (8.Aufl.) • E Estler, *Pharmakologie und Toxikologie,* Schattauer (5. Aufl.) •

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BMS10 - Industry-Related Topics 2 (Regulatory Affairs & IP Management)

Course of studies	Biomedical Sciences (MSc)					
Module	Industry-Related Topics 1 (Regulatory Affairs & IP Management)					
Abbreviation	BMS10					
Course(s)	• Regulatory Affairs • IP Management					
Semester	Summer					
Person responsible for the module	Prof. Dr. Alexander Schuhmacher					
Instructor	Dr. Kuschel Prof. Dr. Alexander Schuhmacher					
Language	English					
Status within the curriculum	Elective Module					
Type of course / WH	Course	L	E			
	Regulatory Affairs	2				
	IP Management	2				
Workload in hours	Course	Class attendance		Study outside of class	Total	CP
	Regulatory Affairs	30		45	75	
	IP Management	30		45	75	
	Sum	**60**		**90**	**150**	**5**
Credit points	5					
Prerequisites for attending this course	See examination regulations					
Recommended knowledge / course work	No specific knowledge required					

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Module goals / desired outcome	The primary goal is to understanding the strategic and operational relevance of regulatory affairs and intellectual property (IP) rights for high-tech industries, such as the pharmaceutical, biotechnology and medical device industries. More specifically, it is the understanding of formalities in the development and manufacturing of medical devices and pharmaceutical products – with a focus of the respective national and international registration and authorization rules. In Intellectual Property (IP) Management, students will gain knowledge of the international and European patent laws, patentability requirements, how to file a patent application and the writing of patent claims.
Content:	Regulatory affairs • FDA • EMEA • ICH IP Management • European Patent Convention and Patent Cooperation Treaty • Filing a patent application • Searching for patents • Patentability analysis • Writing patent claims
Study and exam requirements	Written examination (2 hours)
Media used	Lecture, group work, interactive discussions, handouts, flip charts
Literature	• The European Patent Convention (http://documents.epo.org/projects/babylon/eponet.nsf/0/00E0CD7FD461C0D5C1257C060050C376/$File/EPC_15th_edition_2013_de_bookmarks.pdf) • National and international guidelines as accessible via FDA and EMEA

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BMS11 - Modules from other schools or universities

Course of studies	Biomedical Sciences (MSc)						
Module	Modules from other schools or universities						
Abbreviation	BMS11						
Course(s)	Elective courses						
Semester	Summer						
Person responsible for the module	Prof. Dr. Reinhard Kuhn						
Instructor	Prof. Dr. Reinhard Kuhn						
Language	English or German						
Status within the curriculum	Elective module						
Type of course / WH	Course	L	E	LW	S		
	Elective Subject I	2					
	Elective Subject II	2					
Workload in hours	Course	Class attendance		Study outside of class	Total	CP	
	Elective Subject I	30		45	75		
	Elective Subject II	30		45	75		
	Summe	**60**		**90**	**150**	**5**	
Credit points	5						
Prerequisites for attending this course	See examination regulations						
Recommended knowledge / course work	None						
Module goals / desired outcome							
Content							
Study and exam requirements	Students must document successful participation in a university course						
Media used	Dependent on elective						
Literature	Dependent on elective						

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BMS12 - Project Oriented Learning

Course of studies	Biomedical Sciences (MSc)					
Module	Project Oriented Learning					
Abbreviation	BMS12					
Course(s)	• Information Retrieval and Evaluation • Research Seminar • Team Project					
Semester	Summer					
Person responsible for the module	Prof. Dr. Reinhard Kuhn					
Instructor	All instructors within the faculty					
Language	English and German					
Status within the curriculum	Mandatory					
Type of course / WH	Course	L	E	LW	S	
	Information Retrieval and Evaluation	-	-	-	2	
	Research Seminar	-	-	-	2	
	Team project			12		
Workload in hours	Course	Class attendance		Study outside of class	Total	CP
	Information Retrieval and Evaluation	30		45	75	
	Research Seminar 30	30		45	75	
		180		270	450	
	Total	240		360	600	20
Credit points	20					
Prerequisites for attending this course	For reasons of occupational safety, the students have to prepare the theoretical and practical contents of the module prior to starting practical work in the laboratory. Proof of this is provided by successful participation in a safety and / or introductory colloquium (written or oral).					
Recommended knowledge / course work	Fundamentals in Chemistry, Physics and Biochemistry					

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Module goals / desired outcome	Objective is the education of the students in setting-up, planning and performing a project aiming at the solution of a specific research question. After successful completion of this module students: • understand how search engines and citation management programs function and can be used (K2). • use relevant literature data bases with respect to scientific publications, patents, reviews, and monographs (K3). • conduct systematic and efficient scientific literature searches (source identification and exploitation) (K3). • cite and organize literature correctly according to respective scientific standards and to save citations using citation managers (K4) • evaluate and efficiently document relevant publications and text/content therein (K5). • can define a research project: how to structure complex scientific questions and break them down into single steps like formulating state of the art and formulating scientific hypotheses. (K6) • successfully apply tools for practical project planning and coordination (Gantt-diagrams, decision gates, milestones, deliverables, etc.). (K5) • professionally apply tools for practical project management (action items, meeting organization, work documentation, efficient use of resources, coordination, etc.). (K4) • effectively extract information from technical and scientific databases and evaluate it with regard to a specific research question. (K4) • gain in-depth knowledge about a specific topic depending on the specified research question. (K3) • select the appropriate scientific methodology depending on the specific research question. (K4) • are able to think conceptually, work beneficial together in project teams and have developed and strengthened their team and communication skills. (K5) • properly present and scientifically sound defense their own findings in front of a panel of experts (= council of supervisors) (K5) • discuss competently experimental results in the light of the state of the art and comparing own findings to the scientific literature. (K4) • assimilate to novel research questions, adapt to / orientate in a new field. (K5) • are able to work in a self-organized manner and as a member of a team and do their work target-oriented and systematically. (K6)

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Content	Information Retrieval and Evaluation • Reference data bases, search engines, citation managers • Literature search examples/exercises based on concrete scientific questions The students will work in teams on a defined research question. The research question is defined by the supervisor at the faculty and will be in accordance with current research activities at the department. The students will prepare a scientific and technological state of the art on this research question and based on this they will define a project plan addressing all relevant issues of a real research project (time schedule, resource plan, objectives, means to arrive at the objectives, required methods, hypotheses, etc.). This project plan will be disseminated as a formal project application with a special focus on a comprehensive state of the art. No single-person projects are admissible and all projects are hosted by the faculty exclusively. The actual research project plan set up by the students will then be realized. The students will perform the necessary scientific and technological experiments based on the state of the art on this research question and their research proposal. The students organize their project by themselves and are guided by the supervising professor. The project results will be disseminated as a formal final project report. The results will also be presented at a final oral defense in front of a panel of all supervising professors and a poster presentation will be prepared.
Study and exam requirements	Study requirements: oral presentation of project plan during semester Exam requirements: Written seminar paper (= state of the art) (50%) Final project report (35%) Final project defense (15%), including oral presentation and poster presentation
Media used	Lecture, board, digital projector, handouts
Literature	1. Chalmers AF (2007) Wege der Wissenschaft. Einführung in die Wissenschaftstheorie, 6. Auflage, Nachdruck, Springer 2. Patzak G, Rattay G (2004) Projektmanagement, 4. Auflage, Linde International 3. Baguley P (1999) Optimales Projektmanagement, Falken 4. Scientific Original papers, depending on the specific research question 5. H.F. Ebel et al. (2006) Schreiben und Publizieren in den Naturwissenschaften, Wiley-VCH Weinheim. Dependent on topic of research project

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BMS13 - Master Thesis

Course of studies	Biomedical Sciences (MSc)					
Module	Master Thesis					
Abbreviation	BMS13					
Course(s)	• Master‘s Thesis Project and Defense (internal/ external) • Research Seminar to Master‘s Thesis					
Semester	3					
Person responsible for the module	Prof. Dr. Reinhard Kuhn					
Instructor	All instructors of the faculty					
Language	English or German					
Status within the curriculum	Mandatory					
Type of course / WH	Course	L	E	LW	S	
	Master‘s Thesis	-	-		-	
	Seminar	-	-	-	2	
Workload in hours	Course	Class attendance	Study outside of class	Total	CP	
	Master‘s Thesis		840	840	28	
	Seminar	30	30	60	2	
	Total			900	30	
Credit points	30					
Prerequisites for attending this course	See examination regulations					
Recommended knowledge / course work	Successful completion of research project					

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Module goals / desired outcome	Ability to implement acquired research abilities within a defined research project General knowledge • Ability to do detailed and in-depth research on a defined scientific field of study Skills • Ability to work independently in a team on a defined research project • Ability to evaluate and implement insights / findings of scientific literature • Ability to prepare and present scientific results Technical competences • Ability to apply modern strategies for finding scientific solutions • Social competences: • Ability to promote team work in a research group
Content	Students will work independently on a defined research project, preferably in a research group at the Reutlingen University or at an external research institute (e.g. NMI at the University of Tübingen or the Fraunhofer Institute in Stuttgart). Students will work under the direction of a professor of our faculty. Their work will culminate in a master's thesis, to be written by each student individually and independently. The thesis work may also be done in an industrial R&D department, provided a professor of the Faculty of Applied Chemistry supervises the project. Each student will research a defined scientific topic, present his/her findings to a board of experts and prepare a scientific publication of the results. Work on the thesis will be accompanied by regular attendance of seminars on the topic of research.
Study and exam requirements	Master's thesis: The master's thesis will be evaluated by the mentoring professor as well as by a second reviewer Seminar on topics related to master's thesis: After completing the master's thesis, students will hold an oral presentation on their work
Media used	Oral presentation, written thesis, digital projector, PowerPoint slides
Literature	Dependent on research project

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BMS14 - Internship Semester - Zusätzliches Modul nur für Studierende mit 180 ECTS Bachelor Abschluss

Course of studies	**Biomedical Sciences (MSc)**					
Module	Internship semester					
Abbreviation	BMS14					
Course(s)	Internship semester					
Semester	Winter or Summer					
Person responsible for the module	Prof. Dr. Reinhard Kuhn					
Instructor	All instructors of faculty					
Language	English or German					
Status within the curriculum	Mandatory for those students who have collected 180 ECTS from their bachelor study					
Type of course / WH	Course	L	E	LW	S	
	Internship semester	-	-	-	-	
Workload in hours	Course	Class attendance		Study outside of class	Total	CP
	Internship semester			900	900	30
	Total			**900**	**900**	**30**
Credit points	30					
Prerequisites for attending this course	See examination regulations					
Recommended knowledge / course work	Successful completion of semesters 1 and 2					

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Module goals / desired outcome	Knowledge: • insight into the structure, organization and operations of an industrial company or a research institution Skills: • introduction to the independent processing of specific tasks within projects Competencies: • ability for determining the status of development / research by literature search • Acquiring the skills for independent implementation of projects • Competence for systematic and structured approach • competence to work scientifically Social competence: • learning the manners and practices in the work environment • improve the team and communication skills through participation in the working group • intercultural competence acquisition
Content	The internship semester is performed in close co-operation between the internship site, the student and the internship Office of the school of Applied Chemistry. In 24 weeks, interns work on projects in their industrial enterprises or their institutions, which are connected to the thematic study content of the curriculum.
Study and exam requirements	Continuous assessment, regular reporting, preparation of a project report manuscript, certificate of the internship site
Media used	
Literature	Depends on actual project

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