# Module Compendium

for the Master's Degree Program Master of Science

## Biomedical Sciences (BMS)

Valid as of October 2024

Faculty of Life Sciences

Study programme director: Prof. Dr. Dr. Isabel Burghardt



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# Table of contents





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# 1. 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 Life Sciences.

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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# 2. Introduction

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 (BMSM01)
- Scientific methods (BMSM02)

These modules provide fundamental knowledge in the field of biomedical science.

In addition, also in the **winter semester, five modules** covering various fields in biomedical sciences are presented, of which **four modules are to be selected:**

- Analytical Methods in Biomedical Sciences“ (BMSW03)
- Materials and Applications in Biomedical Sciences“ (BMSW04)
- Microbiology & Virology (BMSW05)
- Technology Management“ (BMSW06)
- Industry-Related Topics 2 (BMSW07).



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In the **summer term**, the main focus is laid on the **mandatory** module

- Project-Oriented Learning (BMSM12),

This module 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 in the **summer term**, **three modules** are offered, of which **two modules must be selected**:

- Biofabrication & Regenerative Medicine (BMSW08)
- Advanced Pharmacology (BMSW09)
- Industry-Related Topics 1 (BMSW10)

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.

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 | 30h | 60h | 90h | 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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# 3. Overview of the modules in the course of studies

| Module | Courses | * W/S | ** M/E | WH | ECTS |
|---|---|---|---|---|---|
| BMSM01: Statistics in Biomedicine | 1.1: Medical Statistics<br>1.2: Multivariate Data Analysis | W | M | 2<br>2 | 5 |
| BMSM02: Scientific Methods | 2.1: Quantitative Biology<br>2.2: Research Design | W | M | 2<br>2 | 5 |
| BMSW03: Analytical Methods in Biomedical Sciences | 3.1: Analytical Methods in Biomedical Sci.<br>3.2: Diagnostic Technologies | W | E | 2<br>2 | 5 |
| BMSW04: Materials and Applications in Biomedical Sci. | 4.1.: Functional Implants & Surface Technologies<br>4.2: Drug Research and Delivery Systems | W | E | 2<br>2 | 5 |
| BMSW05: Microscopy and Microbial / Viral Pathogens | 5.1: Microscopy and Optics<br>5.2: Microbial / Viral Pathogens and Infection | W | E | 2<br>2 | 5 |
| BMSW06: Technology Management | 6.0: Innovation M/QM/Project M | W | E | 4 | 5 |
| BMSW07: Industry-Related Topics 2 | 7.1: Drug Discovery & Development<br>7.2: Introduction into Medical Technology | W | E | 2<br>2 | 5 |
| BMSW08: Biofabrication & Regenerative Medicine | 8.0 Biofabrication & Regenerative Medicine | S | E | 4 | 5 |
| BMSW09: Advanced Pharmacology | 9.1: Biomedical Pharmacology<br>9.2: Advanced Bioanalysis | S | E | 2<br>2 | 5 |
| BMSW10: Industry-Related Topics 1 | 10.1: Regulatory Affairs<br>10.2: IP Management | S | E | 2<br>2 | 5 |
| BMSW11: Modules from other Schools or Universities | 11.0: Modules from other Schools or Universities | S | E | 4 | 5 |
| BMSM12: Project Oriented Learning | 12.1: Information Retrieval and Evaluation<br>12.2: Research Seminar<br>12.3. Team Project | S | M | 2<br>2<br>12 | 20 |
| BMSM13: Master‘s Thesis | 13.1: Master’s Thesis Project and Defense<br>13.2: Research Seminar | 3<br>3 | M | -<br>2 | 30 |
| BMSW14: Internship semester (Add. Module only for stud. with 180 ECTS BSc's degree) | 14.0: Internship semester | W/S | E | - | 30 |

* Semester: W (Winter) / S (Summer)
**Type: M (Mandatory) / E (Elective)



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# 4. 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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# 5. Module description

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 BMSM1 stands for the first module in Biomedical Sciences (the second „M“ stands for „Mandatory“, „W“ stands for „Elective“ = „Wahlpflichtmodul“).

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.



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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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# BMSM01: Statistics in Biomedicine

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Statistics in Biomedicine | | | | | |
| **Abbreviation** | BMSM01 | | | | | |
| **Course(s)** | Medical Statistics<br>Multivariate Data Analysis (MDA) | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Rumen Krastev | | | | | |
| **Instructor(s)** | Dr. Nadejda Krasteva<br>Prof. Dr. Karsten Rebner | | | | | |
| **Language** | English / German for MDA course | | | | | |
| **Status within the curriculum** | Mandatory | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | Medical Statistics | | 2 | | | |
| | Multivariate Data Analysis (MDA) | | 1 | 1 | | |
| **Workload in hours** | Course | Class Attendance | Study outside of class | | Total | CP |
| | Medical Statistics | 30 | 45 | | 75 | |
| | Multivariate Data Analysis (MDA) | 30 | 45 | | 75 | |
| | **Total** | **60** | **90** | | **150** | **5** |
| **Credit points** | 5 | | | | | |
| **Prerequisites for attending this course** | See examination regulations | | | | | |
| **Recommended knowledge / course work** | Fundamentals of mathematics, IT, biology, chemistry, physics and/or medicine | | | | | |
| **Module goals / desired outcome** | <u>General knowledge:</u><br>• Ability to think statistically<br>• Basic knowledge of statistical methods and multivariate data analyses | | | | | |



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|---|---|
| | • Basic knowledge of principles of experiment design and statistical learning<br><br>Technical competences:<br>• Ability to use databases for simple data retrieval<br>• Ability to identify and use appropriate methods in statistics<br>• Ability to perform and interpret simple statistical methods and tests<br>• Ability to recognize the limitations of statistical tests<br>• Ability to develop linear and non-linear regression methods<br>• Ability to design new multivariate models for a given data set<br>• Ability to describe medical processes statistically<br>• Ability to use the knowledge in approval processes for medical devices.<br>• Ability to use software tools for statistics, data and image analysis and data visualization<br><br>Social competences and skills:<br>• Ability to research, interpret and present scientific results |
| **Content** | • Medical and pharmaceutical statistics<br>Statistics in clinical practice: gathering, interpreting and presenting statistical data from medical studies<br>Design of experiments for drug development, optimization and approval procedures Approval of test hypothesis in clinical studies<br>• Multivariate Data Analysis<br>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) |
| **Media used** | PowerPoint slides, flip charts, board, computer, software tools |
| **Literature** | • Statistical methods in medical research, P Armitage, G Berry, J N S Matthews, Blackwell Scientific Publications (Oxford, Boston) 2002<br>• Esbensen, Kim, et al. Multivariate Data Analysis: An Introduction to Multivariate Analysis, Process Analytical Technology and Quality by Design. Camo, 2018.<br>• Kessler, W.: Multivariate Datenanalyse für die Pharma-, Bio- und Prozessanalytik, Wiley-VCH, 2007 |



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# BMSM02: Statistics in Biomedicine

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Scientific Methods | | | | | |
| **Abbreviation** | BMSM02 | | | | | |
| **Course(s)** | Quantitative Biology<br>Research Design | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Ralf Kemkemer | | | | | |
| **Instructor(s)** | Prof. Dr. Ralf Kemkemer | | | | | |
| **Language** | English | | | | | |
| **Status within the curriculum** | Mandatory | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | Quantitative Biology | | 1 | 1 | | |
| | Research Design | | 1 | 1 | | |
| **Workload in hours** | Course | Class Attendance | Study outside of class | | Total | CP |
| | Quantitative Biology | 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 / course work** | | | | | | |
| **Module goals / desired outcome** | <u>General knowledge:</u><br>Successful students will obtain<br>• Overview of how to use relevant literature data bases with respect to scientific publications, patents, reviews, and monographs | | | | | |



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



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|---|---|
| | • Principles of science funding<br>• Principles of scientific research and literary research with practical examples<br>• Aspects of a scientific project (hypothesis, planning, research, financing, data evaluation,...)<br>• 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<br>• Scientific Publications |



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# BMSW03: Analytical Methods in Biomedical Sciences

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Analytical Methods in Biomedical Sciences | | | | | |
| **Abbreviation** | BMSW03 | | | | | |
| **Course(s)** | Analytical Methods in Biomedical Sciences<br>Diagnostic Technologies | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Günther Proll | | | | | |
| **Instructor(s)** | Prof. Dr. Jörg Mittelstät<br>Prof. Dr. Günther Proll | | | | | |
| **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 | | | | | |
| **Module goals / desired outcome** | <u>General knowledge:</u><br>Successful students will obtain<br>• Profound overview of current bioanalytical techniques that are significant in biomedical and pharmaceutical research | | | | | |



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| | • Profound understanding of materials for diagnostic applications<br>• Profound understanding of technologies and functioning of laboratory diagnostics, point-of-care testing and applications<br>• Fundamental understanding of principles of cell biology, and molecular biology<br><br><u>Skills:</u><br>• Understanding of complex relationships in bioanalytics<br>• Understanding of the aspects of -OMICS that are relevant for R&D in biotechnology, pharmaceutical and diagnostics industries<br>• Understanding of principles of interaction of biological systems and molecules with materials<br>• Understanding of principles of structure of diagnostic systems and prerequisites for certain applications<br>• Ability to name limitations of existing technologies<br>• Ability to evaluate various methods of laboratory diagnostics<br>• Ability to read and understand scientific publications<br><br><u>Social competences:</u><br>• Ability to prepare and deliver a scientific presentation for a seminar<br>• Ability to do scientific research and to present scientific findings |
| **Content** | <u>Analytical Methods in Biomedical Sciences</u><br>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:<br>• Biomarkers<br>• Proteomics and metabolomics<br>• Pharmaceutical analysis |



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| | • Selected topics of bioanalysis e.g, high content bioimaging, cellomics, epigenomics<br><br>Diagnostic Technologies<br>Structure, function and application of laboratory diagnostic methods, in particular micro-technologies and microfluidics, lab-on-a-chip technology, Bio-MEMS, point-of-care testing, personalized medicine, companion diagnostics, AI in diagnostics |
| **Study and exam requirements** | Written exam (2h), presentation, term paper |
| **Media used** | Lecture, script as download, board, student presentations, digital projector, handouts |
| **Literature** | • Jens Kurreck, Joachim W. Engels, Friedrich Lottspeich, Bioanalytik, Springer-Verlag GmbH Berlin 2022<br>• Albert Folch, Introduction to BioMEMS, CRC Press (2013)<br>• Peter Luppa, POCT - Patientennahe Labordiagnostik, Springer (2017)<br>• Strachan T, Read AP, Matson RS, Human Molecular Genetics, CRC Press (2018).<br>• Barh D, Blum K, Madigan MA, OMICS – Biomedical Perspectives and Applications, CRC Press (2012)<br>• Rehm, H., Letzel, T.: Der Experimentator – Proteinbiochemie/Proteomics, Spektrum Verlag<br>• Scientific publications |



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# BMSW04: Materials and Applications in Biomedical Sciences

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Materials and Applications in Biomedical Sciences | | | | | |
| **Abbreviation** | BMSW04 | | | | | |
| **Course(s)** | Functional Implants & Surface Technologies<br>Drug Release and Delivery Systems | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Rumen Krastev | | | | | |
| **Instructor(s)** | Prof. Dr. Rumen Krastev<br>Dr. Xin Xiong | | | | | |
| **Language** | English | | | | | |
| **Status within the curriculum** | Elective module | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | Functional Implants & Surface Technologies | | 2 | | | |
| | Drug Release and Delivery Systems | | 2 | | | |
| **Workload in hours** | Course | Class Attendance | Study outside of class | | Total | CP |
| | Functional Implants & Surface Technologies | 30 | 45 | | 75 | |
| | Drug Release and Delivery Systems | 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 (BSc-level) of chemistry, biology and biomedical technology, material sciences | | | | | |
| **Module goals / desired outcome** | <u>General knowledge:</u><br>• Knowledge of materials for biomedical application in in- vitro and in-vivo applications<br>• Understanding of technologies for surface modifications for implants and related methods | | | | | |



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|---|---|
| | • Knowledge of biomedical implant technologies - application examples and challenges<br>• Understating of drug delivery concepts and application of polymers<br>• Understanding of drug release methods, kinetics and applications<br><br><u>Technical competences:</u><br>• Students will be able to understand surface and polymer chemistry technologies and transfer these to appropriate applications in the biomedical field<br>• Students will be able to identify technical working principles of complex implants<br>• Students will be able to understand the complexity of tissue-material interaction and relate this to material properties<br>• Students will be able to classify the suitability of different materials classes for specific applications<br>• Students will be able to name limitations of current technologies in the field<br><br><u>Social competences:</u><br>• Students develop skills in research, reading and interpretation of scientific texts<br>• Students gain an awareness of ethical aspects in the development of medical products. |
| **Content** | <u>Functional Implants & Surface Technologies</u><br>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.<br><br><u>Drug Release and Delivery Systems</u><br>• Approaches, formulations, technologies, and systems for transporting of active pharmaceutical compounds as needed to achieve the desired therapeutic effect |



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| | • Release based on diffusion, degradation, swelling, and affinity-based mechanisms<br>• Immobilization and delivery of "biologicals" e.g. peptides, proteins, antibodies, vaccines and gene therapie<br>• Current approaches – site and time specific targeting, facilitated pharmacokinetics<br>• 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** | • Saber AminYavari (ed.) - Surface Engineering of Biomaterials MDPI Press 2020<br>• Tasaltin N; P.S. Nnamchi (Eds.) Advanced Functional Materials MDPI Press 2020<br>• King M.R.: Principles of Cellular Engineering – Understanding the Biomolecular Interface, Academic Press, 2006<br>• Ritter A.B., et al.: Biomedical Engineering Principles, CRC Press, 2012<br>• Narayan R.: Biomedical Materials, Springer Publisher, 2009 Ratner B.D. et al.: Biomaterial Sciences, Elsevier Oxford, 2012<br>• Wintermantel E., H. Suk-Woo Ha: Medizintechnik: Life Science Engineering, Springer 2009<br>• Drug delivery: Fundamentals and Applications, CRC Press, 2017, Edited By Anya Hillery, Kinam Park, , ISBN 9781482217711<br>• Drug Delivery: Principles and Applications, edited by Binghe Wang, Longqin Hu, Teruna J. Siahaan. Wiley, 2016. ISBN: 978-1-118-83336-0 |



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# BMSW05 - Microscopy and Microbial / Viral Pathogens

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Microscopy and Microbial / Viral Pathogens | | | | | |
| **Abbreviation** | BMSW05 | | | | | |
| **Course(s)** | Microscopy and Optics<br>Microbial / Viral Pathogens and Infection | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Günther Proll | | | | | |
| **Instructor(s)** | Prof. Dr. Günther Proll<br>Dr. Doğan Doruk Demircioğlu | | | | | |
| **Language** | English and German | | | | | |
| **Status within the curriculum** | Elective module | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | 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 | |
| | **Total** | **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) | | | | | |
| **Module goals / desired outcome** | <u>Microscopy and Optics</u><br>• Students have a detailed knowledge of geometrical and ray optics (K1) | | | | | |



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| | • Students understand the formation of images by Basic understanding of physics, microbiology, biochemistry (BSc level) lenses (K2)<br>• Students understand the difference between geometrical and wave optics (K2)<br>• Students are able to solve problems of intermediate complexity (K3)<br>• Students are able to construct images formed by a simple lens system (e.g. a microscope) (K3)<br>• Students have a profound knowledge of the most relevant microscopic techniques (K1)<br>• Students are able to assign a problem to the most relevant microscopy techniques (K4)<br>• Students are able to analyze a given microscopy technique and find out the most relevant relations (K4)<br>• Students create and give an oral presentation about a microscopic technique for other students (K6)<br><br><u>Microbial / Viral Pathogens and Infection</u><br>• Students can classify viruses and bacteria into categories.<br>• Based on the cellular structure of bacterial cell walls, they can classify bacteria.<br>• They understand the mechanisms of infection pathways.<br>• Students are able to describe different toxins and explain their effects on humans.<br>• They know the importance of vaccinations in preventing infectious diseases and understand the mechanisms of immunization.<br>• They have learned the basics of epidemiology.<br>• They are able to identify different techniques for inactivating pathogens and apply them to examples. |



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| **Content** | <u>Microscopy and Optics</u><br>• Optical technologies are a cornerstone of many analytical technologies. The lecture begins with a brief review of geometrical optics. We discuss wave optics in free space and look at aberrations of optical elements, lens design and technical optics.<br>• In the second part, we focus on microscopy and discuss the resolution of a conventional microscope, as well as fluorescence microscopy and the confocal microscope. Furthermore, the methods TIRF and FRET, as well as methods for resolution enhancement such as structured illumination, 4Pi, STED, STORM and FLIM microscopy are discussed.<br>• Furthermore, resolution enhancements through software solutions as well as automated microscopy techniques and AI-based approaches are discussed.<br>• Examples of applications are given in all parts.<br><br><u>Microbial / Viral Pathogens and Infection</u><br>• Students will understand the fundamentals of microbiology/virology, including viral and bacterial taxonomy, metabolism etc.<br>• Students will understand basic concepts of Microbial Genetics<br>• Students will understand what a disease is, what causes a disease and how the human immune system clears an infectious disease<br>• Students will understand the enormous and diverse impact of microbiota/the microbiome on humans<br>• Students will understand the importance of vaccinations for the prevention of infectious diseases caused by Gram-negative or positive pathogens or viruses and understand the underlying mechanism of immunization |



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| | • Students will learn how antibiotics work, why AMR is a global health concern and how to tackle it<br>• Students will get an overview of virus biology and antiviral chemotherapy |
| **Study and exam requirements** | Written exam (2h), presentation |
| **Media used** | Lecture, board, digital projector, handouts |
| **Literature** | • Hecht, E.: Optics, Addison-Wesley, 2001<br>• Murphy, D.B.: Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Blackwell; 2nd ed. 2012<br>• Jens Kurreck, Joachim W. Engels, Friedrich Lottspeich, Bioanalytik, Springer-Verlag GmbH Berlin 2022<br>• Modrow, S.; Molekulare Virologie; Spektrum Akademischer Verlag, 2022<br>• Allgemeine Mikrobiologie, Thieme, 2021<br>• Brock Microbiology of Microorganisms, Global Edition, 2021<br>• Jane Flint, Vincent R. Racaniello et al.: Principles of Virology, 2020<br>• Scientific publications |



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# BMSW06: Technology Management

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Technology Management | | | | | |
| **Abbreviation** | BMSW06 | | | | | |
| **Course(s)** | Project Management<br>Innovation Management | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Andreas Kandelbauer | | | | | |
| **Instructor(s)** | Prof. Dr. Andreas Kandelbauer<br>Dr. Xin Xiong<br>Dr. Andreas Paar | | | | | |
| **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 | | | | | |
| **Module goals / desired outcome** | <u>Project Management:</u><br>• Ability to understand and use the principles of project management principles in managing a research project (time and costs).<br>• Ability to successfully lead a team. | | | | | |



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



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# BMSW07: Industry-Related Topics 2

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| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Industry-Related Topics 2 | | | | | |
| **Abbreviation** | BMSW07 | | | | | |
| **Course(s)** | Drug Discovery & Development<br>Introduction into Medical Technology | | | | | |
| **Semester** | Winter | | | | | |
| **Person responsible for the module** | Prof. Dr. Jörg Mittelstät | | | | | |
| **Instructor(s)** | Prof. Dr. Jörg Mittelstät<br>Dr. Andreas Schüle | | | | | |
| **Language** | English | | | | | |
| **Status within the curriculum** | Elective module | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | Drug Discovery & Development | | 2 | | | |
| | Introduction into Medical Technology | | 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, knowledge of the principles of pharmaceutical and medical technology industries<br>• Basic knowledge of natural sciences<br>• Basic knowledge of the pharmaceutical and medical technology industries | | | | | |



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| **Module goals / desired outcome** | Understanding of strategic and operational topics concerning drug discovery, drug development, medical and biomedical technologies.<br>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 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.<br><br>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).<br>Students will know:<br>• the definition of biomedical engineering and<br>• the basic principles and medical background of different technologies.<br>Thus, students will improve their ability to<br>• understand and use new vocabulary<br>• read, summarize and discuss scientific topics and<br>• prepare and present scientific results in the form of short presentations in teams. |
| **Content** | Drug Discovery and Development<br>• Global epidemiology<br>• Pharma-economics<br>• Financing of innovation<br>• Drug targets<br>• Preclinical safety |



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| | • Pharmaceutical development<br>• Translational medicine<br>• Clinical development<br>• Biologics and ATMPs<br>• Bioequivalence and Biosimilars<br>• Regulatory considerations<br>• Pharmaceutical strategies<br><u>Introduction to Medical Technologies</u><br>Introduction<br>• Definition<br>• Overview<br>• Short summary of the basics<br>Medical background and technology fundamentals: Medical imaging<br>• MRT<br>• CT<br>• Sonography<br>• PET<br>• etc.<br>Life support systems<br>• Dialysis<br>• Heart-lung machine<br>• Artificial lung<br>• etc.<br>Implants<br>• Stent<br>• Heart valve<br>• Cochlear<br>• 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** | • Blass BE, Basic Principles of Drug Discovery and Development,2nd Edition, Elsevier Academic Press, 2021<br>• Hill RG, Richards DB, Drug Discovery and Development – Technology in Transition, 3rd Edition, Elsevier.<br>• 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<br>• Ratner, B. D., Hoffman A.S. et al. (eds.): Biomaterials Science - An Introduction to Materials in Medicine, Elsevier Academic Press, 2004<br>• Joseph Bronzino and Donald R. Peterson : The Biomedical Engineering Handbook, Fourth Edition: Four Volume Set, Crc Pr Inc; 2015<br>• Pierre Morgon (2014) Sustainable Development in the Healthcare System, Springer |



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# BMSW08: Biofabrication & Regenerative Medicine

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Biofabrication & Regenerative Medicine | | | | | |
| **Abbreviation** | BMSW08 | | | | | |
| **Course(s)** | Biofabrication<br>Regenerative Medicine | | | | | |
| **Semester** | Summer | | | | | |
| **Person responsible for the module** | Prof. Dr. Petra Kluger | | | | | |
| **Instructor(s)** | 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** | 5 | | | | | |
| **Prerequisites for attending this course** | See examination regulations | | | | | |
| **Recommended knowledge / course work** | Cell biology, physiology, biomaterials, tissue engineering, biomedical engineering | | | | | |
| **Module goals / desired outcome** | Students get insight into biofabrication technologies (including bioinks, CAD, automation, different 3D printing methods) for future perspectives in biomedical engineering | | | | | |



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| | 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<br><br><u>students can</u>:<br>• define the term biofabrication<br>• explain basic principles for automation, especially for automated cell and tissue culture as well as clinical applications<br>• distinguish different biofabrication technologies, their characteristics and their pros & cons<br>• analyze materials for their use as bioinks and their limitations<br>• create of digital models by Computer aided design programs and the printing of the self-designed models<br>• evaluate potential applications of these biofabrication technologies in biomedical sciences<br>• define the term regenerative medicine<br>• compare characteristics of stem cells and their clinical use<br>• analyze different matrix components and their properties as well as the potential clinical applications of different matrices<br>• explain basic contents of the regulatory framework<br>• describe key facts concerning the global regenerative medicine market<br>• evaluate the state of the art in selected applications and the challenges<br><br><u>students improve their ability in:</u><br>• understanding and use new vocabulary<br>• read, summarize, discuss and evaluate scientific topics<br>• prepare and present results and short presentation in teams |



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| **Content** | <u>Biomedical Technologies - Biofabrication</u><br>• Introduction Biofabrication<br>• Overview of different biofabrication technologies<br>• Lab automation for cell and tissue cultures<br>• Bioinks for scaffold and tissue fabrication<br>• CAD of models and the printing of these files<br><br><u>Regenerative Medicine</u><br>• Definition and short summary of fundamentals<br>• Stem cells (basics and clinical applications)<br>• Matrix materials (basics and clinical applications)<br>• State-of-the-art clinical applications<br>• Regulatory affairs and market |
| **Study and exam requirements** | written examination (2 hours) |
| **Media used** | Lecture, interactive discussions, group work, flip chart, PCs, presentations |
| **Literature** | • Gustav Steinhoff, Regenerative Medicine: From Protocol to Patient, Springer 2013<br>• Anthony Atala, Robert Lanza, James A., Thomson, and Robert M. Nerem, Principles of Regenerative Medicine, Elsevier, 2008<br>• Ratner, B. D., Hoffman A.S. et al. (eds.): Biomaterials Science - An Introduction to Materials in Medicine, Elsevier Academic Press, 2004<br>• Joseph Bronzino and Donald R. Peterson: The Biomedical Engineering Handbook, Fourth Edition: Four Volume Set, Crc Pr Inc; 2015r |



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# BMSW09: Advanced Pharmacology

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| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Advanced Pharmacology | | | | | |
| **Abbreviation** | BMSW09 | | | | | |
| **Course(s)** | Biomedical Pharmacology<br>Advanced Bioanalysis | | | | | |
| **Semester** | Summer | | | | | |
| **Person responsible for the module** | Prof. Dr. Jörg Mittelstät | | | | | |
| **Instructor(s)** | Prof. Dr. Jörg Mittelstät<br>Prof. Dr. Günther Proll | | | | | |
| **Language** | English | | | | | |
| **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 |
| | BiomedicalP harmacology | 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 | | | | | |
| **Module goals / desired outcome** | <u>General knowledge:</u><br>• Profound overview of current bioanalytical techniques relevant for biomedical as well as pharmaceutical research | | | | | |



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| | • Understanding of mode of action of drugs<br><br><u>Skills:</u><br>• Understanding of drug interaction in the human organism<br>• In-depth knowledge of Pharmaco-kinetics and Pharmaco- dynamics<br>• Understanding of the use of modern analysis systems and biosensors in drug development and personalized medicine<br>• Understanding of the functioning of microarray-systems and multiplexing<br>• Ability to read and understand scientific publications<br><br><u>Social competences:</u><br>• Preparation and presentation of a scientific presentation for a seminar<br>• Ability to do scientific research and present scientific findings |
| **Content** | <u>Analytical Methods in Biomedical Sciences</u><br>• Special instrumental analysis<br>• Imaging methods<br>• Biosensors<br>• Characterization of viral vectors<br>• In silico analysis<br>• Automation in drug discovery<br>• Effect-directed analytics<br><br><u>Biomedical Pharmacology</u><br>• Fundamentals and Nomenclature in Pharmacology<br>• Pharmacokinetics<br>• Pharmacodynamics<br>• Pharmacology of Thrombosis<br>• Pharmacology of Hypertension<br>• Pharmacology of Pain and inflammation |



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| **Study and exam requirements** | written examination (2 hours) |
| **Media used** | Lecture, script for download, board, digital projector, handouts |
| **Literature** | • Jens Kurreck, Joachim W. Engels, Friedrich Lottspeich, Bioanalytik, Springer-Verlag GmbH Berlin 2022<br>• Karl Cammann, Instrumentelle Chemie, Spektrum Akademischer Verlag GmbH (2001)<br>• Günter Gauglitz, David S. Moore, Handbook of Spectroscopy, Wiley-VCH Verlag GmbH & Co. KGaA (2010)<br>• Ullmann`s Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA (2016) |



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# BMSW10: Industry-Related Topics 1

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Industry-Related Topics 1 | | | | | |
| **Abbreviation** | BMSW10 | | | | | |
| **Course(s)** | Regulatory Affairs<br>IP Management | | | | | |
| **Semester** | Summer | | | | | |
| **Person responsible for the module** | Prof. Dr. Andreas Kandelbauer | | | | | |
| **Instructor(s)** | Prof. Dr. Andreas Kandelbauer<br>Dr. Xin Xiong | | | | | |
| **Language** | English | | | | | |
| **Status within the curriculum** | Elective module | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | 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 | |
| | **Total** | **60** | **90** | | **150** | **5** |
| **Credit points** | 5 | | | | | |
| **Prerequisites for attending this course** | See examination regulations | | | | | |
| **Recommended knowledge / course work** | No specific knowledge required | | | | | |
| **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. | | | | | |



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| | 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.<br><br>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<br>• FDA<br>• EMEA, MDR, IVDR<br>• ICH<br>• Development and validation of analytical procedure<br>• Life cycle regulation, risk and quality management<br><br>IP Management<br>• European Patent Convention and Patent Cooperation Treaty<br>• Filing a patent application<br>• Searching for patents<br>• Patentability analysis<br>• Writing patent claims |
| **Study and exam requirements** | written examination (2 hours) |
| **Media used** | Lecture, script for download, board, digital projector, handouts |
| **Literature** | • The European Patent Convention (http://documents.epo.org/projects/babylon/eponet.nsf/0/00E0CD7FD461C0D5C1257C060050C376/$File/EPC_15th_edition_2013_de_bookmarks.pdf)<br>• National and international guidelines as accessible via FDA and EMEA<br>• David Mantus & Douglas J. Pisano, FDA regulatory affairs, ISBN-13:978-1841849195<br>• Medical regulatory affairs ISBN: 9789814877862 |



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# BMSW11: Modules from other Schools or Universities

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Modules from other Schools or Universities | | | | | |
| **Abbreviation** | BMSW11 | | | | | |
| **Course(s)** | Elective course | | | | | |
| **Semester** | Summer | | | | | |
| **Person responsible for the module** | Prof. Dr. Dr. Isabel Burghardt | | | | | |
| **Instructor(s)** | Instructors from other Schools or Universities | | | | | |
| **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 | |
| | **Total** | **60** | **90** | | **150** | **5** |
| **Credit points** | 5 | | | | | |
| **Prerequisites for attending this course** | See examination regulations | | | | | |
| **Recommended knowledge / course work** | None | | | | | |
| **Module goals / desired outcome** | Dependent on elective | | | | | |
| **Content** | Dependent on elective | | | | | |
| **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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# BMSM12: Project Oriented Learning

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Project Oriented Learning | | | | | |
| **Abbreviation** | BMSM12 | | | | | |
| **Course(s)** | Information Retrieval and Evaluation<br>Research Seminar<br>Team Project | | | | | |
| **Semester** | Summer | | | | | |
| **Person responsible for the module** | Prof. Dr. Dr. Isabel Burghardt | | | | | |
| **Instructor(s)** | 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 | 45 | | 75 | |
| | Team Project | 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). | | | | | |



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| **Recommended knowledge / course work** | Fundamentals in Chemistry, Physics and Biochemistry |
| **Module goals / desired outcome** | Objective is the education of the students in setting-up, planning<br>and performing a project aiming at the solution of a specific research question.<br>After successful completion of this module students:<br>• understand how search engines and citation management programs function and can be used (K2).<br>• use relevant literature data bases with respect to scientific publications, patents, reviews, and monographs (K3).<br>• conduct systematic and efficient scientific literature searches (source identification and exploitation) (K3).<br>• cite and organize literature correctly according to respective scientific standards and to save citations using citation managers (K4)<br>• evaluate and efficiently document relevant publications and text/content therein (K5).<br>• 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)<br>• successfully apply tools for practical project planning and coordination (Gantt-diagrams, decision gates, milestones, deliverables, etc.). (K5)<br>• professionally apply tools for practical project management (action items, meeting organization, work documentation, efficient use of resources, coordination, etc.). (K4)<br>• effectively extract information from technical and scientific databases and evaluate it with regard to a specific research question. (K4)<br>• gain in-depth knowledge about a specific topic depending on the specified research question. (K3) |



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| | • select the appropriate scientific methodology depending on the specific research question. (K4)<br>• are able to think conceptually, work beneficial together in project teams and have developed and strengthened their team and communication skills. (K5)<br>• properly present and scientifically sound defense their own findings in front of a panel of experts (= council of supervisors) (K5)<br>• discuss competently experimental results in the light of the state of the art and comparing own findings to the scientific literature. (K4)<br>• assimilate to novel research questions, adapt to / orientate in a new field. (K5)<br>• 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) |
| **Content** | <u>Information Retrieval and Evaluation</u><br>• Reference data bases, search engines, citation managers<br>• Literature search examples/exercises based on concrete scientific questions<br><br><u>Team Project and Research Seminar</u><br>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- |



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| | 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.<br>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<br>Exam requirements:<br>Written seminar paper (= state of the art) (50%)<br>Final project report (35%)<br>Final project defense (15%), including oral presentation and/or poster presentation |
| **Media used** | Lecture, board, digital projector, handouts |
| **Literature** | • Chalmers AF (2007) Wege der Wissenschaft. Einführung in die Wissenschaftstheorie, 6. Auflage, Nachdruck, Springer<br>• Patzak G, Rattay G (2004) Projektmanagement, 4. Auflage, Linde International<br>• Baguley P (1999) Optimales Projektmanagement, Falken<br>• Scientific Original papers, depending on the specific research question<br>• H.F. Ebel et al. (2006) Schreiben und Publizieren in den Naturwissenschaften, Wiley-VCH Weinheim.<br>• Others, dependent on topic of research project |



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# BMSM13: Master‘s Thesis

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| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Master‘s Thesis | | | | | |
| **Abbreviation** | BMSM13 | | | | | |
| **Course(s)** | Master‘s Thesis Project and Defense (internal/ external)<br>Research Seminar to Master‘s Thesis | | | | | |
| **Semester** | 3 | | | | | |
| **Person responsible for the module** | Prof. Dr. Dr. Isabel Burghardt | | | | | |
| **Instructor(s)** | All instructors within the faculty | | | | | |
| **Language** | English and German | | | | | |
| **Status within the curriculum** | Mandatory | | | | | |
| **Type of course / WH** | Course | | L | E | LW | S |
| | Master‘s Thesis Project and Defense (internal/ external) | | | | | |
| | Research Seminar to Master‘s Thesis | | | | | 2 |
| **Workload in hours** | Course | Class Attendance | Study outside of class | | Total | CP |
| | Master‘s Thesis Project and Defense (internal/ external) | | 840 | | 840 | 28 |
| | Research Seminar to Master‘s Thesis | 30 | 30 | | 60 | 2 |
| | **Total** | **240** | **360** | | **600** | **30** |
| **Credit points** | 30 | | | | | |
| **Prerequisites for attending this course** | See examination regulations | | | | | |
| **Recommended knowledge / course work** | Successful completion of research project | | | | | |
| **Module goals / desired outcome** | Ability to implement acquired research abilities within a defined research project<br><br><u>General knowledge</u><br>• Ability to do detailed and in-depth research on a defined scientific field of study | | | | | |



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| | <u>Skills</u><br>• Ability to work independently in a team on a defined research project<br>• Ability to evaluate and implement insights / findings of scientific literature<br>• Ability to prepare and present scientific results<br><br><u>Technical competences</u><br>• Ability to apply modern strategies for finding scientific solutions<br><br><u>Social competences</u><br>• 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 Life Sciences 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** | <u>Master's thesis:</u><br>The master's thesis will be evaluated by the mentoring professor as well as by a second reviewer<br><br><u>Seminar on topics related to master's thesis:</u><br>After completing the master's thesis, students will hold an oral presentation on their work |



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| **Media used** | Oral presentation, written thesis, digital projector, PowerPoint slides |
| **Literature** | Dependent on research project |



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# BMSW14: Internship semester (Add. Module only for stud. with 180 ECTS BSc's degree)

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|---|---|---|---|---|---|---|
| **Course of studies** | Biomedical Sciences (MSc) | | | | | |
| **Module** | Internship semester | | | | | |
| **Abbreviation** | BMSW14 | | | | | |
| **Course(s)** | Internship semester | | | | | |
| **Semester** | Winter or Summer | | | | | |
| **Person responsible for the module** | Prof. Dr. Dr. Isabel Burghardt | | | | | |
| **Instructor(s)** | All instructors of faculty | | | | | |
| **Language** | English or German | | | | | |
| **Status within the curriculum** | Mandatory | | | | | |
| **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 |
| **Credit points** | 30 | | | | | |
| **Prerequisites for attending this course** | See examination regulations | | | | | |
| **Recommended knowledge / course work** | Successful completion of semesters 1 and 2 | | | | | |
| **Module goals / desired outcome** | After successful completion of this module:<br>• Students have a profound insight into the structure, organization and operations of an industrial company or a research institution. (K2)<br>• Students are aware of the independent processing of specific tasks within projects. (K2)<br>• Students are able to determine the status of development / research by literature search. (K4)<br>• Students have acquired the skills for independent implementation of projects. (K4) | | | | | |



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| | • Students have gained the competence for a systematic and a structured approach. (K5)<br>• Students have gained the competence to work scientifically. (K6)<br>• Students have experienced the manners and practices in the work environment. (K2)<br>• Students have improved their team and communication skills through participation in the working group. (K3)<br>• Students interact successfully in intercultural surroundings. (K4) |
| **Content** | The internship semester is performed in close co-operation between the internship site, the student and the internship Office of the school of Life Sciences.<br><br>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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