Brandenburgische Technische Universität Cottbus - Senftenberg
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Brandenburgische
Technische Universität
Cottbus - Senftenberg

Modulhandbuch für den Studiengang Biotechnology (anwendungsbezogenes Profil), Master of Science, Prüfungsordnung 2018

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Module 12770 Master Thesis

assign to: Total Account

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12770	Mandatory

Modul Title	**Master Thesis** Master-Arbeit
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. rer. nat. Hansen, Barbara
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	On special announcement
Credits	30
Learning Outcome	Students acquire the ability to solve a scientific problem within a limited time budget under the guidance of a supervisor. They use their acquired theoretical and practical knowledge to justify scientifically their solution of the problem as well as their improvements. The development of new knowledge and techniques is a major objective. They acquire the ability to present scientific facts clearly in written and oral form
Contents	• Guided, mostly experimental work on a complex scientific problem • Accompanying study of primary literature on the research topic • Participation in literature and progress seminars of the working group • Laboratory report on the establishment of the experimental approach for the elaboration of the task and discussion of the first results • Preparation of the written thesis (max. 60 pages) • Colloquium with oral presentation and discussion The academic supervisor is responsible for the topic and the content of the thesis.
Recommended Prerequisites	none
Mandatory Prerequisites	The topic of the master thesis will be issued if all mandatory modules and compulsory elective modules have been passed in the amount of at least 10 CP.
Forms of Teaching and Proportion	Self organised studies - 900 hours
Teaching Materials and Literature	It depends on the individual subject. Corresponding material will be named and provided by the supervisor.

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• The grade of the Master thesis results from the thesis, which accounts for 60 percent, and its defense, which accounts for 40 percent. • The presentation and the discussion go into equal parts in the grade of the colloquium.
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	none
Components to be offered in the Current Semester	No assignment

Module 11825 Tissue Engineering

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11825	Mandatory

Modul Title	**Tissue Engineering** Entwicklung und Kultivierung von Geweben
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	• Explain and apply fundamental scientific principles as well as advanced, specialized knowledge in tissue engineering and regenerative medicine. • Describe the basic structure of tissues and analyze interactions between cells and the extracellular matrix. • Explain key developmental processes in mammals and relate them to tissue engineering strategies. • Identify and explain the core components of tissue engineering, including cells, signaling molecules, biomaterials, bioreactors, and three-dimensional (3D) cell culture systems. • Distinguish between different cell-based therapies and evaluate their roles as therapeutic concepts in regenerative medicine. • Analyze and discuss 3D cell culture approaches and evaluate their relevance for tissue engineering, disease modeling, toxicology and pharmacology and translational research.

	• Develop independent ideas and concepts for solving scientific problems related to tissue engineering.
Contents	• Basic organisation of tissues: Cells and extracellular matrix (ECM)
	• ECM: Molecular structure & function • Cell-ECM Interaction
	• Cell-Cell interactions • Cellular Development and Fate Decisions (Proliferation, migration, determination, differentiation, cell-cell & cell-matrix interaction, apoptosis)
	• Cells Sources for Tissue Engineering: stem cells, differentiated cells from adult tissues, problem of donor-recipient cell transfer
	• Wound healing as a Natural Model of "Tissue Engineering": Inflammation, tissue formation, tissue remodelling
	• Cell based therapies: Principles and Applications
	• 3D Cell Cultures Systems: Principles and Applications
Recommended Prerequisites	Basic knowledge in cell biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015 • Cell and Molecular Biology. Concepts and experiments. Karp G., John Wiley & Sons, 2008 • Principles of Tissue Engineering, Lanza R. P. et al., Academic Press, 2nd edition 2000 • Methods of Tissue Engineering, Anthony Atala, Robert P. Lanza (eds.), Academic Press, New York, 2002 • Tissue Engineering, Clemens van Blitterswijk (senior editor), Elsevier, Amsterdan,Boston, Heidelberg, … (2008) • Functional Tissue Engineering, Farshid Guilak, David L. Butler, Steven A. Goldstein, David Mooney, C. MacLachlan, Springer, New York, Berlin, 2003 • Specific original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded

Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Tissue Engineering" • Seminar "Tissue Engineering" • Examination "Tissue Engineering"
Components to be offered in the Current Semester	**210728** Examination Tissue Engineering

Module 12175 Molecular Dynamics of the Cell

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12175	Mandatory

Modul Title	**Molecular Dynamics of the Cell** Molekulare Prozesse in Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The overall aim of the Module is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected. The lecture focuses on molecular processes that connects DNA damage signalling with cell cycle arrest, DNA repair or apoptosis. Furthermore, the student learns about the dynamics of a particular important cell types, the hepatocyte. Based on a profound understanding of molecular processes, the students will also better understand the molecular pathology of human diseases (e.g. cancer) which occur if there is a defect in one of these processes. Understanding the etiology of such diseases is the prerequisite for specific and effective therapies. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).
Contents	The lecture contains the following topics: • Molecular biology of eucaryotic DNA replication as a prerequisite to understand DNA damage signaling and DNA repair • Spectrum of DNA damages • DNA damage signaling: Molecular DNA damage sensors such as ATM and DNA-Pk, mediators, transducers/ effectors and cellular genotoxic responses such as apoptosis or cell cycle arrest, resp.; human diseases by defects in DNA damage signaling • Human DNA repair pathways: Direct DNA repair, Mismatch Repair, Base- & Nucleotide Excision Repair, Recombination Repair; defects

	in repair pathways leading to defined diseases or syndromes, their specific diagnostics and molecular strategies for therapies if possible • Molecular Dynamics of hepatocytes
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Molecular Dynamics of the Cell" • Seminar "Molecular Dynamics of the Cell" • Examination "Molecular Dynamics of the Cell"
Components to be offered in the Current Semester	**211018** Examination Molecular Dynamics of the Cell

Module 12762 Signal Transduction

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12762	Mandatory

Modul Title	**Signal Transduction** Signaltransduktion
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Understanding inter- and intracellular communications is essential when working in life science. Although the complexity of the issue makes the subject almost unmanageable there exist general principles and types of molecules that play a key role in signal transduction. A profound knowledge of these provides the basis to look into any kind of pathway successfully. In addition to understand the concepts it is of the same value to also know key experimental approaches that are applicable to elucidate signal transduction components and networks. It is therefore the aim of the lecture to develop an understanding not only of key signaling pathways (professional competences) but also of the experimental methodology used to study signal transduction in the lab. Summary: At the end of the module students are able to remember general mechanisms and understand the relevant scientific literature. They are able to apply the knowledge to design and perform own experiments. They can analyze and evaluate the data they obtain and should be able to create various new approaches to study and work in the field of signal transduction.
Contents	Due to the importance and the basic student knowledge of G-protein coupled receptors (GPCR) general aspects of ligand-receptor interaction, receptor activation and desensitization are discussed focusing on this subject. The importance of protein translocation and modification is underlined and explained using several examples. Within the same context binding experiments and the analysis of agonists and antagonist are explained. Using the GPCR topic a complete “story” is developed starting with ligand affinity down to the FRET-based

	methods of measuring receptor activation and inactivation. Students understanding is challenged by questions concerning the outline and the execution of relevant experiments to make clear that in general very similar approaches are used to study completely different signaling pathways. Emphasis is placed on experiments based on knock-down, knock-out, overexpression and inhibitors. A seminar is offered to deepen the understanding of the contents of the lecture and to prepare the students for their "working" with current scientific studies. <u>Membrane Receptor mediated</u> • G-protein coupled • Enzyme based (i.e. Receptor Tyrosine Kinase, JAK/STAT, TGFbeta) • Cytokine classes I-IV • Ion channels • Special pathways (Wnt, Hedgehog, Notch, Cholesterol) <u>Non-membrane receptor mediated</u> • Nitric oxide (NO) pathway • Steroid hormone receptors
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Textbook: Signal Transduction, IJisbrand M. Kramer, AP • Signal Transduction Knowledge Environment (stke.sciencemag.org) • Recent original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Signal Transduction" • Seminar "Signal Transduction" • Examination "Signal Transduction"
Components to be offered in the Current Semester	**210460** Lecture Signal Transduction - 2 Hours per Term **210465** Seminar Signal Transduction - 1 Hours per Term

210468 Examination
Signal Transduction

Module 12771 Cells and Tissues - Culture and Evaluation

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12771	Mandatory

Modul Title	**Cells and Tissues - Culture and Evaluation** Zell- und Gewebekultur
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	• After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities • Acquire theoretical knowledge and practical experience in basic principles of cell culture techniques. • Get familiar with the morpholgy, physiology and way to work with different animal and human cell lines. • Generate awareness for the use of cells in culture (advantages and limitations). • Understand the principles as well as application of cell biological methods to characterise the main parameters of cell behaviour like proliferation, differentiation, and viability. • Engineering artificial tissues (3D-culture) using cell lines. Discriminate the special features of cells cultured in 3D and cells growing as a monolayer in a culture flask (2D-culture). • Applying advanced techniques of cell biological methods to characterise the main parameters of cell behaviour like proliferation, viability, toxicity, and differentiation. • Advanced knowledge and experience in microscopical techniques (Phase contrast, brightfield, fluorescence)
Contents	• Sterile working technique, media preparation

- Routine maintenance of cell lines: Medium replacement, subculture of adherend and suspension cells, cell counting, cryopreservation, contamination control (microscopical observation, mycoplasma screening)
- Cultivation of cells in monolayer (2D) and engineering of in vitro tissues of different cell types (3D-cell culture systems; spheroids)
- Application of special test systems to monitor proliferation, viability, and toxicity in monolayer cells
- Analyses of morphology of cells in 2D- and 3D (preparation of cryosections of spheroids, histological analyses)
- Working with different microscopic techniques: Phase contrast microscopy (basis “life cell” analyses), brightfield microscopy, fluorescence microscopy

Recommended Prerequisites

Basic knowledge in cell culture.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Culture of Animal Cells: A Manual of Basic Technique, Freshney R. I., 6th edition, Wiley-Blackwell, 2010
- Zell- und Gewebekultur. Von den Grundlagen zur Laborbank, Lindl T und Gstraunthaler G., Spektrum Akademischer Verlag, 6. Auflage, 2008
- Der Experimentator: Zellkultur, Spektrum Akademischer Verlag, 3. Auflage 2011
- Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015
- Specific original scientific publications
- Manuals (SOPs) for cell culture & cell analytics of the Lab of Prof. U. Anderer

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

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<p>Lab work: 4 experiments, performance, critical evaluation of data, time management (25%) <p>Presentation (10 min) and discussion (5 min) in the seminar, duration depends on the topic (25%) <p>Protocol: Introduction, Methods, Results and Discussion, 10-15 pages (25%) <p>Written exam, duration: 45 min (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Cells and Tissues – Culture and Evaluation" • Seminar "Cells and Tissues – Culture and Evaluation"
Components to be offered in the Current Semester	No assignment

Module 12772 Bioengineering of Animal/Human Cells

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12772	Mandatory

Modul Title	**Bioengineering of Animal/Human Cells** Biotechnologie mit tierischen und menschlichen Zellen
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays. Furthermore they broaden their methodological background in analysis, interpretation, and reporting of lab data. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to sum up and discuss the experimental results train additional soft skills like the ability to communicate orally and written to individuals and groups and to tailor the communication to the level and experience of the audience. The students use appropriate software, graphics, and other tools to clarify complex information. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	Culture of cells in Monolayer (2D) of different cell types (including differentiation). - culture and differentiation of macrophages and monocytes - detection and visualization of inflammasome activation - microscopy of blood smears and immune organs - culture and differentiation of myogenic cells - functional analysis of specific genes in myogenic cells Contents of the seminar: Deepening the knowledge of the theoretical background used in the Labcourse.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry.

	Participation in the laboratory course *12771 - Cells and Tissues - Culture and Evaluation* is highly recommended.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications ; 2010 • Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008 • Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011 • Specific original scientific publications • Manuals (SOPs) for cell culture & cell analytics of the Labs of Prof. U. Anderer, Prof. Manuela Rossol and Prof. Julia von Maltzahn
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	weeks 1-3 (Prof. Manuela Rossol): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min, 10 pages (12.5%) • written exam, duration: 45 min (12.5%) weeks 4-6 (Prof. Julia von Maltzahn): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min. 10 pages (12.5%) • written exam, duration: 45 min (12.5%) The duration of the presentation will be announced at the beginning of the course.
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course (split in 2 parts of 3 weeks duration each).
Module Components	• Lab Course "Bioengineering of Animal/Human Cells" • Seminar "Bioengineering of Animal/Human Cells"

Components to be offered in the Current Semester	No assignment

Module 12773 Genetic Engineering of Eukaryotic Cells

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12773	Mandatory

Modul Title	**Genetic Engineering of Eukaryotic Cells** Genetische Veränderung eukaryotischer Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	Based on practical work in the lab, the overall aim is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected, and how they can be manipulated experimentally. Practical Course: Connected to actual scientific research projects of the group, the students work on genetically manipulated mammalian cells. The students learn to analyze consequences of recombinant gene expressions on various cellular responses, being dependent on the research project into which they are integrated. Furthermore, students learn strategies to obtain specific cell types from multipotent and/or pluripotent stem cells. Seminar: The students present and discuss “classical” as well as actual literature on selected topics of the practical course. Competences acquired after successful completion of the course: In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. In addition, the students learn to perform standardized data documentation by using electronic protocols.
Contents	The practical course is integrated into actual research projects of the group and thus contents will vary during time. Generally, the following practical paths will be followed: • Culturing of cell lines and primary cells • Working with genetically engineered mammalian cells, especially with hepatocytes and cancer cells

- Analsis of gene expressions by e.g. immunofluorescence, Western blotting, flow cytometry and / or PCR
- If working on hepatocytes, liver markers such as CYP450 will be analyzed
- If working on hepatocytes, conversions with drugs into metabolites and metabolite detection will be performed
- Investigation of drug effects on liver and / or cancer cells by means of toxicology analysis with XTT, ATP, membrane integrity tests, apoptosis tests, proliferation analysis etc
- Differentiation of multipotent and/or pluripotent stem cells into cardiomyocytes and / or hepatocytes and testing of specific differentiation protocols

Recommended Prerequisites

- 12175 *Molecular Dynamics of the Cell*

Mandatory Prerequisites

- 12771 *Cells and Tissues – Culture and Evaluation*
- 12772 *Bioengineering of Animal/Human Cells*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones
- Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones
- Selected original scientific journal articles and reviews on the fields discussed.
- Actual Version of Lab Manual & Standard Operating Procedures in Molecular Cell Biology by Prof. Küpper, BTU Cottbus-Senftenberg

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Lab work-preparation of experiment, performance, discussion, time management (30%)
- SPresentation and discussion in the seminar, duration depends on the topic (20%)
- Presentation of results (20%)
- Oral Test, duration: 15 min (15%)
- Electronic protocols (15%)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

8

Remarks

"Recommended Placement in the Study Plan"

- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course
- Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

The module takes place as a 6 week block course.

Module Components

- Lab Course "Genetic Engineering of Eukaryotic Cells"
- Seminar "Genetic Engineering of Eukaryotic Cells"

Components to be offered in the Current Semester	**211013** Practical training Genetic Engineering of Eukaryotic Cells - 7 Hours per Term **211015** Seminar/Practical training Genetic Engineering of Eukaryotic Cells - 1 Hours per Term

Module 11795 Immunology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11795	Compulsory elective

Modul Title	**Immunology** Immunologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Roggenbuck, Dirk
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	At the end of the module, the students are able to create a common understanding of immune responses and their relevance regarding the protection against pathogens. They are able to evaluate cellular and humoral immune mechanisms and to understand and apply immunological tools in diagnostics and therapy. Further, they are able to analyze the main molecular mechanisms of an immune response in the context of pathophysiological processes in immune-mediated disorders. Students are able to evaluate immunological markers within the differential diagnosis of immune-mediated diseases.At the end oh the module students can explain and apply scientific principles as well as specialised and in-depth knowledge. They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	• History of immunology • Innate immune system • Specific acquired immunity • Basic immune protection systems – complement • Dendritic cells and antigen presentation • Apoptosis • Structure and function of antibodies • B-cells and antigen recognition • HLA system – membrane receptors for antigen presentation • T-cells – development and functions • Cytokines • Immune responses • Clinical Immunology – allergy and autoimmunity

Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Immunology, 13th edition, P.J.Delves, S.J. Marting, D.R. Burton, I.M. Roitt, Wiley-Blackwell, corresponding web site with interactive questions, podcasts and videos • Cellular and molecular Immunology: with Student consult online access, 7th edition, A.K. Abbas, A.H. Lichtman, S. Pillai, Elsevier
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Immunology" • Seminar "Immunology" • Examination "Immunology"
Components to be offered in the Current Semester	**210020** Lecture Immunology - 2 Hours per Term **210025** Seminar Immunology - 1 Hours per Term **210028** Examination Immunology

Module 11858 Proteostasis

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11858	Compulsory elective

Modul Title	**Proteostasis** Proteostase
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	Proteostasis is a concept to summarize the contributions of protein synthesis, folding, modification, trafficking and degradation to steady state maintenance and dynamics of proteomes in cells. Major aim of the module is to deepen mechanistic knowledge in protein structure and function and the contributions of aforementioned processes during regulation of cellular homeostasis. The topic requires confrontation with complexity of living systems and scientific terminology. The consideration of mechanistic details of cellular processes should deepen the comprehension of important principles as foundations of cellular homeostasis and molecular pathology. Based on a mechanistic understanding of cell biological and molecular processes within the concept of protostasis, students are invited to contribute with their future work to progress in the understanding of the molecular pathology, diagnostics and therapy of human diseases (e.g. neurodegeneration, cancer, aging). Apart from these specific topics one major idea of the lecture is to enlighten the philosophy behind the scientific method. Historical milestones during the discovery of proteolytic systems involved in cell cycle control, apoptosis and cell survival signalling pathways, illustrated with original papers and reviews exemplifies deductive strategies and causality within scientific philosophy. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions.
Contents	Central topic of the module are cellular and molecular processes shaping the functionality of cellular proteomes. Protein synthesis,

	protein folding and misfolding, protein modification, subcompartimental localization and degradation are interconnected topics central to the understanding of molecular cell biology. The unique feature of this module is to look at these processes from the perspective of distinct proteolytic systems such as ubiquitin-dependent and independent proteasomal proteases, lysosomal proteases in autophagy, or caspases in apoptosis and inflammation and generally protease in antigen processing. Firstly, basics in protein biochemistry as well as technologies to analyze steady state and turnover of proteins are discussed. Next, the enzymology of proteases (protease families and mechanisms, inhibitors, diseases and therapy), proteolytic systems and protein modifications is a specific focus of this module. While considering complex proteolytic systems such as those of autophagy, apoptosis and the ubiquitin proteasome system, the module connects the topic of proteostasis specifically with cell survival signaling as exemplified by NFkB or p53 pathways, cell cycle regulation or apoptotic/inflammatory pathways. While emphasizing the role of proteases for cellular homeostasis, peptide generation as a principle of antigen processing should not be neglected. Hence, the discussion of MHC class I and class II pathways demonstrates the roles of proteolytic systems for the immune response.
Recommended Prerequisites	Basic level in biochemistry, cell biology and molecular biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	As a starting point textbooks of molecular cell biology and protein biochemistry are recommended: • Alberts, Johnson, et al. (2008) Molecular Biology of the Cell, 5th Edition (or newer) Garland Science • Nelson, Cox (2008) Lehninger Principles of Biochemistry 5th Edition • Lodish, Berk, et al. (2008 or later). Molecular biology of the cell 6th Edition, W.H.Freemann and Company Reviews as starting point: • Klaips, C.L., Jayaraj, G.G. and Hartl, F.U. (2017). Pathways of cellular proteostasis in aging and disease. J. Cell Biol. http://doi.org/10.1083/jcb.201709072
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none

Module Components	• Lecture "Proteostasis" • Seminar "Proteostasis" • Examination "Proteostasis"
Components to be offered in the Current Semester	**210238** Examination Proteostasis

Module 12763 Enzyme Technology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12763	Compulsory elective

Modul Title	**Enzyme Technology** Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The use of catalysts, and particularly of their biological version (enzymes), has recently been the subject of increased debate in research, technology and environmental policy. Enzyme technology is regarded as a key technology for a sustainable future; it renders possible the manufacturing of innovative products (e.g. pharmaceuticals, fine chemicals, flavors, food and feed ingredients) and opens new doors for the application of biological agents in chemical processes, which leads to positive environmental effects and energy savings. Enzyme technology has a great potential for breaking down the boundaries between individual scientific disciplines (biotechnology, chemistry, microbiology, etc.) and between fundamental and applied research. Aims of this teaching unit are - to provide a basic knowledge of relevant protein structures, to acquire an understanding of the principles by which enzymes catalyse biochemical reactions, and - to provide a comprehensive overview of enzyme applications to introduce economic and sustainable goals associated with enzyme technologies, historical background and modern approaches of enzyme application (e.g. nanobiotechnology, biofuels, protein production, extremophiles, biopharmaceutical production, microbial natural products). For students the lecture and seminar will provide an understanding of scientific principles and will provide practice of advanced white biotechnology (professional competences) and its exploitation in commercial practice (methodic competences) for get individual orientation skills e.g. concerning an career as scientist, PhD studend or to understand how to create and manage a biotech business).

Contents	An instructive and comprehensive overview of the current enzyme applications in the so-called White, Red and Green Biotechnology. Basic Tools: Biocatalysts, Advantages & Disadvantages of Enzyme Processes, Aspects of Enzyme Application, Protein Structure, Enzyme Classification, Enzyme Kinetics, Sources of Enzymes, Search and Screening for New Biocatalysts, Protein Engineering, Enzyme Production, Advanced Tool: Enzymes in Food Industry (e.g. Baking, Brewing, Dairy, Saccharification), Enzymes in Non-Food Applications (e.g. Detergents, Pulp and Paper, Textile Industry), Enzymes in Chemical Production Processes (Organic Synthesis, Chiral Molecules, Drugs), Perspectives of Enzyme Exploration and Application, Current Research Activities (e.g. National and European Research Programs), New/Own Research Activities (e.g. Fungal Oxidoreductases for Industrial Processes, Biocatalysts for Refinement of Renewable Polymers) Scientific Seminar: present and discuss published current experimental findings and contemporary issues
Recommended Prerequisites	Multidisciplinary cross section require basic knowledge in biochemistry, microbiology, molecular biology, chemistry and engineering sciences.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Hofrichter, M., K. Esser, The Mycota: Industrial Applications, 2010, Springer-Verlag Berlin Heidelberg • Fessner, W., Anthonsen, T.: Modern Biocatalysis, 2008, Wiley-VCH, Weinheim • Illanes, A.: Enzyme Biocatalysis, Principles and Application, 2008, Springer • Liese, A., Seelbach, K., Wandrey, C, Industrial Biotransformations, 2006, Wiley-VCH, Weinheim • Buchholz, K., Kasche, V., Bornscheuer, U. T., Biocatalysts and Enzyme Technology, 2005, Wiley-VCH, Weinheim • Bommarius, A.S., Riebel, B.R.: Biocatalysis, Fundamentals & Application, 2004, Wiley-VCH, Weinheim • Aehle, W., Enzymes in Industry, 2004, Wiley-VCH, Weinheim Several current publications e.g.: • Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677). • Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).

	• Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Module Examination	Prerequisite + Final Module Examination (MAP)
Assessment Mode for Module Examination	• Requirements: Successful participation at the seminar including a 30 min presentation and 15 min discussion. • Final written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	The module is only offered in the winter semester.
Module Components	• Lecture "Enzyme Technology" in winter semester • Seminar "Enzyme Technology" in winter semester • Examination "Enzyme Technology"
Components to be offered in the Current Semester	**211110** Lecture Enzyme Technology - 2 Hours per Term **211115** Seminar Enzyme Technology - 1 Hours per Term **211118** Examination Enzyme Technology

Module 12764 Synthetic Microbiology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12764	Compulsory elective

Modul Title	**Synthetic Microbiology** Synthetische Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The "Synthetic Microbiology" module promotes the interactive work and learning of the participating students by combining different teaching disciplines such as a lecture series, a seminar and a practical course. The ability of the students to work in teams will be stimulated by discussing current literature in the context of the lecture content. After successfully completing the module, the students will have acquired competences in terms of self-organization and communication skills in addition to the acquired specialized scientific knowledge. Moreover, the use of a correct scientific language for communication and the presentation of scientific data will be trained.
Contents	After an introduction to the microbial world, the course will provide an overview of the diversity, structure, and functioning of microbial communities. Particular emphasis will be placed on understanding microorganisms as members of complex and dynamic communities rather than as isolated organisms. Students will learn how microbial interactions shape community composition, stability, and function, and how these interactions influence ecosystem processes in environmental, agricultural, and host-associated habitats. The lecture series will introduce the principles and methodologies used to investigate microbial communities, including cultivation-dependent and cultivation-independent approaches, high-throughput sequencing technologies, and multi-omics methods. Concepts for the characterization of microbial diversity, community structure, microbial

interactions, and community function will be presented, together with approaches for the analysis and interpretation of microbiome data.

Furthermore, the course will explore the ecological and biotechnological relevance of microbiomes and discuss how microbial communities contribute to ecosystem functioning, human and environmental health, and sustainable biotechnological applications. Building on this knowledge, students will be introduced to emerging concepts in synthetic microbiology, including the design, engineering, and manipulation of microbial communities for specific functions.

Recommended Prerequisites

Basic knowledge in genetics, microbiology, biochemistry and molecular biology.

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

Teaching material such as lecture slides and study questions as well as the relevant literature will be provided to the students *via* a the moodle learning platform.
Recommended scientific literature:

- Juhas *et al.* 2014. *Bacillus subtilis* and *Escherichia coli* essential genes and minimal cell factories after one decade of genome engineering. *Microbiology.* 160: 2341-2351.
- Reuß *et al.* 2016. The blueprint of a minimal cell: *MiniBacillus*. *Microbiol Mol Biol Rev.* 80: 955-987.
- Hutchison *et al*. 2016. Design and synthesis of a minimal bacterial genome. *Science* 351: aad6253.
- Reuß *et al.* 2017. The contribution of bacterial genome engineering to sustainable development. *Microb Biotechnol*. 10: 1259-1263.
- Reuß *et al.* 2017. Large-scale reduction of the *Bacillus subtilis* genome: Consequences for the transcriptional network, resource allocation, and metabolism. *Genome Res.* 27: 289-299.
- Brock Biology of Microorganisms, 15th edition, 2019, Pearson. ISBN.10: 1292235101.
- Microbes and evolution - The world that Darwin never saw. Essays on microbes and evolution. 2012. ASM press.ISBN: 978-1-55581-540-0.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

The final module grade is composed of a written module examination (60%) and a continuous assessment component (40%).

Written Module Examination (60%)

Written examination (90 minutes).

Continuous Assessment (40%)

The continuous assessment component consists of three practical data analysis assignments and one oral presentation.

Students will complete three practical exercises covering key aspects of microbiome data analysis. Each exercise will involve the analysis of a provided dataset using R and the submission of a short report (2–3 pages) summarizing the analytical approach, results, and interpretation. Topics may include microbial community composition, diversity metrics, ordination methods, statistical analysis, data visualization, and the ecological interpretation of microbiome data.

The results of the assignments will be presented in a short oral presentation (15 minutes) followed by a discussion and questions (10 minutes).

Weighting of the Continuous Assessment:

- Practical assignments (three reports): 20%
- Oral presentation and discussion: 20%

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

none

Module Components

- Lecture "Synthetic Microbiology" only in summer semester
- Seminar "Synthetic Microbiology" only in summer semester
- Examination "Synthetic Microbiology"

Components to be offered in the Current Semester

210130 Lecture
Synthetic Microbiology - 2 Hours per Term
210136 Seminar
Synthetic Microbiology - 1 Hours per Term
210138 Examination
Synthetic Microbiology

Module 12765 Nanobiotechnology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12765	Compulsory elective

Modul Title	**Nanobiotechnology** Nanobiotechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The goal of the course is to provide a systematic description of nanotechnolgy-driven techniques and approaches that are relevant in biotechnology. By the end of the course, students will be able to (1) explain physical principles governing biological systems at the nanoscale, (2) compare relevant (single-molecule) techniques and evaluate their possibilities and limitations, (3) interpret experimental and computational data, (4) design (thought) experiments to probe biomolecules and their interactions, (5) critically analyze primary literature, and (6) asses the translational potential of the discussed techniques. Short talks will enable students to present state of the art developments with the overall aim to encourage the development of independent ideas and concepts to solve scientific and societal challenges.
Contents	Nanobiotechnology explores biological processes at the nanometer scale and develops technologies to measure, manipulate, and engineer individual biomolecules and ensembles thereof. After introducing the term nanobiotechnology and discussing the physical principles relevant at the nanoscale, the course will introduce key concepts in detection, manipulation, and utilisation of biomolecules. A focus will be set on fluorescence-based, single-molecule detection schemes and the use of RNA/DNA nanotechnology that, taken together, let to breakthroughs in next-generation sequencing technologies and diagnostics. Students will learn, how nanoscale tools reveal hidden biological heterogeneity and how these discoveries can be translated into clinical and industrial innovations.

	The course further includes lectures on (1) (super-resolution) optical microscopy and live-cell imaging, (2) nanoparticles/fluorescent probes and their applications in biology and medicine, (3) applied surface science and nano/micro fluidics (including the basics of surface electrostatics, methods of surface analysis, self-assembled monolayers, covalent immobilization of biomolecules), (4) affinity biosensors (surface plasmon resonance and field-effect biosensors), (5) model lipid systems (liposomes, lipid monolayers, planar lipid bilayers), (6) DNA and nanopore technology. Additionally, the theoretical course includes short presentations of students and subsequent discussions on recent topics of nano(bio)technology, for example: DNA-origami, single-molecule kinetics, self-assembly, etc.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Science.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	In addition to the provided lecture scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	
Module Components	• Lecture "Nanobiotechnology" • Seminar "Nanobiotechnology" • Examination "Nanobiotechnology"
Components to be offered in the Current Semester	**210818** Examination Nanobiotechnology

Module 12766 Bioprocess Development

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12766	Compulsory elective

Modul Title	**Bioprocess Development** Entwicklung von Bioprozessen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. rer. nat. Hansen, Barbara
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	After participating in the module, students are able to apply the basics of heat and mass transport, bioreaction technology to biotechnological processes.
Contents	Use of living cells for the planning and implementation of a process, the development of process control and processing methods for the products, the control of production processes and their continuous optimization.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; 2010
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none

Remarks	No offer from WiSe 2024/25!
Module Components	• Lecture "Bioprocess Development" • Seminar "Bioprocess Development" • Examination "Bioprocess Development"
Components to be offered in the Current Semester	No assignment

Module 12767 Point of Care Diagnostic

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12767	Compulsory elective

Modul Title	**Point of Care Diagnostic** Point-of-Care-Diagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. Dame, Gregory
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The module teaches the basics of point of care diagnostics / point of care analysis, molecular diagnostics, biochip technology and their techniques. The students will be able to explain the term point of care testing using concrete examples and are introduced in scientific thinking. The module teaches special abilities and knowledge in the field of bioanalytics for biotechnologically and biochemically oriented students.After successful participation in the module students are able to explain and apply scientific principles as well as specialised and in-depth knowledge. -They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	In the lecture different bioanalytical detection techniques will be presented, whereby the biosensorics occupy a partly higher importance. Important combinations of biomolecules with sensors and their bioanalytical application are discussed. On the basis of practice-relevant examples, the development of individual biosensors will be presented, as well as their limitations and solutions for optimization discussed. Other topics include biochip technology, molecular diagnostics, point of care testing (POCT), on-site analysis and nanobiotechnology. • Enzymatic sensor concepts and selected examples (glucose oxidase enzyme electrode) • DNA Sensors • Immunosensors • Cell-based biosensors • In vivo Biosensors

- Disposable biosensors in point-of-care applications: concepts and fabrication
- Clinical applications: blood gas analyses, coagulation diagnosis, cardiovascular diseases

Current publications in the field of point-of-care diagnostics and on-site analysis will be presented and discussed with regard to a point-of-care application.

Recommended Prerequisites

none

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

POCT-Patientennahe Labordiagnostik, P. Luppa, R. Junker (eds), ISBN 978-3-662-54195-1, ISBN 978-3-662-54196-8 (ebook)

Publications:
- Khan et al, Diagnostics 2017, 7, 39; doi: 10.3390/diagnostics7030039
- Krampa et al., Diagnostics 2017,7, 54; doi: 10.3390/diagnostics/7030054
- Mashamba-Thompson et al, Diagnostics 2016,6,31;doi: 10.3390/diagnostics6030031

Module Examination

Final Module Examination (MAP)

Assessment Mode for Module Examination

Written Examination (120 min)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course
- Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

"Responsible Staff Member"

1. Prof. Frank Hufert (no)
2. Dr. Gregory Dame (no)

Module Components

- Lecture "Point of Care Diagnostic"
- Seminar "Point of Care Diagnostic"
- Examination "Point of Care Diagnostic"

Components to be offered in the Current Semester

210040 Lecture
Point of Care Diagnostic - 2 Hours per Term
210045 Seminar

Point of Care Diagnostic - 1 Hours per Term
210048 Examination
Point of Care Diagnostic

Module 12768 Introduction to Laboratory Diagnostics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12768	Compulsory elective

Modul Title	**Introduction to Laboratory Diagnostics** Einführung in die Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The aim of the module is to familiarize students with the concepts of laboratory medicine, which focus on screening, diagnosis, risk assessment and therapy monitoring and include tools for routine laboratory diagnostics. In lectures that introduce the basics of laboratory medicine, students are enabled to understand the concept and principles of laboratory medicine. Subsequently, the students will deepen their knowledge of pathophysiology and pathobiochemistry of diseases with a view to characterising the diseases using laboratory medical instruments. In lectures, students learn the methodology of the analytical tools commonly used in laboratory medicine and discuss selected methods in seminars to deepen their understanding. The student learns the specific analytical tools focused on related diseases and students should be able to select analytical tools related to screening, risk assessment, diagnosis and monitoring. Upon completion of the module, students should be able to interpret analytical results for disease screening, risk assessment, diagnosis and monitoring and discuss the results with the applicant. Students should be able to understand and work with the scientific literature of laboratory medicine. Students should be able to design and interpret their own studies of laboratory medicine. A special aspect will be the area of personalised medicine. Personalised medicine distinguishes itself by classifying individuals on the basis of information about genetic, molecular and cellular properties in order to define individual therapies. It comprises products and services based on biomarker-based diagnostics and therapy for small patient groups. The students learn about personalised medicine ideas and learn how

	medical progress can lead to the scientific and technical development of new diagnostics and therapies, especially on the basis of genome and post-genome research.
Contents	• Introduction to laboratory medicine: • Laboratory medicine with emphasis on specific metabolism (lipids, nucleic acids, proteins, trace elements) • Laboratory medicine with focus on specific systems (immune system, exocrine system, endocrine system, neoplasia) • Laboratory medicine with emphasis on specific organs (liver and bile ducts, intestines, kidneys and urinary tract) • Development of strategies for personalized medicine • Definition of a biomarker, definition of biomarker panels • Comparison of strategies of personalised medicine with conventional medicine
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Will be announced during the lecture.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	re-examination oral (30 min)
Module Components	• Lecture "Introduction to Laboratory Diagnostics" • Seminar "Introduction to Laboratory Diagnostics" • Examination "Introduction to Laboratory Diagnostics"
Components to be offered in the Current Semester	**210968** Examination Introduction to Laboratory Diagnostics

Module 12769 Molecular Biotechnology and Society

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12769	Compulsory elective

Modul Title	**Molecular Biotechnology and Society** Molekulare Biotechnologie in der Gesellschaft
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	6
Learning Outcome	This highly interdisciplinary lecture should demonstrate the students that many recent biotechnological developments do not only influence scientific fields, but can also have a clear-cut impact on the whole society. The students learn about biotechnological fields which are relevant for political & ethical issues, medical issues and economical issues, i.e. emerging biotechnological industries. Since biotechnology is a rather broad field, the lecture highlights some “prominent” examples. The lecture is called “Molecular Biotechnology” because of its further focus on molecular principles used in the presented biotechnological fields. For each biotechnological topic, the molecular basics are presented followed by presentation of their respective influences on politics, medicine and / or economy. If applicable, the lecture also covers some basics on relevant “Biotech” laws. The students should learn that although the awareness and knowledge of Biotechnology in society is quite low, it definitely is a key technology of the 21th century influencing many aspects of life. In addition, the students should obtain a deep understanding of the molecular principles presented in the lecture to be competent for future discussions outside the University. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).

Contents	The lecture starts with an introduction into the awareness of people towards biotechnology, importance of biotechnology for medicine & sustainable industry, provide examples of the biotechnological presence. In addition, the lecture contains the following topics: • Forensic DNA science, their techniques, ethical issues and their national regulations (e.g. German DNA Analysedatei) • Medical DNA screening including techniques of genetic tests, examples of single gene disorders and chromosomal disorders, regulations such as the German “Gendiagnostikgesetz” • Special lectures are provided on cell cycle regulation, **Signal Transduction**, cellular mortality/immortality and molecular carcinogenesis to provide the basis for understanding the molecular defects of the discussed diseases and their respective diagnostics. • Stem cells and cloning, including stem cell biology, therapeutic and reproductive cloning, preimplantation diagnostics and their discussions in society as well as national regulations such as the German “Embryonenschutzgesetz”. • Concepts of Personalized Medicine • Biotechnology and Global Warming: This last part of the lecture makes the focus on recent developments in biotechnology that could help to mitigate global warming
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Genetik, Klug et al., Pearson Studium, 8. Auflage (2007) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

Module Components	• Lecture "Molecular Biotechnology and Society" • Seminar "Molecular Biotechnology and Society" • Examination "Molecular Biotechnology and Society"
Components to be offered in the Current Semester	**211030** Lecture Molecular Biotechnology and Society - 2 Hours per Term **211035** Seminar Molecular Biotechnology and Society - 2 Hours per Term **211038** Examination Molecular Biotechnology and Society

Module 12776 Eukaryotic Microorganisms/Microalgae

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12776	Compulsory elective

Modul Title	**Eukaryotic Microorganisms/Microalgae** Eukaryotische Mikroorganismen/Mikroalgen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	In the laboratory course the practical skills of the students by applying different methods for the classification and cultivation of eukaryotic microorganisms (e.g. heterotrophic marine dinoflagellates, algae-like peronosporomycetes, lower and higher fungi), for the development of culture conditions, the quantitative and qualitative analysis of cell growth, the extraction of natural substances (e.g. fatty acids, enzymes) and the analytical product identification with chromatographic methods are trained. Herein each student should isolate and determine eukaryotic microorganisms from natural sources, purify one strain and determine contents and activities by using screening techniques. The students work in small teams (2-3 persons) and coordinate the approaches/practical work between the different group members. In this way, the students improve their soft skills in terms of communication and coordination of the work flow. Additionally, the laboratory course will strengthen the students competencies in the interpretation, evaluation and presentation of lab data by summarizing the results in a final report and by an oral presentation at the end of the course. The accompanying seminar intents to train the scientific competencies of the students by searching for and presenting relevant literature focusing on the topics of the practical course.
Contents	<u>Contents of the Lab Course:</u> • preparation of labware and cultivation media • inoculation of eukaryotic microorganism cultures using culture flask/ bioreactors • monitoring of culture parameters (pH, OD, biomass dry weight, enzyme activities)

- sampling at different time points during the cultivation
- sample preparation: cell disintegration (e.g. french press), hydrolysis, dialysis, micro-/ultrafiltration, freeze-drying
- liquid extraction of lipophilic compounds (e.g. PUFA´s)
- photometric assays for the determination of protein content and enzyme activity
- protein purification using FPLC
- compound analysis with HPLC/ELSD/DAD and LCMS
- data evaluation, presentation, report

Contents of the Seminar:
- The seminar course will give a current overview to the state of the art of science in those topics and microorganisms which are in the focus of the practical course.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Madigan M. T., Martinko J. M., Bender K.: Brock Biology of Microorganisms. Pearson 2018, ISBN 9781292235103
- Esser K., Hofrichter M.: The Mycota - A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research, Industrial Application X. Springer 2010, ISBN 9783642114571
- Dörfelt H., Jetschke G.: Wörterbuch der Mycologie. Spektrum 2001, ISBN 9783827409201
- Bucholz K., Kasche V., Bornscheuer U. T.: Biocatalysts and Enzyme Technology. Wiley-Blackwell, 2012, ISBN: 9783527329892

Several publications e.g.:
- Yue Jiang, Feng Chen, Shi-Zhong Liang (1996). Production potential of docosahexaenoic acid by the heterotrophic marine dinoflagellate *Crypthecodinium cohnii.* Process Biochemistry 34: 633–637
- Blackman, L.M., Cullerne, D.P. & Hardham, A.R. (2014) Bioinformatic characterisation of genes encoding cell wall degrading enzymes in the Phytophthora parasitica genome. BMC Genomics 15, 785 (2014). https://doi.org/10.1186/1471-2164-15-785
- Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi:10.1002/anie.201605430)
- C. André Lévesque (2011). Fifty years of oomycetes—from consolidation to evolutionary and genomic exploration. Fungal Diversity 50:35–46 DOI 10.1007/s13225-011-0128-7

	• Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002) • Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677)
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (50%) • Presentation and discussion in the seminar, duration depends on the topic (20%) • Oral Test/ final colloquium, duration: 15 min (20%) • Report, c. 20 pages (10%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	none
Module Components	• Lab Course "Eukaryotic Microorganisms" • Seminar "Eukaryotic Microorganisms"
Components to be offered in the Current Semester	No assignment

Module 12777 Methods in Synthetic Microbiology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12777	Compulsory elective

Modul Title	**Methods in Synthetic Microbiology** Methoden der synthetischen Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. This course aims to teach diverse techniques and methods used for genetic engineering, molecular cloning, expression in procaryotic or eucaryotic systems, conceptional thinking, independent preparation, execution, evaluation of experiments, and adequate documentation.
Contents	• cultivation of Microorganisms under suitable conditions • isolation and modification of DNA • constructing genetic tools or overexpression vectors • create relevant synthetic microorganisms such as genetically modified strains for biotechnological purposes or further investigations
Recommended Prerequisites	Basic lab experience; basis knowledge in molecular biology, biochemistry, microbiology.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester

	Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	1. Campbell Biologie (ISBN-10: 3868943668) 2. Brock Biology of Microorganisms (ISBN-10: 1292404795) 3. Der Experimentator Molekularbiologie / Genomics (ISBN-10: 3642346359) 4. Molecular Cloning: A Laboratory Manual (ISBN-10: 1936113422)
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	After completing the experiments, each student submits a manuscript about the experimental results and give an oral presentation and discussion. • lab performance: 20% • manuscript (max. 10 pages): 40 % • oral presentation and discussion (15 min): 40 %
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The lab performance (theoretical preparation, organization and execution in the lab, time management) of each student will be observed. For safety reasons we will evaluate the theoretical preparation of each student occasionally. We therefore reserve the right to interrupt laboratory work and experiments can be continued when successful background knowledge is confirmed.
Module Components	• Lab Course "Methods in Synthetic Microbiology" • Seminar "Methods in Synthetic Microbiology"
Components to be offered in the Current Semester	No assignment

Module 12791 Metabolic Analysis and Engineering

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12791	Compulsory elective

Modul Title	**Metabolic Analysis and Engineering** Metabolische Analyse und Entwicklung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	**Lab Course** Provide the student with an understanding of metabolic pathways and networks, the roles of enzymes and their regulation. The student will learn to estimate the power of tools, e.g. growth of designed mutants disrupted in single genes, and will get experience with different analytical methods. Communication between the students is stimulated by dividing them into four TEAMs, each responsible for a different system. In the first and second week each TEAM can focus on its system understanding methods, theoretical background and the objective. In the following weeks each TEAM is supervising one of the other three TEAMs in the performance of the experiment. That means from the third week on each TEAM is involved in parallel in two experiments, one as supervisor and a second as trainee. **Seminar** Each students has to present the scientific question, the experimental approach, results and conclusions of a original paper which was publised by the host father recently. Communication skills are trained by presention and discussion. The students introduce each other. They learn to ask questions and one of them has to summarize the main points of the discussion.
Contents	The module takes place as a 6 week block course. The seminar is a compulsory part of the module. Each TEAM is supervised by a PhD student. This means that the subjects are adapted for each course to the current state of their scientific work. The following systems are examples:

- System 1: Chemostatic cultivation as a tool to study regulation; a promotor::lacZ reporter strain of *A.gossypii* is cultivated; down-shifts in dilution rate stimulate reporter expression detectable *via* beta-galactosidase assay and riboflavin production; several online parameter are controlled, e.g. pH, and/or determined, e.g. CO2 in the exhaust *via* IR spectrometry;
- System 2: Feeding studies in shaking flasks or on agar plates; the uptake of amino acids in a defined medium is monitored by HPLC; Auxotrophy of *S. cerevisiae* mutants disrupted in *GLY1*, *SHM1*, *SHM2* and/or *AGX1* is studied on glucose or ethanol as sole carbon source plus/minus glycine;
- System 3: Kinetic studies on a Michaelis-Menten in comparison with an allosterically regulated enzyme; impact of ATP or AMP on NAD-dependent ICDH is compared with the NADP-dependent peroxisomal isoenzyme;
- System 4: Transformation and genotype analysis; fungal cells are transformed with DNA *via* electroporation; replacement with a marker by homologous recombination is studied by locus specific PCR with genomic DNA;

Recommended Prerequisites

Three months lab experience; basic knowledge in microbiology, biochemistry, molecular biology.

Mandatory Prerequisites

- 12777 - *Methods in Synthetic Microbiology*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

The students receive original scientific literature for each experimental system e.g.
- System 1: Microbiology 147: 3377-3386; Environmental Microbiology 3: 545-550
- System 2: Yeast 21: 63-73
- System 3: Journal of Molecular Catalysis 10: 335-343
- System 4: Biochemical Journal 369: 263-273

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

Each TEAM (2 student) will take part in an oral presentation and discussion (15 min); furthermore a short manuscript about results of the experiments has to be submitted; presentation and quality of the manuscript will be scored each 50 % for the final mark.

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

8

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course

	• Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lab Course "Metabolic Analysis and Engineering" • Seminar "Metabolic Analysis and Engineering"
Components to be offered in the Current Semester	**210343** Practical training Metabolic Analysis and Engineering - 7 Hours per Term **210345** Seminar/Practical training Metabolic Analysis and Engineering - 1 Hours per Term

Module 12792 Methods in Nanobiotechnology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12792	Compulsory elective

Modul Title	**Methods in Nanobiotechnology** Methoden der Nanobiotechnology
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Upon successful completion of this course, students will be able to independently design, perform, and critically evaluate experiments in modern nanobiotechnology. They will acquire hands-on experience with single-particle tracking, single-molecule FRET using DNA-based sensors, and super-resolution microscopy in live bacterial cells. Students will learn to prepare samples, operate advanced fluorescence microscopes, and optimize acquisition parameters for reaching single-molecule sensitivity. Students will analyze experimental data using appropriate statistical and computational tools (Python), extracting biologically meaningful parameters such as diffusion coefficients, molecular distances, and nanoscale spatial organization. The course will strengthen the ability to connect physical measurement principles with biological questions. Finally, students will critically assess experimental limitations, sources of artifacts, and the translational relevance of single-molecule and super-resolution approaches.
Contents	The course is organized around a sequence of laboratory modules that introduce experimental strategies in nanobiotechnology. It begins with an overview of fluorescence microscopy setups, optical alignment, and intricate sample preparation required for achieving single-molecule sensitivity. Students then perform single-particle tracking experiments to study nanoscale motion and heterogeneity, followed by single-molecule Fluorescence Resonance Energy Transfer (smFRET) measurements using, e.g., DNA-based sensors to investigate conformational changes in the nanometer range. A dedicated module addresses live-cell imaging in bacteria and the application of single-molecule localization microscopy to resolve subcellular structures beyond the diffraction

	limit. Throughout the course, practical sessions are complemented by guided data processing, including diffusivity analysis, FRET efficiency calculations, and localization reconstructions. The final part of the course focuses on integrating experimental results into a coherent scientific report and discussing biological context and potential applications.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Sciences.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	In addition to the provided scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• presentation of a scientific topic (will be announced at the beginning of the lab course) (20%), 10 slides, 20 min presentation • written test on the content of the course 60 min (20%) • protocol reporting on the experiments and data analysis (40%), 10-12 pages • experimental work (preparation of experiment, performance, discussion, time management) (20%), weekly evaluation by the supervisors on the above described criteria
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Nanobiotechnology" • Seminar "Methods in Nanobiotechnology"
Components to be offered in the Current Semester	No assignment

Module 12793 Purification and Characterisation of Proteins

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12793	Compulsory elective

Modul Title	**Purification and Characterisation of Proteins** Reinigung und Charakterisierung von Proteinen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	**Lab Course** The course is aimed to train master students on basic techniques in protein biochemistry and proteome research. To develop strategies for the purification and characterization of various proteins is the major goal of this course. Another didactic aim is to consolidate problem solving abilities and structured experimental team work as well as individual responsibilities. During a lab course students are working individually or as a team depending on the complexity of the analytic task to strengthen team work, as well as individual responsibility. Technical competences in protein purification are reaching from culturing prokaryotic and eukaryotic cells, providing cell lysates, via enrichment of proteins by subcellular fractionation towards classical strategies of salt precipitation, ultrafiltration and chromatography. Characterization encompasses electrophoreses (NEPHGE, IEF, SDSPAGE) and immune-identification (immunoblotting). Functionality of proteins is accessed by assays for enzymatic activites or protein-protein interaction depending on the specific research task provided. **Seminar** Since each student experiences various purification approaches associated with specific problems, the weekly research seminar provides the opportunity to makes this knowledge available for each participant of the lab course. During oral presentations the participants introduce into relevant literature, covering the theoretical background and principles of methods applied. Scientific questions, experimental approaches and results of individual projects are presented as well.

	These compulsory seminars are strengthening the student´s conceptual skills by planning their experimental activities for the next week, by drawing conclusions from experimental data. Certainly, the seminars are also aimed to promote the development of professional communication skills.
Contents	The experimental work of the students is integrated in actual research projects (proteolytic systems, proteasome regulators, apoptosis, protein modification etc). Basic techniques such as homogenization, centrifugation and salt precipitation, as well as ion exchange chromatography and other FPLC techniques are applied to research topics of the biochemistry unit. In a second step the composition of purified protein fractions is analyzed simply by SDS PAGE and Western blotting or via isoelectric focusing (IEF) and non-equilibrium pH gradient gel electrophoresis (NEPHGE). Enzyme assays and immune-detection methods are applied to monitor the quality of target proteins during protein fractionation. Fractionated salt precipitation, ultracentrifugation and ion exchange chromatography are the basic methods to purify proteasome regulators and their functional mutants. Other proteins may be useful for the standardization of immune-detections.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Practical Approach Series (David Hames, Editor; 185 volumes since 1981; IRL Press; Oxford University Press). Topics: • Coligan, Dunn, Speicher, Wingfield (2002) Short Protocols in Protein Science, Wiley • Barker, Kathy (2005). At the Bench: A Laboratory Navigator ISBN-13: 978-0879697082 • Original publications (depending on the assigned project). • Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request. • To strengthen professional skills, students have do develop their information acquisition strategies. Hence, seminar/lab course participants have to supplement provided information/material by their independent contributions.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Practical laboratory work 50% • Presentation and discussion in the seminar, duration depends on the topic (25%) • Lab work protocol, 10-20 pages (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course “Purification and Characterization of Proteins” • Seminar “Functional Analysis of Proteins”
Components to be offered in the Current Semester	No assignment

Module 12794 Methods in Enzyme Technology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12794	Compulsory elective

Modul Title	**Methods in Enzyme Technology** Methoden der Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	For students the course with complex tasks will enhance key skills such as teamwork, communications, problem-solving and business awareness (professional methodically and social competences). The first step in the development of a new enzyme product is to find the organism that produces the optimal enzyme. Each student should isolate and determinate one fungal strain from natural sources; purify the strain and determine enzyme activities by using several screening methods. Students use well-studied microorganisms from internal strain collection for producing extracellular and intracellular oxidoreductases and hydrolases. The biocatalysts are separated, concentrated and lyophilised and individual enzyme activities, kinetic parameter and stabilities are studied. In the second part, isolated enzyme reactions - as well as bioreactions by cell preparations - will be performed in several application techniques, including analytical product identification, activities in dependence of changing incubation parameters and yields. The main objective is to demonstrate regio- and stereoselective reactions and to analyse the potential applications of oxidoreductases and hydrolases by several analytical methods.
Contents	The course consists of practical exercises for isolation and screening of enzymes from natural habitats (lignocellulose), strain cultivation for fermentative enzyme production, preparation of extra- and intracellular enzymes, enzyme conservation, characterisation of the enzymes' application potential (factors for regulation of enzyme activity, textile bleaching, xenobiotic degradation potential, regioselective halogenation

and hydroxylation). Oxidoreductases and hydrolases will be used for exemplary degradation of xenobiotic organopollutants, e.g. laccase to determine application conditions in washing processes, versatile haloperoxigenase and peroxygenase (catalysing the regiospecific hydroxylation of basic chemical structures) we will investigated and the halogenation potential will be studied. The use of enzymes in technologies for industrial waste treatment is carried out by constitutive and inducible mono- and dioxygenases of imperfect fungi.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

- 12793 *Purification and Characterisation of Proteins*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

Bisswangeer H., Figura R., Möschel K., Nouaimi M: Enzymkinetik, Ligandenbindung und Enzymtechnologie. ISBN 3-8265-7175-4, 2001
Heiden S., Bock A-K., Antranikian G.: Industrielle Nutzung von Biokatalysatoren. ISBN: 3-503-04861-8, 1999
Several current publications e.g.:
Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677).
Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).
Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Individual practical work in the lab: preparation of experiments, performance, discussion, time management (50%)
- Presentation and discussion in seminars, duration depends on the topic (20%)
- Final colloquium, duration: 15 min (20%)
- Final report, approx. 20 pages (10%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The Laboratory course takes place as a 6 week block course. The seminar is an obligatory part of the lab course.
Module Components	• Lab Course "Methods in Enzyme Technology" • Seminar "Methods in Enzyme Technology"
Components to be offered in the Current Semester	**211133** Practical training Methods in Enzyme Technology - 7 Hours per Term **211135** Seminar/Practical training Methods in Enzyme Technology - 1 Hours per Term

Module 12797 Methods in Laboratory Diagnostics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12797	Compulsory elective

Modul Title	**Methods in Laboratory Diagnostics** Methoden der Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities The students are involved in the latest developments in the field of laboratory medicine. Students learn how to use modern technical laboratory diagnostic equipment. Students learn how to plan a strategy for developing a new diagnostic assay or diagnostic instrument. Students will work on and validate aspects of assay or instrument development in practice.
Contents	On the basis of the available literature and publications of the research group, the students design protocols for assay or instrument development, which are discussed in the seminar. The students work mainly in the fields of nucleic acid detection, autoimmunity, infection serology and tumor diagnostics. Mainly cell or microbead-based assays are developed. The students carry out their practical work under the supervision of the members of the research group and are integrated into the current research work of the working group.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:

	Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	Current scientific literature of the own research group and generally accessible literature on the respective subject area.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (30%) • Presentation and discussion in the seminar, duration depends on the topic (25%) • Presentation of results (25%) • Oral Test, duration: 15 min (20%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Laboratory Diagnostics" • Seminar "Methods in Laboratory Diagnostics"
Components to be offered in the Current Semester	No assignment

Module 12798 Methods in Bioanalytics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12798	Compulsory elective

Modul Title	**Methods in Bioanalytics** Methoden in der Bioanalytik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. PD Dr. rer. nat. habil. Rödiger, Stefan
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	First the students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays (incl. analysis of DNA damage upon treatment with single (etoposide) and multiple chemotherapeutic substances, FISH to asses genomic alterations of cancer cells). In particular, the cell assays have relevance in precision medicine and pharmacology/pharmaceutical research. Furthermore, they broaden their methodological background in analysis, interpretation and reporting of lab data by different methods used in applied statistical bioinformatics, forensics, pharmaceutical research and precision medicine. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to present and discuss the experimental results train additional soft skills like the ability to communicate orally to individuals and groups and to tailor the oral communication to the level and experience of the audience. The students use appropriate scientific open source software (incl. R statistical computing language, Python general purpose programming language), graphics, and other tools to clarify complex information. The analysis of the data includes methods used in applied statistical bioinformatics and bioanalytical pharmacology. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	• Sterile working technique, media preparation • Routine maintenance of cell lines: Medium replacement, subculture of adherent cells

- Cryopreservation: Freezing and thawing of cells
- Contamination control: Microscopical observation, etc.
- Characterization of human (tumor) cells or cell lines
- Morphology: microscopy of cells
- Proliferation: Growth curve, population doubling-time
- Testing of (mouse monoclonal) antibodies ((m)Ab). Immunocytochemistry and immunochemistry with (m)Abs
- Comparison of different cell assays e.g. gamma H2AX-Assays and FISH assays
- Assesment of the effect of chemoterapeutic substances

Contents of the seminar:

Deepening the knowledge of the methods used in the labcourse. Methods in applied statistical bioinformatics, literate programming and report generation (Remarkdown or Jupyter notebook).

Recommended Prerequisites

Basic knowledge in Cell biology, Biochemistry, applied biostatistics and bioinformatics.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications; 2010
- Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008
- Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011
- Logan, M., Biostatistical Design and Analysis Using R: A Practical Guide. 2010
- Selvin, S., 1998. Modern Applied Biostatistical Methods: Using S-Plus, Monographs in Epidemiology and Biostatistics. Oxford University Press, Oxford, New York.
- Lee, J.K., 2010. Statistical Bioinformatics: For Biomedical and Life Science Researchers. Wiley.
- Sencar, H.T., Memon, N. (Eds.), 2013. Digital Image Forensics. Springer New York, New York, NY. https://doi.org/10.1007/978-1-4614-0757-7
- National Research Council (US) Committee on A Framework for Developing a New Taxonomy of Disease, 2011. Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease, The National Academies Collection: Reports funded by National Institutes of Health. National Academies Press (US), Washington (DC).

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	<div id="meta-origin" data-coolorigin="https%3A%2F%2Fwww.b-tu.de%2Forgcloud%2Fapps%2Frichdocumentscode%2Fproxy.php%3Freq%3D%2Fcool%2Fclipboard%3FWOPISrc%3Dhttps%253A%252F%252Fwww.b-tu.de%252Forgcloud%252Findex.php%252Fapps%252Frichdocuments%252Fwopi%252Ffiles%252F9418674_ochtzup9yafk%26ServerId%3Dde63ef99%26ViewId%3D7%26Tag%3D0de54f906567e99d"> <p>Laboratory Work – design, execution, in–lab discussion, and time management (55 %) <p>Presentation & Discussion (Journal Club of a Research Paper) - each student selects one current research paper from the field of bioanalytics; 15–minute presentation followed by a 10–minute group discussion (15 %) <p>Written Tests – 3 separate tests (each 30 min.),(15 %) <p>General knowledge about Methods in Bioanalytics and related topics <p>Knowledge of statistical bioinformatics and associated methods <p>Lab–course–specific content <p>Presentation of Lab–Course Results – two components (15 %) <p>Lab report (10 pages) produced from a reproducible document (e.g., Quarto, RMarkdown), due at the end of the course <p>Oral presentation using that reproducible document: 10 minutes for the presentation followed by a 10–minute group discussion <p class="western">
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Bioanalytics" • Seminar "Methods in Bioanalytics"
Components to be offered in the Current Semester	No assignment

Module 12799 Molecular Biology: Principles, Methods and Applications

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12799	Compulsory elective

Modul Title	**Molecular Biology: Principles, Methods and Applications** Molekularbiologie: Grundlagen, Methoden und Anwendung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	It is the aim of this laboratory course to provide basic molecular biology techniques in the first place. Students should experience isolation and manipulation of DNA and RNA in a way that they understand the underlying principles of these fundamental methods. In a second step, students have to learn different techniques used to transfect pro- and eukaryotic cells as these are important methods in biotechnology. Therefore, the course provides the complete scenario from the preparation of DNA up to the functional analysis of different expression plasmids. Third, students will become familiar with viruses, as these biological agents are important "work horses“ in different areas of molecular biology. Working with microbeads to detect nucleic acids and proteins in a multiplex format provides the opportunity for state of the art bioanalytical methods. This part is complemented by genome editing experiments. Students will get in touch with a state of the art complex methodology and get hands-on experience. The seminar has the task of broadening the theoretical basis of the methods used in the practical course. Presentations and enhanced discussions will provide the stage for a fruitful enhancement of molecular biology knowledge. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to train their practical lab skills and generic competences as they have to solve scientific problems.

All these projects require search and understanding of relevant scientific literature, design of experimental protocols, documentation and a critical discussion of results.

Contents

Students will isolate expression vector DNA using different protocols and reagents and will later on compare the influence of these different procedures on transfection efficiency again applying different gene transfer methodologies. Here the students will perform the complete set of steps necessary for eukaryotic cell transfection. These experiments form the basis for the central part of the course the genome editing. Students will use the CRISPR/Cas system to induce genome mutations and create site directed specific sequence alteration. The analysis of the cell physiological effects of these editings will be performed using cell culture experiments. In addition little projects will be given to students including the following methods: coupling of nucleic acids and proteins to fluorescence coded microbeads: detection of the protein targets by antibody detection; nucleic acids are detected on the bead surface via hybridization or PCR; expression and purification of recombinant proteins; design of primers for qPCR, PCR and PCR based cloning. Because the master course is integrated into the scientific research of the group experiments will be adapted accordingly.

Recommended Prerequisites

none

Mandatory Prerequisites

- 12797 *Methods in Laboratory Diagnostics*
- 12798 *Methods in Bioanalytics*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- iGenetics: A Molecular Approach. Peter J. Russell. ISBN 10: 0805346651
- Molecular Biology of the Gene. James D. Watson, Tania A. Baker, Stephen P. Bell et al. ISBN-13: 9780321507815
- Molecular biotechnology / by Carolyn A. Dehlinger; Jones & Bartlett Learning, ISBN 978-1-284-05783-6
- Variable original publications depending on the project given.
- Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request.
- On the other hand it is part of the seminar that students have to search for appropriate information and to develop different information acquisition strategies.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Practical laboratory work-preparation of experiment, performance, discussion, time management (50%)
- Presentation and discussion in the seminar; duration depends on the topic (25%)
- Lab report (including title, abstract, introduction, methods and materials, results, discussion, conclusion, and references; 15-20 pages) (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course The module takes place as a 6 week block course.
Module Components	• Lab Course "Molecular Biology: Principles, Methods and Applications" • Seminar "Molecular Biology: Principles, Methods and Applications"
Components to be offered in the Current Semester	**210413** Practical training Molecular Biology: Principles, Methods and Applications - 7 Hours per Term **210415** Seminar/Practical training Molecular Biology: Principles, Methods and Applications - 1 Hours per Term

Module 12800 Microbial Metabolism

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Zellbiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12800	Compulsory elective

Modul Title	**Microbial Metabolism** Stoffwechsel der Mikroorganismen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Goal of the lecture is 1. repetition of basics in bacterial and fungal metabolism and its regulation 2. in depth understanding of selected topics based on recent original papers and current reviews 3. to understand how conclusions are drawn from data, especially experimental data 4. to understand how independent research strategies can lead to overlapping evidences 5. to understand the difference qualitative and quantitative experimental approaches 6. to understand the route starting from a scientific question over experimental data to a model explaining complex phenomena of microbiology 7. to become able to work as a PhD student
Contents	**Microbial Metabolism and Regulation** As a general principle all statements presented in the lectures are based on conclusions drawn from original data. Topics: a) Mutations affecting metabolic pathways: (conditional) auxotrophy; supplementation; glycine biosynthesis; definded growth media; b) Isoenzymes: isocitrate DHs; serine hydroxymethyltransferases; carbon flux analysis; subcellular compartmentation; aspartate kinases of *E. coli* c) Regulation of metabolism: lac, ara, trp operon; repression, induction, attenuation, mRNA half-life control;; adenylation of glutamine synthetase; phosphorylation; feed back inhibition

	d) Circadian clocks: control of photosynthesis and nitrogenase in *Synechococcus* and *Anabaena*; sporulation in *Neurospora* e) Reporter systems: *lacZ*; green fluorescent protein; organelle targeting; f) Quorum sensing: biofilms; signal systems in Gram-positive and Gram-negative bacteria;
Recommended Prerequisites	Basic knowledge in biochemistry, molecular biology, microbiology.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	About 30 pdf-files of original research reports, review articles, PhD theses are available for the students e.g. Biochem J 369: 263-73; PNAS 100: 5914-9; Genes Develop 15:1468-80; YEAST 21: 63-73; EMBO J 22: 2127-34; J Bacteriol 185: 2066-79; Schlüpen C Diss Uni Düsseldorf; PNAS 90: 5672-6; PNAS 99: 9697-702; Microbiology 154: 2184-94; Mol Cell Biol 6221-8; BBA 1577: 240-50; J Mol Cat 10: 335-43; PNAS 98: 12221-6; J Bacteriol 182: 1-8; J Biol Chem 271: 11113-9; Microbiol 147: 3377-86; PNAS 107: 2043-47
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" Biotechnology (Master of Science, 3 Semester Version): Master 1st year course Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Microbial Metabolism and Regulation" • Examination "Microbial Metabolism and Regulation"
Components to be offered in the Current Semester	**210330** Lecture Microbial Metabolism and Regulation - 2 Hours per Term **210338** Examination Microbial Metabolism and Regulation

Module 11858 Proteostasis

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11858	Mandatory

Modul Title	**Proteostasis** Proteostase
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	Proteostasis is a concept to summarize the contributions of protein synthesis, folding, modification, trafficking and degradation to steady state maintenance and dynamics of proteomes in cells. Major aim of the module is to deepen mechanistic knowledge in protein structure and function and the contributions of aforementioned processes during regulation of cellular homeostasis. The topic requires confrontation with complexity of living systems and scientific terminology. The consideration of mechanistic details of cellular processes should deepen the comprehension of important principles as foundations of cellular homeostasis and molecular pathology. Based on a mechanistic understanding of cell biological and molecular processes within the concept of protostasis, students are invited to contribute with their future work to progress in the understanding of the molecular pathology, diagnostics and therapy of human diseases (e.g. neurodegeneration, cancer, aging). Apart from these specific topics one major idea of the lecture is to enlighten the philosophy behind the scientific method. Historical milestones during the discovery of proteolytic systems involved in cell cycle control, apoptosis and cell survival signalling pathways, illustrated with original papers and reviews exemplifies deductive strategies and causality within scientific philosophy. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions.
Contents	Central topic of the module are cellular and molecular processes shaping the functionality of cellular proteomes. Protein synthesis,

	protein folding and misfolding, protein modification, subcompartimental localization and degradation are interconnected topics central to the understanding of molecular cell biology. The unique feature of this module is to look at these processes from the perspective of distinct proteolytic systems such as ubiquitin-dependent and independent proteasomal proteases, lysosomal proteases in autophagy, or caspases in apoptosis and inflammation and generally protease in antigen processing. Firstly, basics in protein biochemistry as well as technologies to analyze steady state and turnover of proteins are discussed. Next, the enzymology of proteases (protease families and mechanisms, inhibitors, diseases and therapy), proteolytic systems and protein modifications is a specific focus of this module. While considering complex proteolytic systems such as those of autophagy, apoptosis and the ubiquitin proteasome system, the module connects the topic of proteostasis specifically with cell survival signaling as exemplified by NFkB or p53 pathways, cell cycle regulation or apoptotic/inflammatory pathways. While emphasizing the role of proteases for cellular homeostasis, peptide generation as a principle of antigen processing should not be neglected. Hence, the discussion of MHC class I and class II pathways demonstrates the roles of proteolytic systems for the immune response.
Recommended Prerequisites	Basic level in biochemistry, cell biology and molecular biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	As a starting point textbooks of molecular cell biology and protein biochemistry are recommended: • Alberts, Johnson, et al. (2008) Molecular Biology of the Cell, 5th Edition (or newer) Garland Science • Nelson, Cox (2008) Lehninger Principles of Biochemistry 5th Edition • Lodish, Berk, et al. (2008 or later). Molecular biology of the cell 6th Edition, W.H.Freemann and Company Reviews as starting point: • Klaips, C.L., Jayaraj, G.G. and Hartl, F.U. (2017). Pathways of cellular proteostasis in aging and disease. J. Cell Biol. http://doi.org/10.1083/jcb.201709072
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none

Module Components	• Lecture "Proteostasis" • Seminar "Proteostasis" • Examination "Proteostasis"
Components to be offered in the Current Semester	**210238** Examination Proteostasis

Module 12765 Nanobiotechnology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12765	Mandatory

Modul Title	**Nanobiotechnology** Nanobiotechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The goal of the course is to provide a systematic description of nanotechnolgy-driven techniques and approaches that are relevant in biotechnology. By the end of the course, students will be able to (1) explain physical principles governing biological systems at the nanoscale, (2) compare relevant (single-molecule) techniques and evaluate their possibilities and limitations, (3) interpret experimental and computational data, (4) design (thought) experiments to probe biomolecules and their interactions, (5) critically analyze primary literature, and (6) asses the translational potential of the discussed techniques. Short talks will enable students to present state of the art developments with the overall aim to encourage the development of independent ideas and concepts to solve scientific and societal challenges.
Contents	Nanobiotechnology explores biological processes at the nanometer scale and develops technologies to measure, manipulate, and engineer individual biomolecules and ensembles thereof. After introducing the term nanobiotechnology and discussing the physical principles relevant at the nanoscale, the course will introduce key concepts in detection, manipulation, and utilisation of biomolecules. A focus will be set on fluorescence-based, single-molecule detection schemes and the use of RNA/DNA nanotechnology that, taken together, let to breakthroughs in next-generation sequencing technologies and diagnostics. Students will learn, how nanoscale tools reveal hidden biological heterogeneity and how these discoveries can be translated into clinical and industrial innovations.

	The course further includes lectures on (1) (super-resolution) optical microscopy and live-cell imaging, (2) nanoparticles/fluorescent probes and their applications in biology and medicine, (3) applied surface science and nano/micro fluidics (including the basics of surface electrostatics, methods of surface analysis, self-assembled monolayers, covalent immobilization of biomolecules), (4) affinity biosensors (surface plasmon resonance and field-effect biosensors), (5) model lipid systems (liposomes, lipid monolayers, planar lipid bilayers), (6) DNA and nanopore technology. Additionally, the theoretical course includes short presentations of students and subsequent discussions on recent topics of nano(bio)technology, for example: DNA-origami, single-molecule kinetics, self-assembly, etc.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Science.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	In addition to the provided lecture scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	
Module Components	• Lecture "Nanobiotechnology" • Seminar "Nanobiotechnology" • Examination "Nanobiotechnology"
Components to be offered in the Current Semester	**210818** Examination Nanobiotechnology

Module 12766 Bioprocess Development

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12766	Mandatory

Modul Title	**Bioprocess Development** Entwicklung von Bioprozessen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. rer. nat. Hansen, Barbara
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	After participating in the module, students are able to apply the basics of heat and mass transport, bioreaction technology to biotechnological processes.
Contents	Use of living cells for the planning and implementation of a process, the development of process control and processing methods for the products, the control of production processes and their continuous optimization.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; 2010
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none

Remarks	No offer from WiSe 2024/25!
Module Components	• Lecture "Bioprocess Development" • Seminar "Bioprocess Development" • Examination "Bioprocess Development"
Components to be offered in the Current Semester	No assignment

Module 12792 Methods in Nanobiotechnology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12792	Mandatory

Modul Title	**Methods in Nanobiotechnology** Methoden der Nanobiotechnology
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Upon successful completion of this course, students will be able to independently design, perform, and critically evaluate experiments in modern nanobiotechnology. They will acquire hands-on experience with single-particle tracking, single-molecule FRET using DNA-based sensors, and super-resolution microscopy in live bacterial cells. Students will learn to prepare samples, operate advanced fluorescence microscopes, and optimize acquisition parameters for reaching single-molecule sensitivity. Students will analyze experimental data using appropriate statistical and computational tools (Python), extracting biologically meaningful parameters such as diffusion coefficients, molecular distances, and nanoscale spatial organization. The course will strengthen the ability to connect physical measurement principles with biological questions. Finally, students will critically assess experimental limitations, sources of artifacts, and the translational relevance of single-molecule and super-resolution approaches.
Contents	The course is organized around a sequence of laboratory modules that introduce experimental strategies in nanobiotechnology. It begins with an overview of fluorescence microscopy setups, optical alignment, and intricate sample preparation required for achieving single-molecule sensitivity. Students then perform single-particle tracking experiments to study nanoscale motion and heterogeneity, followed by single-molecule Fluorescence Resonance Energy Transfer (smFRET) measurements using, e.g., DNA-based sensors to investigate conformational changes in the nanometer range. A dedicated module addresses live-cell imaging in bacteria and the application of single-molecule localization microscopy to resolve subcellular structures beyond the diffraction

	limit. Throughout the course, practical sessions are complemented by guided data processing, including diffusivity analysis, FRET efficiency calculations, and localization reconstructions. The final part of the course focuses on integrating experimental results into a coherent scientific report and discussing biological context and potential applications.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Sciences.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	In addition to the provided scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• presentation of a scientific topic (will be announced at the beginning of the lab course) (20%), 10 slides, 20 min presentation • written test on the content of the course 60 min (20%) • protocol reporting on the experiments and data analysis (40%), 10-12 pages • experimental work (preparation of experiment, performance, discussion, time management) (20%), weekly evaluation by the supervisors on the above described criteria
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Nanobiotechnology" • Seminar "Methods in Nanobiotechnology"
Components to be offered in the Current Semester	No assignment

Module 12793 Purification and Characterisation of Proteins

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12793	Mandatory

Modul Title	**Purification and Characterisation of Proteins** Reinigung und Charakterisierung von Proteinen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	**Lab Course** The course is aimed to train master students on basic techniques in protein biochemistry and proteome research. To develop strategies for the purification and characterization of various proteins is the major goal of this course. Another didactic aim is to consolidate problem solving abilities and structured experimental team work as well as individual responsibilities. During a lab course students are working individually or as a team depending on the complexity of the analytic task to strengthen team work, as well as individual responsibility. Technical competences in protein purification are reaching from culturing prokaryotic and eukaryotic cells, providing cell lysates, via enrichment of proteins by subcellular fractionation towards classical strategies of salt precipitation, ultrafiltration and chromatography. Characterization encompasses electrophoreses (NEPHGE, IEF, SDSPAGE) and immune-identification (immunoblotting). Functionality of proteins is accessed by assays for enzymatic activites or protein-protein interaction depending on the specific research task provided. **Seminar** Since each student experiences various purification approaches associated with specific problems, the weekly research seminar provides the opportunity to makes this knowledge available for each participant of the lab course. During oral presentations the participants introduce into relevant literature, covering the theoretical background and principles of methods applied. Scientific questions, experimental approaches and results of individual projects are presented as well.

These compulsory seminars are strengthening the student´s conceptual skills by planning their experimental activities for the next week, by drawing conclusions from experimental data. Certainly, the seminars are also aimed to promote the development of professional communication skills.

Contents

The experimental work of the students is integrated in actual research projects (proteolytic systems, proteasome regulators, apoptosis, protein modification etc). Basic techniques such as homogenization, centrifugation and salt precipitation, as well as ion exchange chromatography and other FPLC techniques are applied to research topics of the biochemistry unit.
In a second step the composition of purified protein fractions is analyzed simply by SDS PAGE and Western blotting or via isoelectric focusing (IEF) and non-equilibrium pH gradient gel electrophoresis (NEPHGE). Enzyme assays and immune-detection methods are applied to monitor the quality of target proteins during protein fractionation.
Fractionated salt precipitation, ultracentrifugation and ion exchange chromatography are the basic methods to purify proteasome regulators and their functional mutants. Other proteins may be useful for the standardization of immune-detections.

Recommended Prerequisites

none

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Practical Approach Series (David Hames, Editor; 185 volumes since 1981; IRL Press; Oxford University Press). Topics:
- Coligan, Dunn, Speicher, Wingfield (2002) Short Protocols in Protein Science, Wiley
- Barker, Kathy (2005). At the Bench: A Laboratory Navigator ISBN-13: 978-0879697082
- Original publications (depending on the assigned project).
- Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request.
- To strengthen professional skills, students have do develop their information acquisition strategies. Hence, seminar/lab course participants have to supplement provided information/material by their independent contributions.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Practical laboratory work 50%
- Presentation and discussion in the seminar, duration depends on the topic (25%)
- Lab work protocol, 10-20 pages (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course “Purification and Characterization of Proteins” • Seminar “Functional Analysis of Proteins”
Components to be offered in the Current Semester	No assignment

Module 12794 Methods in Enzyme Technology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12794	Mandatory

Modul Title	**Methods in Enzyme Technology** Methoden der Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	For students the course with complex tasks will enhance key skills such as teamwork, communications, problem-solving and business awareness (professional methodically and social competences). The first step in the development of a new enzyme product is to find the organism that produces the optimal enzyme. Each student should isolate and determinate one fungal strain from natural sources; purify the strain and determine enzyme activities by using several screening methods. Students use well-studied microorganisms from internal strain collection for producing extracellular and intracellular oxidoreductases and hydrolases. The biocatalysts are separated, concentrated and lyophilised and individual enzyme activities, kinetic parameter and stabilities are studied. In the second part, isolated enzyme reactions - as well as bioreactions by cell preparations - will be performed in several application techniques, including analytical product identification, activities in dependence of changing incubation parameters and yields. The main objective is to demonstrate regio- and stereoselective reactions and to analyse the potential applications of oxidoreductases and hydrolases by several analytical methods.
Contents	The course consists of practical exercises for isolation and screening of enzymes from natural habitats (lignocellulose), strain cultivation for fermentative enzyme production, preparation of extra- and intracellular enzymes, enzyme conservation, characterisation of the enzymes' application potential (factors for regulation of enzyme activity, textile bleaching, xenobiotic degradation potential, regioselective halogenation

and hydroxylation). Oxidoreductases and hydrolases will be used for exemplary degradation of xenobiotic organopollutants, e.g. laccase to determine application conditions in washing processes, versatile haloperoxigenase and peroxygenase (catalysing the regiospecific hydroxylation of basic chemical structures) we will investigated and the halogenation potential will be studied. The use of enzymes in technologies for industrial waste treatment is carried out by constitutive and inducible mono- and dioxygenases of imperfect fungi.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

- 12793 *Purification and Characterisation of Proteins*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

Bisswangeer H., Figura R., Möschel K., Nouaimi M: Enzymkinetik, Ligandenbindung und Enzymtechnologie. ISBN 3-8265-7175-4, 2001
Heiden S., Bock A-K., Antranikian G.: Industrielle Nutzung von Biokatalysatoren. ISBN: 3-503-04861-8, 1999
Several current publications e.g.:
Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677).
Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).
Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Individual practical work in the lab: preparation of experiments, performance, discussion, time management (50%)
- Presentation and discussion in seminars, duration depends on the topic (20%)
- Final colloquium, duration: 15 min (20%)
- Final report, approx. 20 pages (10%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The Laboratory course takes place as a 6 week block course. The seminar is an obligatory part of the lab course.
Module Components	• Lab Course "Methods in Enzyme Technology" • Seminar "Methods in Enzyme Technology"
Components to be offered in the Current Semester	**211133** Practical training Methods in Enzyme Technology - 7 Hours per Term **211135** Seminar/Practical training Methods in Enzyme Technology - 1 Hours per Term

Module 11795 Immunology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11795	Compulsory elective

Modul Title	**Immunology** Immunologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Roggenbuck, Dirk
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	At the end of the module, the students are able to create a common understanding of immune responses and their relevance regarding the protection against pathogens. They are able to evaluate cellular and humoral immune mechanisms and to understand and apply immunological tools in diagnostics and therapy. Further, they are able to analyze the main molecular mechanisms of an immune response in the context of pathophysiological processes in immune-mediated disorders. Students are able to evaluate immunological markers within the differential diagnosis of immune-mediated diseases.At the end oh the module students can explain and apply scientific principles as well as specialised and in-depth knowledge. They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	• History of immunology • Innate immune system • Specific acquired immunity • Basic immune protection systems – complement • Dendritic cells and antigen presentation • Apoptosis • Structure and function of antibodies • B-cells and antigen recognition • HLA system – membrane receptors for antigen presentation • T-cells – development and functions • Cytokines • Immune responses • Clinical Immunology – allergy and autoimmunity

Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Immunology, 13th edition, P.J.Delves, S.J. Marting, D.R. Burton, I.M. Roitt, Wiley-Blackwell, corresponding web site with interactive questions, podcasts and videos • Cellular and molecular Immunology: with Student consult online access, 7th edition, A.K. Abbas, A.H. Lichtman, S. Pillai, Elsevier
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Immunology" • Seminar "Immunology" • Examination "Immunology"
Components to be offered in the Current Semester	**210020** Lecture Immunology - 2 Hours per Term **210025** Seminar Immunology - 1 Hours per Term **210028** Examination Immunology

Module 11825 Tissue Engineering

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11825	Compulsory elective

Modul Title	**Tissue Engineering** Entwicklung und Kultivierung von Geweben
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	• Explain and apply fundamental scientific principles as well as advanced, specialized knowledge in tissue engineering and regenerative medicine. • Describe the basic structure of tissues and analyze interactions between cells and the extracellular matrix. • Explain key developmental processes in mammals and relate them to tissue engineering strategies. • Identify and explain the core components of tissue engineering, including cells, signaling molecules, biomaterials, bioreactors, and three-dimensional (3D) cell culture systems. • Distinguish between different cell-based therapies and evaluate their roles as therapeutic concepts in regenerative medicine. • Analyze and discuss 3D cell culture approaches and evaluate their relevance for tissue engineering, disease modeling, toxicology and pharmacology and translational research.

	• Develop independent ideas and concepts for solving scientific problems related to tissue engineering.
Contents	• Basic organisation of tissues: Cells and extracellular matrix (ECM)
	• ECM: Molecular structure & function • Cell-ECM Interaction
	• Cell-Cell interactions • Cellular Development and Fate Decisions (Proliferation, migration, determination, differentiation, cell-cell & cell-matrix interaction, apoptosis)
	• Cells Sources for Tissue Engineering: stem cells, differentiated cells from adult tissues, problem of donor-recipient cell transfer
	• Wound healing as a Natural Model of "Tissue Engineering": Inflammation, tissue formation, tissue remodelling
	• Cell based therapies: Principles and Applications
	• 3D Cell Cultures Systems: Principles and Applications
Recommended Prerequisites	Basic knowledge in cell biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015 • Cell and Molecular Biology. Concepts and experiments. Karp G., John Wiley & Sons, 2008 • Principles of Tissue Engineering, Lanza R. P. et al., Academic Press, 2nd edition 2000 • Methods of Tissue Engineering, Anthony Atala, Robert P. Lanza (eds.), Academic Press, New York, 2002 • Tissue Engineering, Clemens van Blitterswijk (senior editor), Elsevier, Amsterdan,Boston, Heidelberg, … (2008) • Functional Tissue Engineering, Farshid Guilak, David L. Butler, Steven A. Goldstein, David Mooney, C. MacLachlan, Springer, New York, Berlin, 2003 • Specific original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded

Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Tissue Engineering" • Seminar "Tissue Engineering" • Examination "Tissue Engineering"
Components to be offered in the Current Semester	**210728** Examination Tissue Engineering

Module 12175 Molecular Dynamics of the Cell

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12175	Compulsory elective

Modul Title	**Molecular Dynamics of the Cell** Molekulare Prozesse in Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The overall aim of the Module is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected. The lecture focuses on molecular processes that connects DNA damage signalling with cell cycle arrest, DNA repair or apoptosis. Furthermore, the student learns about the dynamics of a particular important cell types, the hepatocyte. Based on a profound understanding of molecular processes, the students will also better understand the molecular pathology of human diseases (e.g. cancer) which occur if there is a defect in one of these processes. Understanding the etiology of such diseases is the prerequisite for specific and effective therapies. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).
Contents	The lecture contains the following topics: • Molecular biology of eucaryotic DNA replication as a prerequisite to understand DNA damage signaling and DNA repair • Spectrum of DNA damages • DNA damage signaling: Molecular DNA damage sensors such as ATM and DNA-Pk, mediators, transducers/ effectors and cellular genotoxic responses such as apoptosis or cell cycle arrest, resp.; human diseases by defects in DNA damage signaling • Human DNA repair pathways: Direct DNA repair, Mismatch Repair, Base- & Nucleotide Excision Repair, Recombination Repair; defects

	in repair pathways leading to defined diseases or syndromes, their specific diagnostics and molecular strategies for therapies if possible • Molecular Dynamics of hepatocytes
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Molecular Dynamics of the Cell" • Seminar "Molecular Dynamics of the Cell" • Examination "Molecular Dynamics of the Cell"
Components to be offered in the Current Semester	**211018** Examination Molecular Dynamics of the Cell

Module 12762 Signal Transduction

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12762	Compulsory elective

Modul Title	**Signal Transduction** Signaltransduktion
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Understanding inter- and intracellular communications is essential when working in life science. Although the complexity of the issue makes the subject almost unmanageable there exist general principles and types of molecules that play a key role in signal transduction. A profound knowledge of these provides the basis to look into any kind of pathway successfully. In addition to understand the concepts it is of the same value to also know key experimental approaches that are applicable to elucidate signal transduction components and networks. It is therefore the aim of the lecture to develop an understanding not only of key signaling pathways (professional competences) but also of the experimental methodology used to study signal transduction in the lab. Summary: At the end of the module students are able to remember general mechanisms and understand the relevant scientific literature. They are able to apply the knowledge to design and perform own experiments. They can analyze and evaluate the data they obtain and should be able to create various new approaches to study and work in the field of signal transduction.
Contents	Due to the importance and the basic student knowledge of G-protein coupled receptors (GPCR) general aspects of ligand-receptor interaction, receptor activation and desensitization are discussed focusing on this subject. The importance of protein translocation and modification is underlined and explained using several examples. Within the same context binding experiments and the analysis of agonists and antagonist are explained. Using the GPCR topic a complete “story” is developed starting with ligand affinity down to the FRET-based

	methods of measuring receptor activation and inactivation. Students understanding is challenged by questions concerning the outline and the execution of relevant experiments to make clear that in general very similar approaches are used to study completely different signaling pathways. Emphasis is placed on experiments based on knock-down, knock-out, overexpression and inhibitors. A seminar is offered to deepen the understanding of the contents of the lecture and to prepare the students for their "working" with current scientific studies. <u>Membrane Receptor mediated</u> • G-protein coupled • Enzyme based (i.e. Receptor Tyrosine Kinase, JAK/STAT, TGFbeta) • Cytokine classes I-IV • Ion channels • Special pathways (Wnt, Hedgehog, Notch, Cholesterol) <u>Non-membrane receptor mediated</u> • Nitric oxide (NO) pathway • Steroid hormone receptors
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Textbook: Signal Transduction, IJisbrand M. Kramer, AP • Signal Transduction Knowledge Environment (stke.sciencemag.org) • Recent original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Signal Transduction" • Seminar "Signal Transduction" • Examination "Signal Transduction"
Components to be offered in the Current Semester	**210460** Lecture Signal Transduction - 2 Hours per Term **210465** Seminar Signal Transduction - 1 Hours per Term

210468 Examination
Signal Transduction

Module 12763 Enzyme Technology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12763	Compulsory elective

Modul Title	**Enzyme Technology** Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The use of catalysts, and particularly of their biological version (enzymes), has recently been the subject of increased debate in research, technology and environmental policy. Enzyme technology is regarded as a key technology for a sustainable future; it renders possible the manufacturing of innovative products (e.g. pharmaceuticals, fine chemicals, flavors, food and feed ingredients) and opens new doors for the application of biological agents in chemical processes, which leads to positive environmental effects and energy savings. Enzyme technology has a great potential for breaking down the boundaries between individual scientific disciplines (biotechnology, chemistry, microbiology, etc.) and between fundamental and applied research. Aims of this teaching unit are - to provide a basic knowledge of relevant protein structures, to acquire an understanding of the principles by which enzymes catalyse biochemical reactions, and - to provide a comprehensive overview of enzyme applications to introduce economic and sustainable goals associated with enzyme technologies, historical background and modern approaches of enzyme application (e.g. nanobiotechnology, biofuels, protein production, extremophiles, biopharmaceutical production, microbial natural products). For students the lecture and seminar will provide an understanding of scientific principles and will provide practice of advanced white biotechnology (professional competences) and its exploitation in commercial practice (methodic competences) for get individual orientation skills e.g. concerning an career as scientist, PhD studend or to understand how to create and manage a biotech business).

Contents	An instructive and comprehensive overview of the current enzyme applications in the so-called White, Red and Green Biotechnology. Basic Tools: Biocatalysts, Advantages & Disadvantages of Enzyme Processes, Aspects of Enzyme Application, Protein Structure, Enzyme Classification, Enzyme Kinetics, Sources of Enzymes, Search and Screening for New Biocatalysts, Protein Engineering, Enzyme Production, Advanced Tool: Enzymes in Food Industry (e.g. Baking, Brewing, Dairy, Saccharification), Enzymes in Non-Food Applications (e.g. Detergents, Pulp and Paper, Textile Industry), Enzymes in Chemical Production Processes (Organic Synthesis, Chiral Molecules, Drugs), Perspectives of Enzyme Exploration and Application, Current Research Activities (e.g. National and European Research Programs), New/Own Research Activities (e.g. Fungal Oxidoreductases for Industrial Processes, Biocatalysts for Refinement of Renewable Polymers) Scientific Seminar: present and discuss published current experimental findings and contemporary issues
Recommended Prerequisites	Multidisciplinary cross section require basic knowledge in biochemistry, microbiology, molecular biology, chemistry and engineering sciences.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Hofrichter, M., K. Esser, The Mycota: Industrial Applications, 2010, Springer-Verlag Berlin Heidelberg • Fessner, W., Anthonsen, T.: Modern Biocatalysis, 2008, Wiley-VCH, Weinheim • Illanes, A.: Enzyme Biocatalysis, Principles and Application, 2008, Springer • Liese, A., Seelbach, K., Wandrey, C, Industrial Biotransformations, 2006, Wiley-VCH, Weinheim • Buchholz, K., Kasche, V., Bornscheuer, U. T., Biocatalysts and Enzyme Technology, 2005, Wiley-VCH, Weinheim • Bommarius, A.S., Riebel, B.R.: Biocatalysis, Fundamentals & Application, 2004, Wiley-VCH, Weinheim • Aehle, W., Enzymes in Industry, 2004, Wiley-VCH, Weinheim Several current publications e.g.: • Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677). • Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).

	• Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Module Examination	Prerequisite + Final Module Examination (MAP)
Assessment Mode for Module Examination	• Requirements: Successful participation at the seminar including a 30 min presentation and 15 min discussion. • Final written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	The module is only offered in the winter semester.
Module Components	• Lecture "Enzyme Technology" in winter semester • Seminar "Enzyme Technology" in winter semester • Examination "Enzyme Technology"
Components to be offered in the Current Semester	**211110** Lecture Enzyme Technology - 2 Hours per Term **211115** Seminar Enzyme Technology - 1 Hours per Term **211118** Examination Enzyme Technology

Module 12764 Synthetic Microbiology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12764	Compulsory elective

Modul Title	**Synthetic Microbiology** Synthetische Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The "Synthetic Microbiology" module promotes the interactive work and learning of the participating students by combining different teaching disciplines such as a lecture series, a seminar and a practical course. The ability of the students to work in teams will be stimulated by discussing current literature in the context of the lecture content. After successfully completing the module, the students will have acquired competences in terms of self-organization and communication skills in addition to the acquired specialized scientific knowledge. Moreover, the use of a correct scientific language for communication and the presentation of scientific data will be trained.
Contents	After an introduction to the microbial world, the course will provide an overview of the diversity, structure, and functioning of microbial communities. Particular emphasis will be placed on understanding microorganisms as members of complex and dynamic communities rather than as isolated organisms. Students will learn how microbial interactions shape community composition, stability, and function, and how these interactions influence ecosystem processes in environmental, agricultural, and host-associated habitats. The lecture series will introduce the principles and methodologies used to investigate microbial communities, including cultivation-dependent and cultivation-independent approaches, high-throughput sequencing technologies, and multi-omics methods. Concepts for the characterization of microbial diversity, community structure, microbial

interactions, and community function will be presented, together with approaches for the analysis and interpretation of microbiome data.

Furthermore, the course will explore the ecological and biotechnological relevance of microbiomes and discuss how microbial communities contribute to ecosystem functioning, human and environmental health, and sustainable biotechnological applications. Building on this knowledge, students will be introduced to emerging concepts in synthetic microbiology, including the design, engineering, and manipulation of microbial communities for specific functions.

Recommended Prerequisites

Basic knowledge in genetics, microbiology, biochemistry and molecular biology.

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

Teaching material such as lecture slides and study questions as well as the relevant literature will be provided to the students *via* a the moodle learning platform.
Recommended scientific literature:

- Juhas *et al.* 2014. *Bacillus subtilis* and *Escherichia coli* essential genes and minimal cell factories after one decade of genome engineering. *Microbiology.* 160: 2341-2351.
- Reuß *et al.* 2016. The blueprint of a minimal cell: *MiniBacillus*. *Microbiol Mol Biol Rev.* 80: 955-987.
- Hutchison *et al*. 2016. Design and synthesis of a minimal bacterial genome. *Science* 351: aad6253.
- Reuß *et al.* 2017. The contribution of bacterial genome engineering to sustainable development. *Microb Biotechnol*. 10: 1259-1263.
- Reuß *et al.* 2017. Large-scale reduction of the *Bacillus subtilis* genome: Consequences for the transcriptional network, resource allocation, and metabolism. *Genome Res.* 27: 289-299.
- Brock Biology of Microorganisms, 15th edition, 2019, Pearson. ISBN.10: 1292235101.
- Microbes and evolution - The world that Darwin never saw. Essays on microbes and evolution. 2012. ASM press.ISBN: 978-1-55581-540-0.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

The final module grade is composed of a written module examination (60%) and a continuous assessment component (40%).

Written Module Examination (60%)

Written examination (90 minutes).

Continuous Assessment (40%)

The continuous assessment component consists of three practical data analysis assignments and one oral presentation.

Students will complete three practical exercises covering key aspects of microbiome data analysis. Each exercise will involve the analysis of a provided dataset using R and the submission of a short report (2–3 pages) summarizing the analytical approach, results, and interpretation. Topics may include microbial community composition, diversity metrics, ordination methods, statistical analysis, data visualization, and the ecological interpretation of microbiome data.

The results of the assignments will be presented in a short oral presentation (15 minutes) followed by a discussion and questions (10 minutes).

Weighting of the Continuous Assessment:

- Practical assignments (three reports): 20%
- Oral presentation and discussion: 20%

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

none

Module Components

- Lecture "Synthetic Microbiology" only in summer semester
- Seminar "Synthetic Microbiology" only in summer semester
- Examination "Synthetic Microbiology"

Components to be offered in the Current Semester

210130 Lecture
Synthetic Microbiology - 2 Hours per Term
210136 Seminar
Synthetic Microbiology - 1 Hours per Term
210138 Examination
Synthetic Microbiology

Module 12767 Point of Care Diagnostic

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12767	Compulsory elective

Modul Title	**Point of Care Diagnostic** Point-of-Care-Diagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. Dame, Gregory
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The module teaches the basics of point of care diagnostics / point of care analysis, molecular diagnostics, biochip technology and their techniques. The students will be able to explain the term point of care testing using concrete examples and are introduced in scientific thinking. The module teaches special abilities and knowledge in the field of bioanalytics for biotechnologically and biochemically oriented students.After successful participation in the module students are able to explain and apply scientific principles as well as specialised and in-depth knowledge. -They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	In the lecture different bioanalytical detection techniques will be presented, whereby the biosensorics occupy a partly higher importance. Important combinations of biomolecules with sensors and their bioanalytical application are discussed. On the basis of practice-relevant examples, the development of individual biosensors will be presented, as well as their limitations and solutions for optimization discussed. Other topics include biochip technology, molecular diagnostics, point of care testing (POCT), on-site analysis and nanobiotechnology. • Enzymatic sensor concepts and selected examples (glucose oxidase enzyme electrode) • DNA Sensors • Immunosensors • Cell-based biosensors • In vivo Biosensors

- Disposable biosensors in point-of-care applications: concepts and fabrication
- Clinical applications: blood gas analyses, coagulation diagnosis, cardiovascular diseases

Current publications in the field of point-of-care diagnostics and on-site analysis will be presented and discussed with regard to a point-of-care application.

Recommended Prerequisites

none

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

POCT-Patientennahe Labordiagnostik, P. Luppa, R. Junker (eds), ISBN 978-3-662-54195-1, ISBN 978-3-662-54196-8 (ebook)

Publications:
- Khan et al, Diagnostics 2017, 7, 39; doi: 10.3390/diagnostics7030039
- Krampa et al., Diagnostics 2017,7, 54; doi: 10.3390/diagnostics/7030054
- Mashamba-Thompson et al, Diagnostics 2016,6,31;doi: 10.3390/diagnostics6030031

Module Examination

Final Module Examination (MAP)

Assessment Mode for Module Examination

Written Examination (120 min)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course
- Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

"Responsible Staff Member"

1. Prof. Frank Hufert (no)
2. Dr. Gregory Dame (no)

Module Components

- Lecture "Point of Care Diagnostic"
- Seminar "Point of Care Diagnostic"
- Examination "Point of Care Diagnostic"

Components to be offered in the Current Semester

210040 Lecture
Point of Care Diagnostic - 2 Hours per Term
210045 Seminar

Point of Care Diagnostic - 1 Hours per Term
210048 Examination
Point of Care Diagnostic

Module 12768 Introduction to Laboratory Diagnostics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12768	Compulsory elective

Modul Title	**Introduction to Laboratory Diagnostics** Einführung in die Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The aim of the module is to familiarize students with the concepts of laboratory medicine, which focus on screening, diagnosis, risk assessment and therapy monitoring and include tools for routine laboratory diagnostics. In lectures that introduce the basics of laboratory medicine, students are enabled to understand the concept and principles of laboratory medicine. Subsequently, the students will deepen their knowledge of pathophysiology and pathobiochemistry of diseases with a view to characterising the diseases using laboratory medical instruments. In lectures, students learn the methodology of the analytical tools commonly used in laboratory medicine and discuss selected methods in seminars to deepen their understanding. The student learns the specific analytical tools focused on related diseases and students should be able to select analytical tools related to screening, risk assessment, diagnosis and monitoring. Upon completion of the module, students should be able to interpret analytical results for disease screening, risk assessment, diagnosis and monitoring and discuss the results with the applicant. Students should be able to understand and work with the scientific literature of laboratory medicine. Students should be able to design and interpret their own studies of laboratory medicine. A special aspect will be the area of personalised medicine. Personalised medicine distinguishes itself by classifying individuals on the basis of information about genetic, molecular and cellular properties in order to define individual therapies. It comprises products and services based on biomarker-based diagnostics and therapy for small patient groups. The students learn about personalised medicine ideas and learn how

	medical progress can lead to the scientific and technical development of new diagnostics and therapies, especially on the basis of genome and post-genome research.
Contents	• Introduction to laboratory medicine: • Laboratory medicine with emphasis on specific metabolism (lipids, nucleic acids, proteins, trace elements) • Laboratory medicine with focus on specific systems (immune system, exocrine system, endocrine system, neoplasia) • Laboratory medicine with emphasis on specific organs (liver and bile ducts, intestines, kidneys and urinary tract) • Development of strategies for personalized medicine • Definition of a biomarker, definition of biomarker panels • Comparison of strategies of personalised medicine with conventional medicine
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Will be announced during the lecture.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	re-examination oral (30 min)
Module Components	• Lecture "Introduction to Laboratory Diagnostics" • Seminar "Introduction to Laboratory Diagnostics" • Examination "Introduction to Laboratory Diagnostics"
Components to be offered in the Current Semester	**210968** Examination Introduction to Laboratory Diagnostics

Module 12769 Molecular Biotechnology and Society

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12769	Compulsory elective

Modul Title	**Molecular Biotechnology and Society** Molekulare Biotechnologie in der Gesellschaft
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	6
Learning Outcome	This highly interdisciplinary lecture should demonstrate the students that many recent biotechnological developments do not only influence scientific fields, but can also have a clear-cut impact on the whole society. The students learn about biotechnological fields which are relevant for political & ethical issues, medical issues and economical issues, i.e. emerging biotechnological industries. Since biotechnology is a rather broad field, the lecture highlights some “prominent” examples. The lecture is called “Molecular Biotechnology” because of its further focus on molecular principles used in the presented biotechnological fields. For each biotechnological topic, the molecular basics are presented followed by presentation of their respective influences on politics, medicine and / or economy. If applicable, the lecture also covers some basics on relevant “Biotech” laws. The students should learn that although the awareness and knowledge of Biotechnology in society is quite low, it definitely is a key technology of the 21th century influencing many aspects of life. In addition, the students should obtain a deep understanding of the molecular principles presented in the lecture to be competent for future discussions outside the University. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).

Contents	The lecture starts with an introduction into the awareness of people towards biotechnology, importance of biotechnology for medicine & sustainable industry, provide examples of the biotechnological presence. In addition, the lecture contains the following topics: • Forensic DNA science, their techniques, ethical issues and their national regulations (e.g. German DNA Analysedatei) • Medical DNA screening including techniques of genetic tests, examples of single gene disorders and chromosomal disorders, regulations such as the German “Gendiagnostikgesetz” • Special lectures are provided on cell cycle regulation, **Signal Transduction**, cellular mortality/immortality and molecular carcinogenesis to provide the basis for understanding the molecular defects of the discussed diseases and their respective diagnostics. • Stem cells and cloning, including stem cell biology, therapeutic and reproductive cloning, preimplantation diagnostics and their discussions in society as well as national regulations such as the German “Embryonenschutzgesetz”. • Concepts of Personalized Medicine • Biotechnology and Global Warming: This last part of the lecture makes the focus on recent developments in biotechnology that could help to mitigate global warming
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Genetik, Klug et al., Pearson Studium, 8. Auflage (2007) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

Module Components	• Lecture "Molecular Biotechnology and Society" • Seminar "Molecular Biotechnology and Society" • Examination "Molecular Biotechnology and Society"
Components to be offered in the Current Semester	**211030** Lecture Molecular Biotechnology and Society - 2 Hours per Term **211035** Seminar Molecular Biotechnology and Society - 2 Hours per Term **211038** Examination Molecular Biotechnology and Society

Module 12771 Cells and Tissues - Culture and Evaluation

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12771	Compulsory elective

Modul Title	**Cells and Tissues - Culture and Evaluation** Zell- und Gewebekultur
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	• After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities • Acquire theoretical knowledge and practical experience in basic principles of cell culture techniques. • Get familiar with the morpholgy, physiology and way to work with different animal and human cell lines. • Generate awareness for the use of cells in culture (advantages and limitations). • Understand the principles as well as application of cell biological methods to characterise the main parameters of cell behaviour like proliferation, differentiation, and viability. • Engineering artificial tissues (3D-culture) using cell lines. Discriminate the special features of cells cultured in 3D and cells growing as a monolayer in a culture flask (2D-culture). • Applying advanced techniques of cell biological methods to characterise the main parameters of cell behaviour like proliferation, viability, toxicity, and differentiation. • Advanced knowledge and experience in microscopical techniques (Phase contrast, brightfield, fluorescence)
Contents	• Sterile working technique, media preparation

- Routine maintenance of cell lines: Medium replacement, subculture of adherend and suspension cells, cell counting, cryopreservation, contamination control (microscopical observation, mycoplasma screening)
- Cultivation of cells in monolayer (2D) and engineering of in vitro tissues of different cell types (3D-cell culture systems; spheroids)
- Application of special test systems to monitor proliferation, viability, and toxicity in monolayer cells
- Analyses of morphology of cells in 2D- and 3D (preparation of cryosections of spheroids, histological analyses)
- Working with different microscopic techniques: Phase contrast microscopy (basis “life cell” analyses), brightfield microscopy, fluorescence microscopy

Recommended Prerequisites

Basic knowledge in cell culture.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Culture of Animal Cells: A Manual of Basic Technique, Freshney R. I., 6th edition, Wiley-Blackwell, 2010
- Zell- und Gewebekultur. Von den Grundlagen zur Laborbank, Lindl T und Gstraunthaler G., Spektrum Akademischer Verlag, 6. Auflage, 2008
- Der Experimentator: Zellkultur, Spektrum Akademischer Verlag, 3. Auflage 2011
- Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015
- Specific original scientific publications
- Manuals (SOPs) for cell culture & cell analytics of the Lab of Prof. U. Anderer

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

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<p>Lab work: 4 experiments, performance, critical evaluation of data, time management (25%) <p>Presentation (10 min) and discussion (5 min) in the seminar, duration depends on the topic (25%) <p>Protocol: Introduction, Methods, Results and Discussion, 10-15 pages (25%) <p>Written exam, duration: 45 min (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Cells and Tissues – Culture and Evaluation" • Seminar "Cells and Tissues – Culture and Evaluation"
Components to be offered in the Current Semester	No assignment

Module 12772 Bioengineering of Animal/Human Cells

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12772	Compulsory elective

Modul Title	**Bioengineering of Animal/Human Cells** Biotechnologie mit tierischen und menschlichen Zellen
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays. Furthermore they broaden their methodological background in analysis, interpretation, and reporting of lab data. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to sum up and discuss the experimental results train additional soft skills like the ability to communicate orally and written to individuals and groups and to tailor the communication to the level and experience of the audience. The students use appropriate software, graphics, and other tools to clarify complex information. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	Culture of cells in Monolayer (2D) of different cell types (including differentiation). - culture and differentiation of macrophages and monocytes - detection and visualization of inflammasome activation - microscopy of blood smears and immune organs - culture and differentiation of myogenic cells - functional analysis of specific genes in myogenic cells Contents of the seminar: Deepening the knowledge of the theoretical background used in the Labcourse.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry.

	Participation in the laboratory course *12771 - Cells and Tissues - Culture and Evaluation* is highly recommended.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications ; 2010 • Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008 • Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011 • Specific original scientific publications • Manuals (SOPs) for cell culture & cell analytics of the Labs of Prof. U. Anderer, Prof. Manuela Rossol and Prof. Julia von Maltzahn
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	weeks 1-3 (Prof. Manuela Rossol): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min, 10 pages (12.5%) • written exam, duration: 45 min (12.5%) weeks 4-6 (Prof. Julia von Maltzahn): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min. 10 pages (12.5%) • written exam, duration: 45 min (12.5%) The duration of the presentation will be announced at the beginning of the course.
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course (split in 2 parts of 3 weeks duration each).
Module Components	• Lab Course "Bioengineering of Animal/Human Cells" • Seminar "Bioengineering of Animal/Human Cells"

Components to be offered in the Current Semester	No assignment

Module 12773 Genetic Engineering of Eukaryotic Cells

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12773	Compulsory elective

Modul Title	**Genetic Engineering of Eukaryotic Cells** Genetische Veränderung eukaryotischer Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	Based on practical work in the lab, the overall aim is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected, and how they can be manipulated experimentally. Practical Course: Connected to actual scientific research projects of the group, the students work on genetically manipulated mammalian cells. The students learn to analyze consequences of recombinant gene expressions on various cellular responses, being dependent on the research project into which they are integrated. Furthermore, students learn strategies to obtain specific cell types from multipotent and/or pluripotent stem cells. Seminar: The students present and discuss “classical” as well as actual literature on selected topics of the practical course. Competences acquired after successful completion of the course: In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. In addition, the students learn to perform standardized data documentation by using electronic protocols.
Contents	The practical course is integrated into actual research projects of the group and thus contents will vary during time. Generally, the following practical paths will be followed: • Culturing of cell lines and primary cells • Working with genetically engineered mammalian cells, especially with hepatocytes and cancer cells

- Analsis of gene expressions by e.g. immunofluorescence, Western blotting, flow cytometry and / or PCR
- If working on hepatocytes, liver markers such as CYP450 will be analyzed
- If working on hepatocytes, conversions with drugs into metabolites and metabolite detection will be performed
- Investigation of drug effects on liver and / or cancer cells by means of toxicology analysis with XTT, ATP, membrane integrity tests, apoptosis tests, proliferation analysis etc
- Differentiation of multipotent and/or pluripotent stem cells into cardiomyocytes and / or hepatocytes and testing of specific differentiation protocols

Recommended Prerequisites

- 12175 *Molecular Dynamics of the Cell*

Mandatory Prerequisites

- 12771 *Cells and Tissues – Culture and Evaluation*
- 12772 *Bioengineering of Animal/Human Cells*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones
- Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones
- Selected original scientific journal articles and reviews on the fields discussed.
- Actual Version of Lab Manual & Standard Operating Procedures in Molecular Cell Biology by Prof. Küpper, BTU Cottbus-Senftenberg

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Lab work-preparation of experiment, performance, discussion, time management (30%)
- SPresentation and discussion in the seminar, duration depends on the topic (20%)
- Presentation of results (20%)
- Oral Test, duration: 15 min (15%)
- Electronic protocols (15%)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

8

Remarks

"Recommended Placement in the Study Plan"

- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course
- Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

The module takes place as a 6 week block course.

Module Components

- Lab Course "Genetic Engineering of Eukaryotic Cells"
- Seminar "Genetic Engineering of Eukaryotic Cells"

Components to be offered in the Current Semester	**211013** Practical training Genetic Engineering of Eukaryotic Cells - 7 Hours per Term **211015** Seminar/Practical training Genetic Engineering of Eukaryotic Cells - 1 Hours per Term

Module 12776 Eukaryotic Microorganisms/Microalgae

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12776	Compulsory elective

Modul Title	**Eukaryotic Microorganisms/Microalgae** Eukaryotische Mikroorganismen/Mikroalgen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	In the laboratory course the practical skills of the students by applying different methods for the classification and cultivation of eukaryotic microorganisms (e.g. heterotrophic marine dinoflagellates, algae-like peronosporomycetes, lower and higher fungi), for the development of culture conditions, the quantitative and qualitative analysis of cell growth, the extraction of natural substances (e.g. fatty acids, enzymes) and the analytical product identification with chromatographic methods are trained. Herein each student should isolate and determine eukaryotic microorganisms from natural sources, purify one strain and determine contents and activities by using screening techniques. The students work in small teams (2-3 persons) and coordinate the approaches/practical work between the different group members. In this way, the students improve their soft skills in terms of communication and coordination of the work flow. Additionally, the laboratory course will strengthen the students competencies in the interpretation, evaluation and presentation of lab data by summarizing the results in a final report and by an oral presentation at the end of the course. The accompanying seminar intents to train the scientific competencies of the students by searching for and presenting relevant literature focusing on the topics of the practical course.
Contents	<u>Contents of the Lab Course:</u> • preparation of labware and cultivation media • inoculation of eukaryotic microorganism cultures using culture flask/ bioreactors • monitoring of culture parameters (pH, OD, biomass dry weight, enzyme activities)

- sampling at different time points during the cultivation
- sample preparation: cell disintegration (e.g. french press), hydrolysis, dialysis, micro-/ultrafiltration, freeze-drying
- liquid extraction of lipophilic compounds (e.g. PUFA´s)
- photometric assays for the determination of protein content and enzyme activity
- protein purification using FPLC
- compound analysis with HPLC/ELSD/DAD and LCMS
- data evaluation, presentation, report

Contents of the Seminar:

- The seminar course will give a current overview to the state of the art of science in those topics and microorganisms which are in the focus of the practical course.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module

- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Madigan M. T., Martinko J. M., Bender K.: Brock Biology of Microorganisms. Pearson 2018, ISBN 9781292235103
- Esser K., Hofrichter M.: The Mycota - A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research, Industrial Application X. Springer 2010, ISBN 9783642114571
- Dörfelt H., Jetschke G.: Wörterbuch der Mycologie. Spektrum 2001, ISBN 9783827409201
- Bucholz K., Kasche V., Bornscheuer U. T.: Biocatalysts and Enzyme Technology. Wiley-Blackwell, 2012, ISBN: 9783527329892

Several publications e.g.:

- Yue Jiang, Feng Chen, Shi-Zhong Liang (1996). Production potential of docosahexaenoic acid by the heterotrophic marine dinoflagellate *Crypthecodinium cohnii.* Process Biochemistry 34: 633–637
- Blackman, L.M., Cullerne, D.P. & Hardham, A.R. (2014) Bioinformatic characterisation of genes encoding cell wall degrading enzymes in the Phytophthora parasitica genome. BMC Genomics 15, 785 (2014). https://doi.org/10.1186/1471-2164-15-785
- Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi:10.1002/anie.201605430)
- C. André Lévesque (2011). Fifty years of oomycetes—from consolidation to evolutionary and genomic exploration. Fungal Diversity 50:35–46 DOI 10.1007/s13225-011-0128-7

- Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)
- Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677)

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (50%) • Presentation and discussion in the seminar, duration depends on the topic (20%) • Oral Test/ final colloquium, duration: 15 min (20%) • Report, c. 20 pages (10%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	none
Module Components	• Lab Course "Eukaryotic Microorganisms" • Seminar "Eukaryotic Microorganisms"
Components to be offered in the Current Semester	No assignment

Module 12777 Methods in Synthetic Microbiology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12777	Compulsory elective

Modul Title	**Methods in Synthetic Microbiology** Methoden der synthetischen Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. This course aims to teach diverse techniques and methods used for genetic engineering, molecular cloning, expression in procaryotic or eucaryotic systems, conceptional thinking, independent preparation, execution, evaluation of experiments, and adequate documentation.
Contents	• cultivation of Microorganisms under suitable conditions • isolation and modification of DNA • constructing genetic tools or overexpression vectors • create relevant synthetic microorganisms such as genetically modified strains for biotechnological purposes or further investigations
Recommended Prerequisites	Basic lab experience; basis knowledge in molecular biology, biochemistry, microbiology.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester

	Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	1. Campbell Biologie (ISBN-10: 3868943668) 2. Brock Biology of Microorganisms (ISBN-10: 1292404795) 3. Der Experimentator Molekularbiologie / Genomics (ISBN-10: 3642346359) 4. Molecular Cloning: A Laboratory Manual (ISBN-10: 1936113422)
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	After completing the experiments, each student submits a manuscript about the experimental results and give an oral presentation and discussion. • lab performance: 20% • manuscript (max. 10 pages): 40 % • oral presentation and discussion (15 min): 40 %
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The lab performance (theoretical preparation, organization and execution in the lab, time management) of each student will be observed. For safety reasons we will evaluate the theoretical preparation of each student occasionally. We therefore reserve the right to interrupt laboratory work and experiments can be continued when successful background knowledge is confirmed.
Module Components	• Lab Course "Methods in Synthetic Microbiology" • Seminar "Methods in Synthetic Microbiology"
Components to be offered in the Current Semester	No assignment

Module 12791 Metabolic Analysis and Engineering

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12791	Compulsory elective

Modul Title	**Metabolic Analysis and Engineering** Metabolische Analyse und Entwicklung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	**Lab Course** Provide the student with an understanding of metabolic pathways and networks, the roles of enzymes and their regulation. The student will learn to estimate the power of tools, e.g. growth of designed mutants disrupted in single genes, and will get experience with different analytical methods. Communication between the students is stimulated by dividing them into four TEAMs, each responsible for a different system. In the first and second week each TEAM can focus on its system understanding methods, theoretical background and the objective. In the following weeks each TEAM is supervising one of the other three TEAMs in the performance of the experiment. That means from the third week on each TEAM is involved in parallel in two experiments, one as supervisor and a second as trainee. **Seminar** Each students has to present the scientific question, the experimental approach, results and conclusions of a original paper which was publised by the host father recently. Communication skills are trained by presention and discussion. The students introduce each other. They learn to ask questions and one of them has to summarize the main points of the discussion.
Contents	The module takes place as a 6 week block course. The seminar is a compulsory part of the module. Each TEAM is supervised by a PhD student. This means that the subjects are adapted for each course to the current state of their scientific work. The following systems are examples:

- System 1: Chemostatic cultivation as a tool to study regulation; a promotor::lacZ reporter strain of *A.gossypii* is cultivated; down-shifts in dilution rate stimulate reporter expression detectable *via* beta-galactosidase assay and riboflavin production; several online parameter are controlled, e.g. pH, and/or determined, e.g. CO2 in the exhaust *via* IR spectrometry;
- System 2: Feeding studies in shaking flasks or on agar plates; the uptake of amino acids in a defined medium is monitored by HPLC; Auxotrophy of *S. cerevisiae* mutants disrupted in *GLY1*, *SHM1*, *SHM2* and/or *AGX1* is studied on glucose or ethanol as sole carbon source plus/minus glycine;
- System 3: Kinetic studies on a Michaelis-Menten in comparison with an allosterically regulated enzyme; impact of ATP or AMP on NAD-dependent ICDH is compared with the NADP-dependent peroxisomal isoenzyme;
- System 4: Transformation and genotype analysis; fungal cells are transformed with DNA *via* electroporation; replacement with a marker by homologous recombination is studied by locus specific PCR with genomic DNA;

Recommended Prerequisites

Three months lab experience; basic knowledge in microbiology, biochemistry, molecular biology.

Mandatory Prerequisites

- 12777 - *Methods in Synthetic Microbiology*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

The students receive original scientific literature for each experimental system e.g.
- System 1: Microbiology 147: 3377-3386; Environmental Microbiology 3: 545-550
- System 2: Yeast 21: 63-73
- System 3: Journal of Molecular Catalysis 10: 335-343
- System 4: Biochemical Journal 369: 263-273

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

Each TEAM (2 student) will take part in an oral presentation and discussion (15 min); furthermore a short manuscript about results of the experiments has to be submitted; presentation and quality of the manuscript will be scored each 50 % for the final mark.

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

8

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course

	• Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lab Course "Metabolic Analysis and Engineering" • Seminar "Metabolic Analysis and Engineering"
Components to be offered in the Current Semester	**210343** Practical training Metabolic Analysis and Engineering - 7 Hours per Term **210345** Seminar/Practical training Metabolic Analysis and Engineering - 1 Hours per Term

Module 12797 Methods in Laboratory Diagnostics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12797	Compulsory elective

Modul Title	**Methods in Laboratory Diagnostics** Methoden der Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities The students are involved in the latest developments in the field of laboratory medicine. Students learn how to use modern technical laboratory diagnostic equipment. Students learn how to plan a strategy for developing a new diagnostic assay or diagnostic instrument. Students will work on and validate aspects of assay or instrument development in practice.
Contents	On the basis of the available literature and publications of the research group, the students design protocols for assay or instrument development, which are discussed in the seminar. The students work mainly in the fields of nucleic acid detection, autoimmunity, infection serology and tumor diagnostics. Mainly cell or microbead-based assays are developed. The students carry out their practical work under the supervision of the members of the research group and are integrated into the current research work of the working group.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:

	Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	Current scientific literature of the own research group and generally accessible literature on the respective subject area.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (30%) • Presentation and discussion in the seminar, duration depends on the topic (25%) • Presentation of results (25%) • Oral Test, duration: 15 min (20%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Laboratory Diagnostics" • Seminar "Methods in Laboratory Diagnostics"
Components to be offered in the Current Semester	No assignment

Module 12798 Methods in Bioanalytics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12798	Compulsory elective

Modul Title	**Methods in Bioanalytics** Methoden in der Bioanalytik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. PD Dr. rer. nat. habil. Rödiger, Stefan
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	First the students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays (incl. analysis of DNA damage upon treatment with single (etoposide) and multiple chemotherapeutic substances, FISH to asses genomic alterations of cancer cells). In particular, the cell assays have relevance in precision medicine and pharmacology/pharmaceutical research. Furthermore, they broaden their methodological background in analysis, interpretation and reporting of lab data by different methods used in applied statistical bioinformatics, forensics, pharmaceutical research and precision medicine. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to present and discuss the experimental results train additional soft skills like the ability to communicate orally to individuals and groups and to tailor the oral communication to the level and experience of the audience. The students use appropriate scientific open source software (incl. R statistical computing language, Python general purpose programming language), graphics, and other tools to clarify complex information. The analysis of the data includes methods used in applied statistical bioinformatics and bioanalytical pharmacology. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	• Sterile working technique, media preparation • Routine maintenance of cell lines: Medium replacement, subculture of adherent cells

- Cryopreservation: Freezing and thawing of cells
- Contamination control: Microscopical observation, etc.
- Characterization of human (tumor) cells or cell lines
- Morphology: microscopy of cells
- Proliferation: Growth curve, population doubling-time
- Testing of (mouse monoclonal) antibodies ((m)Ab). Immunocytochemistry and immunochemistry with (m)Abs
- Comparison of different cell assays e.g. gamma H2AX-Assays and FISH assays
- Assesment of the effect of chemoterapeutic substances

Contents of the seminar:

Deepening the knowledge of the methods used in the labcourse. Methods in applied statistical bioinformatics, literate programming and report generation (Remarkdown or Jupyter notebook).

Recommended Prerequisites

Basic knowledge in Cell biology, Biochemistry, applied biostatistics and bioinformatics.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications; 2010
- Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008
- Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011
- Logan, M., Biostatistical Design and Analysis Using R: A Practical Guide. 2010
- Selvin, S., 1998. Modern Applied Biostatistical Methods: Using S-Plus, Monographs in Epidemiology and Biostatistics. Oxford University Press, Oxford, New York.
- Lee, J.K., 2010. Statistical Bioinformatics: For Biomedical and Life Science Researchers. Wiley.
- Sencar, H.T., Memon, N. (Eds.), 2013. Digital Image Forensics. Springer New York, New York, NY. https://doi.org/10.1007/978-1-4614-0757-7
- National Research Council (US) Committee on A Framework for Developing a New Taxonomy of Disease, 2011. Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease, The National Academies Collection: Reports funded by National Institutes of Health. National Academies Press (US), Washington (DC).

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	<div id="meta-origin" data-coolorigin="https%3A%2F%2Fwww.b-tu.de%2Forgcloud%2Fapps%2Frichdocumentscode%2Fproxy.php%3Freq%3D%2Fcool%2Fclipboard%3FWOPISrc%3Dhttps%253A%252F%252Fwww.b-tu.de%252Forgcloud%252Findex.php%252Fapps%252Frichdocuments%252Fwopi%252Ffiles%252F9418674_ochtzup9yafk%26ServerId%3Dde63ef99%26ViewId%3D7%26Tag%3D0de54f906567e99d"> <p>Laboratory Work – design, execution, in–lab discussion, and time management (55 %) <p>Presentation & Discussion (Journal Club of a Research Paper) - each student selects one current research paper from the field of bioanalytics; 15–minute presentation followed by a 10–minute group discussion (15 %) <p>Written Tests – 3 separate tests (each 30 min.),(15 %) <p>General knowledge about Methods in Bioanalytics and related topics <p>Knowledge of statistical bioinformatics and associated methods <p>Lab–course–specific content <p>Presentation of Lab–Course Results – two components (15 %) <p>Lab report (10 pages) produced from a reproducible document (e.g., Quarto, RMarkdown), due at the end of the course <p>Oral presentation using that reproducible document: 10 minutes for the presentation followed by a 10–minute group discussion <p class="western">
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Bioanalytics" • Seminar "Methods in Bioanalytics"
Components to be offered in the Current Semester	No assignment

Module 12799 Molecular Biology: Principles, Methods and Applications

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12799	Compulsory elective

Modul Title	**Molecular Biology: Principles, Methods and Applications** Molekularbiologie: Grundlagen, Methoden und Anwendung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	It is the aim of this laboratory course to provide basic molecular biology techniques in the first place. Students should experience isolation and manipulation of DNA and RNA in a way that they understand the underlying principles of these fundamental methods. In a second step, students have to learn different techniques used to transfect pro- and eukaryotic cells as these are important methods in biotechnology. Therefore, the course provides the complete scenario from the preparation of DNA up to the functional analysis of different expression plasmids. Third, students will become familiar with viruses, as these biological agents are important "work horses“ in different areas of molecular biology. Working with microbeads to detect nucleic acids and proteins in a multiplex format provides the opportunity for state of the art bioanalytical methods. This part is complemented by genome editing experiments. Students will get in touch with a state of the art complex methodology and get hands-on experience. The seminar has the task of broadening the theoretical basis of the methods used in the practical course. Presentations and enhanced discussions will provide the stage for a fruitful enhancement of molecular biology knowledge. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to train their practical lab skills and generic competences as they have to solve scientific problems.

All these projects require search and understanding of relevant scientific literature, design of experimental protocols, documentation and a critical discussion of results.

Contents

Students will isolate expression vector DNA using different protocols and reagents and will later on compare the influence of these different procedures on transfection efficiency again applying different gene transfer methodologies. Here the students will perform the complete set of steps necessary for eukaryotic cell transfection. These experiments form the basis for the central part of the course the genome editing. Students will use the CRISPR/Cas system to induce genome mutations and create site directed specific sequence alteration. The analysis of the cell physiological effects of these editings will be performed using cell culture experiments. In addition little projects will be given to students including the following methods: coupling of nucleic acids and proteins to fluorescence coded microbeads: detection of the protein targets by antibody detection; nucleic acids are detected on the bead surface via hybridization or PCR; expression and purification of recombinant proteins; design of primers for qPCR, PCR and PCR based cloning. Because the master course is integrated into the scientific research of the group experiments will be adapted accordingly.

Recommended Prerequisites

none

Mandatory Prerequisites

- 12797 *Methods in Laboratory Diagnostics*
- 12798 *Methods in Bioanalytics*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- iGenetics: A Molecular Approach. Peter J. Russell. ISBN 10: 0805346651
- Molecular Biology of the Gene. James D. Watson, Tania A. Baker, Stephen P. Bell et al. ISBN-13: 9780321507815
- Molecular biotechnology / by Carolyn A. Dehlinger; Jones & Bartlett Learning, ISBN 978-1-284-05783-6
- Variable original publications depending on the project given.
- Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request.
- On the other hand it is part of the seminar that students have to search for appropriate information and to develop different information acquisition strategies.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Practical laboratory work-preparation of experiment, performance, discussion, time management (50%)
- Presentation and discussion in the seminar; duration depends on the topic (25%)
- Lab report (including title, abstract, introduction, methods and materials, results, discussion, conclusion, and references; 15-20 pages) (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course The module takes place as a 6 week block course.
Module Components	• Lab Course "Molecular Biology: Principles, Methods and Applications" • Seminar "Molecular Biology: Principles, Methods and Applications"
Components to be offered in the Current Semester	**210413** Practical training Molecular Biology: Principles, Methods and Applications - 7 Hours per Term **210415** Seminar/Practical training Molecular Biology: Principles, Methods and Applications - 1 Hours per Term

Module 12800 Microbial Metabolism

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Bioanalytik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12800	Compulsory elective

Modul Title	**Microbial Metabolism** Stoffwechsel der Mikroorganismen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Goal of the lecture is 1. repetition of basics in bacterial and fungal metabolism and its regulation 2. in depth understanding of selected topics based on recent original papers and current reviews 3. to understand how conclusions are drawn from data, especially experimental data 4. to understand how independent research strategies can lead to overlapping evidences 5. to understand the difference qualitative and quantitative experimental approaches 6. to understand the route starting from a scientific question over experimental data to a model explaining complex phenomena of microbiology 7. to become able to work as a PhD student
Contents	**Microbial Metabolism and Regulation** As a general principle all statements presented in the lectures are based on conclusions drawn from original data. Topics: a) Mutations affecting metabolic pathways: (conditional) auxotrophy; supplementation; glycine biosynthesis; definded growth media; b) Isoenzymes: isocitrate DHs; serine hydroxymethyltransferases; carbon flux analysis; subcellular compartmentation; aspartate kinases of *E. coli* c) Regulation of metabolism: lac, ara, trp operon; repression, induction, attenuation, mRNA half-life control;; adenylation of glutamine synthetase; phosphorylation; feed back inhibition

	d) Circadian clocks: control of photosynthesis and nitrogenase in *Synechococcus* and *Anabaena*; sporulation in *Neurospora* e) Reporter systems: *lacZ*; green fluorescent protein; organelle targeting; f) Quorum sensing: biofilms; signal systems in Gram-positive and Gram-negative bacteria;
Recommended Prerequisites	Basic knowledge in biochemistry, molecular biology, microbiology.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	About 30 pdf-files of original research reports, review articles, PhD theses are available for the students e.g. Biochem J 369: 263-73; PNAS 100: 5914-9; Genes Develop 15:1468-80; YEAST 21: 63-73; EMBO J 22: 2127-34; J Bacteriol 185: 2066-79; Schlüpen C Diss Uni Düsseldorf; PNAS 90: 5672-6; PNAS 99: 9697-702; Microbiology 154: 2184-94; Mol Cell Biol 6221-8; BBA 1577: 240-50; J Mol Cat 10: 335-43; PNAS 98: 12221-6; J Bacteriol 182: 1-8; J Biol Chem 271: 11113-9; Microbiol 147: 3377-86; PNAS 107: 2043-47
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" Biotechnology (Master of Science, 3 Semester Version): Master 1st year course Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Microbial Metabolism and Regulation" • Examination "Microbial Metabolism and Regulation"
Components to be offered in the Current Semester	**210330** Lecture Microbial Metabolism and Regulation - 2 Hours per Term **210338** Examination Microbial Metabolism and Regulation

Module 12763 Enzyme Technology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12763	Mandatory

Modul Title	**Enzyme Technology** Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The use of catalysts, and particularly of their biological version (enzymes), has recently been the subject of increased debate in research, technology and environmental policy. Enzyme technology is regarded as a key technology for a sustainable future; it renders possible the manufacturing of innovative products (e.g. pharmaceuticals, fine chemicals, flavors, food and feed ingredients) and opens new doors for the application of biological agents in chemical processes, which leads to positive environmental effects and energy savings. Enzyme technology has a great potential for breaking down the boundaries between individual scientific disciplines (biotechnology, chemistry, microbiology, etc.) and between fundamental and applied research. Aims of this teaching unit are - to provide a basic knowledge of relevant protein structures, to acquire an understanding of the principles by which enzymes catalyse biochemical reactions, and - to provide a comprehensive overview of enzyme applications to introduce economic and sustainable goals associated with enzyme technologies, historical background and modern approaches of enzyme application (e.g. nanobiotechnology, biofuels, protein production, extremophiles, biopharmaceutical production, microbial natural products). For students the lecture and seminar will provide an understanding of scientific principles and will provide practice of advanced white biotechnology (professional competences) and its exploitation in commercial practice (methodic competences) for get individual orientation skills e.g. concerning an career as scientist, PhD studend or to understand how to create and manage a biotech business).

Contents	An instructive and comprehensive overview of the current enzyme applications in the so-called White, Red and Green Biotechnology. Basic Tools: Biocatalysts, Advantages & Disadvantages of Enzyme Processes, Aspects of Enzyme Application, Protein Structure, Enzyme Classification, Enzyme Kinetics, Sources of Enzymes, Search and Screening for New Biocatalysts, Protein Engineering, Enzyme Production, Advanced Tool: Enzymes in Food Industry (e.g. Baking, Brewing, Dairy, Saccharification), Enzymes in Non-Food Applications (e.g. Detergents, Pulp and Paper, Textile Industry), Enzymes in Chemical Production Processes (Organic Synthesis, Chiral Molecules, Drugs), Perspectives of Enzyme Exploration and Application, Current Research Activities (e.g. National and European Research Programs), New/Own Research Activities (e.g. Fungal Oxidoreductases for Industrial Processes, Biocatalysts for Refinement of Renewable Polymers) Scientific Seminar: present and discuss published current experimental findings and contemporary issues
Recommended Prerequisites	Multidisciplinary cross section require basic knowledge in biochemistry, microbiology, molecular biology, chemistry and engineering sciences.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Hofrichter, M., K. Esser, The Mycota: Industrial Applications, 2010, Springer-Verlag Berlin Heidelberg • Fessner, W., Anthonsen, T.: Modern Biocatalysis, 2008, Wiley-VCH, Weinheim • Illanes, A.: Enzyme Biocatalysis, Principles and Application, 2008, Springer • Liese, A., Seelbach, K., Wandrey, C, Industrial Biotransformations, 2006, Wiley-VCH, Weinheim • Buchholz, K., Kasche, V., Bornscheuer, U. T., Biocatalysts and Enzyme Technology, 2005, Wiley-VCH, Weinheim • Bommarius, A.S., Riebel, B.R.: Biocatalysis, Fundamentals & Application, 2004, Wiley-VCH, Weinheim • Aehle, W., Enzymes in Industry, 2004, Wiley-VCH, Weinheim Several current publications e.g.: • Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677). • Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).

	• Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Module Examination	Prerequisite + Final Module Examination (MAP)
Assessment Mode for Module Examination	• Requirements: Successful participation at the seminar including a 30 min presentation and 15 min discussion. • Final written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	The module is only offered in the winter semester.
Module Components	• Lecture "Enzyme Technology" in winter semester • Seminar "Enzyme Technology" in winter semester • Examination "Enzyme Technology"
Components to be offered in the Current Semester	**211110** Lecture Enzyme Technology - 2 Hours per Term **211115** Seminar Enzyme Technology - 1 Hours per Term **211118** Examination Enzyme Technology

Module 12764 Synthetic Microbiology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12764	Mandatory

Modul Title	**Synthetic Microbiology** Synthetische Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The "Synthetic Microbiology" module promotes the interactive work and learning of the participating students by combining different teaching disciplines such as a lecture series, a seminar and a practical course. The ability of the students to work in teams will be stimulated by discussing current literature in the context of the lecture content. After successfully completing the module, the students will have acquired competences in terms of self-organization and communication skills in addition to the acquired specialized scientific knowledge. Moreover, the use of a correct scientific language for communication and the presentation of scientific data will be trained.
Contents	After an introduction to the microbial world, the course will provide an overview of the diversity, structure, and functioning of microbial communities. Particular emphasis will be placed on understanding microorganisms as members of complex and dynamic communities rather than as isolated organisms. Students will learn how microbial interactions shape community composition, stability, and function, and how these interactions influence ecosystem processes in environmental, agricultural, and host-associated habitats. The lecture series will introduce the principles and methodologies used to investigate microbial communities, including cultivation-dependent and cultivation-independent approaches, high-throughput sequencing technologies, and multi-omics methods. Concepts for the characterization of microbial diversity, community structure, microbial

interactions, and community function will be presented, together with approaches for the analysis and interpretation of microbiome data.

Furthermore, the course will explore the ecological and biotechnological relevance of microbiomes and discuss how microbial communities contribute to ecosystem functioning, human and environmental health, and sustainable biotechnological applications. Building on this knowledge, students will be introduced to emerging concepts in synthetic microbiology, including the design, engineering, and manipulation of microbial communities for specific functions.

Recommended Prerequisites

Basic knowledge in genetics, microbiology, biochemistry and molecular biology.

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

Teaching material such as lecture slides and study questions as well as the relevant literature will be provided to the students *via* a the moodle learning platform.
Recommended scientific literature:

- Juhas *et al.* 2014. *Bacillus subtilis* and *Escherichia coli* essential genes and minimal cell factories after one decade of genome engineering. *Microbiology.* 160: 2341-2351.
- Reuß *et al.* 2016. The blueprint of a minimal cell: *MiniBacillus*. *Microbiol Mol Biol Rev.* 80: 955-987.
- Hutchison *et al*. 2016. Design and synthesis of a minimal bacterial genome. *Science* 351: aad6253.
- Reuß *et al.* 2017. The contribution of bacterial genome engineering to sustainable development. *Microb Biotechnol*. 10: 1259-1263.
- Reuß *et al.* 2017. Large-scale reduction of the *Bacillus subtilis* genome: Consequences for the transcriptional network, resource allocation, and metabolism. *Genome Res.* 27: 289-299.
- Brock Biology of Microorganisms, 15th edition, 2019, Pearson. ISBN.10: 1292235101.
- Microbes and evolution - The world that Darwin never saw. Essays on microbes and evolution. 2012. ASM press.ISBN: 978-1-55581-540-0.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

The final module grade is composed of a written module examination (60%) and a continuous assessment component (40%).

Written Module Examination (60%)

Written examination (90 minutes).

Continuous Assessment (40%)

The continuous assessment component consists of three practical data analysis assignments and one oral presentation.

Students will complete three practical exercises covering key aspects of microbiome data analysis. Each exercise will involve the analysis of a provided dataset using R and the submission of a short report (2–3 pages) summarizing the analytical approach, results, and interpretation. Topics may include microbial community composition, diversity metrics, ordination methods, statistical analysis, data visualization, and the ecological interpretation of microbiome data.

The results of the assignments will be presented in a short oral presentation (15 minutes) followed by a discussion and questions (10 minutes).

Weighting of the Continuous Assessment:

- Practical assignments (three reports): 20%
- Oral presentation and discussion: 20%

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

none

Module Components

- Lecture "Synthetic Microbiology" only in summer semester
- Seminar "Synthetic Microbiology" only in summer semester
- Examination "Synthetic Microbiology"

Components to be offered in the Current Semester

210130 Lecture
Synthetic Microbiology - 2 Hours per Term
210136 Seminar
Synthetic Microbiology - 1 Hours per Term
210138 Examination
Synthetic Microbiology

Module 12776 Eukaryotic Microorganisms/Microalgae

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12776	Mandatory

Modul Title	**Eukaryotic Microorganisms/Microalgae** Eukaryotische Mikroorganismen/Mikroalgen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	In the laboratory course the practical skills of the students by applying different methods for the classification and cultivation of eukaryotic microorganisms (e.g. heterotrophic marine dinoflagellates, algae-like peronosporomycetes, lower and higher fungi), for the development of culture conditions, the quantitative and qualitative analysis of cell growth, the extraction of natural substances (e.g. fatty acids, enzymes) and the analytical product identification with chromatographic methods are trained. Herein each student should isolate and determine eukaryotic microorganisms from natural sources, purify one strain and determine contents and activities by using screening techniques. The students work in small teams (2-3 persons) and coordinate the approaches/practical work between the different group members. In this way, the students improve their soft skills in terms of communication and coordination of the work flow. Additionally, the laboratory course will strengthen the students competencies in the interpretation, evaluation and presentation of lab data by summarizing the results in a final report and by an oral presentation at the end of the course. The accompanying seminar intents to train the scientific competencies of the students by searching for and presenting relevant literature focusing on the topics of the practical course.
Contents	<u>Contents of the Lab Course:</u> • preparation of labware and cultivation media • inoculation of eukaryotic microorganism cultures using culture flask/ bioreactors • monitoring of culture parameters (pH, OD, biomass dry weight, enzyme activities)

- sampling at different time points during the cultivation
- sample preparation: cell disintegration (e.g. french press), hydrolysis, dialysis, micro-/ultrafiltration, freeze-drying
- liquid extraction of lipophilic compounds (e.g. PUFA´s)
- photometric assays for the determination of protein content and enzyme activity
- protein purification using FPLC
- compound analysis with HPLC/ELSD/DAD and LCMS
- data evaluation, presentation, report

Contents of the Seminar:

- The seminar course will give a current overview to the state of the art of science in those topics and microorganisms which are in the focus of the practical course.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module

- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Madigan M. T., Martinko J. M., Bender K.: Brock Biology of Microorganisms. Pearson 2018, ISBN 9781292235103
- Esser K., Hofrichter M.: The Mycota - A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research, Industrial Application X. Springer 2010, ISBN 9783642114571
- Dörfelt H., Jetschke G.: Wörterbuch der Mycologie. Spektrum 2001, ISBN 9783827409201
- Bucholz K., Kasche V., Bornscheuer U. T.: Biocatalysts and Enzyme Technology. Wiley-Blackwell, 2012, ISBN: 9783527329892

Several publications e.g.:

- Yue Jiang, Feng Chen, Shi-Zhong Liang (1996). Production potential of docosahexaenoic acid by the heterotrophic marine dinoflagellate *Crypthecodinium cohnii.* Process Biochemistry 34: 633–637
- Blackman, L.M., Cullerne, D.P. & Hardham, A.R. (2014) Bioinformatic characterisation of genes encoding cell wall degrading enzymes in the Phytophthora parasitica genome. BMC Genomics 15, 785 (2014). https://doi.org/10.1186/1471-2164-15-785
- Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi:10.1002/anie.201605430)
- C. André Lévesque (2011). Fifty years of oomycetes—from consolidation to evolutionary and genomic exploration. Fungal Diversity 50:35–46 DOI 10.1007/s13225-011-0128-7

- Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)
- Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677)

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (50%) • Presentation and discussion in the seminar, duration depends on the topic (20%) • Oral Test/ final colloquium, duration: 15 min (20%) • Report, c. 20 pages (10%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	none
Module Components	• Lab Course "Eukaryotic Microorganisms" • Seminar "Eukaryotic Microorganisms"
Components to be offered in the Current Semester	No assignment

Module 12777 Methods in Synthetic Microbiology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12777	Mandatory

Modul Title	**Methods in Synthetic Microbiology** Methoden der synthetischen Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. This course aims to teach diverse techniques and methods used for genetic engineering, molecular cloning, expression in procaryotic or eucaryotic systems, conceptional thinking, independent preparation, execution, evaluation of experiments, and adequate documentation.
Contents	• cultivation of Microorganisms under suitable conditions • isolation and modification of DNA • constructing genetic tools or overexpression vectors • create relevant synthetic microorganisms such as genetically modified strains for biotechnological purposes or further investigations
Recommended Prerequisites	Basic lab experience; basis knowledge in molecular biology, biochemistry, microbiology.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester

	Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	1. Campbell Biologie (ISBN-10: 3868943668) 2. Brock Biology of Microorganisms (ISBN-10: 1292404795) 3. Der Experimentator Molekularbiologie / Genomics (ISBN-10: 3642346359) 4. Molecular Cloning: A Laboratory Manual (ISBN-10: 1936113422)
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	After completing the experiments, each student submits a manuscript about the experimental results and give an oral presentation and discussion. • lab performance: 20% • manuscript (max. 10 pages): 40 % • oral presentation and discussion (15 min): 40 %
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The lab performance (theoretical preparation, organization and execution in the lab, time management) of each student will be observed. For safety reasons we will evaluate the theoretical preparation of each student occasionally. We therefore reserve the right to interrupt laboratory work and experiments can be continued when successful background knowledge is confirmed.
Module Components	• Lab Course "Methods in Synthetic Microbiology" • Seminar "Methods in Synthetic Microbiology"
Components to be offered in the Current Semester	No assignment

Module 12791 Metabolic Analysis and Engineering

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12791	Mandatory

Modul Title	**Metabolic Analysis and Engineering** Metabolische Analyse und Entwicklung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	**Lab Course** Provide the student with an understanding of metabolic pathways and networks, the roles of enzymes and their regulation. The student will learn to estimate the power of tools, e.g. growth of designed mutants disrupted in single genes, and will get experience with different analytical methods. Communication between the students is stimulated by dividing them into four TEAMs, each responsible for a different system. In the first and second week each TEAM can focus on its system understanding methods, theoretical background and the objective. In the following weeks each TEAM is supervising one of the other three TEAMs in the performance of the experiment. That means from the third week on each TEAM is involved in parallel in two experiments, one as supervisor and a second as trainee. **Seminar** Each students has to present the scientific question, the experimental approach, results and conclusions of a original paper which was publised by the host father recently. Communication skills are trained by presention and discussion. The students introduce each other. They learn to ask questions and one of them has to summarize the main points of the discussion.
Contents	The module takes place as a 6 week block course. The seminar is a compulsory part of the module. Each TEAM is supervised by a PhD student. This means that the subjects are adapted for each course to the current state of their scientific work. The following systems are examples:

- System 1: Chemostatic cultivation as a tool to study regulation; a promotor::lacZ reporter strain of *A.gossypii* is cultivated; down-shifts in dilution rate stimulate reporter expression detectable *via* beta-galactosidase assay and riboflavin production; several online parameter are controlled, e.g. pH, and/or determined, e.g. CO2 in the exhaust *via* IR spectrometry;
- System 2: Feeding studies in shaking flasks or on agar plates; the uptake of amino acids in a defined medium is monitored by HPLC; Auxotrophy of *S. cerevisiae* mutants disrupted in *GLY1*, *SHM1*, *SHM2* and/or *AGX1* is studied on glucose or ethanol as sole carbon source plus/minus glycine;
- System 3: Kinetic studies on a Michaelis-Menten in comparison with an allosterically regulated enzyme; impact of ATP or AMP on NAD-dependent ICDH is compared with the NADP-dependent peroxisomal isoenzyme;
- System 4: Transformation and genotype analysis; fungal cells are transformed with DNA *via* electroporation; replacement with a marker by homologous recombination is studied by locus specific PCR with genomic DNA;

Recommended Prerequisites

Three months lab experience; basic knowledge in microbiology, biochemistry, molecular biology.

Mandatory Prerequisites

- 12777 - *Methods in Synthetic Microbiology*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

The students receive original scientific literature for each experimental system e.g.
- System 1: Microbiology 147: 3377-3386; Environmental Microbiology 3: 545-550
- System 2: Yeast 21: 63-73
- System 3: Journal of Molecular Catalysis 10: 335-343
- System 4: Biochemical Journal 369: 263-273

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

Each TEAM (2 student) will take part in an oral presentation and discussion (15 min); furthermore a short manuscript about results of the experiments has to be submitted; presentation and quality of the manuscript will be scored each 50 % for the final mark.

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

8

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course

	• Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lab Course "Metabolic Analysis and Engineering" • Seminar "Metabolic Analysis and Engineering"
Components to be offered in the Current Semester	**210343** Practical training Metabolic Analysis and Engineering - 7 Hours per Term **210345** Seminar/Practical training Metabolic Analysis and Engineering - 1 Hours per Term

Module 12800 Microbial Metabolism

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12800	Mandatory

Modul Title	**Microbial Metabolism** Stoffwechsel der Mikroorganismen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Goal of the lecture is 1. repetition of basics in bacterial and fungal metabolism and its regulation 2. in depth understanding of selected topics based on recent original papers and current reviews 3. to understand how conclusions are drawn from data, especially experimental data 4. to understand how independent research strategies can lead to overlapping evidences 5. to understand the difference qualitative and quantitative experimental approaches 6. to understand the route starting from a scientific question over experimental data to a model explaining complex phenomena of microbiology 7. to become able to work as a PhD student
Contents	**Microbial Metabolism and Regulation** As a general principle all statements presented in the lectures are based on conclusions drawn from original data. Topics: a) Mutations affecting metabolic pathways: (conditional) auxotrophy; supplementation; glycine biosynthesis; definded growth media; b) Isoenzymes: isocitrate DHs; serine hydroxymethyltransferases; carbon flux analysis; subcellular compartmentation; aspartate kinases of *E. coli* c) Regulation of metabolism: lac, ara, trp operon; repression, induction, attenuation, mRNA half-life control;; adenylation of glutamine synthetase; phosphorylation; feed back inhibition

	d) Circadian clocks: control of photosynthesis and nitrogenase in *Synechococcus* and *Anabaena*; sporulation in *Neurospora* e) Reporter systems: *lacZ*; green fluorescent protein; organelle targeting; f) Quorum sensing: biofilms; signal systems in Gram-positive and Gram-negative bacteria;
Recommended Prerequisites	Basic knowledge in biochemistry, molecular biology, microbiology.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	About 30 pdf-files of original research reports, review articles, PhD theses are available for the students e.g. Biochem J 369: 263-73; PNAS 100: 5914-9; Genes Develop 15:1468-80; YEAST 21: 63-73; EMBO J 22: 2127-34; J Bacteriol 185: 2066-79; Schlüpen C Diss Uni Düsseldorf; PNAS 90: 5672-6; PNAS 99: 9697-702; Microbiology 154: 2184-94; Mol Cell Biol 6221-8; BBA 1577: 240-50; J Mol Cat 10: 335-43; PNAS 98: 12221-6; J Bacteriol 182: 1-8; J Biol Chem 271: 11113-9; Microbiol 147: 3377-86; PNAS 107: 2043-47
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" Biotechnology (Master of Science, 3 Semester Version): Master 1st year course Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Microbial Metabolism and Regulation" • Examination "Microbial Metabolism and Regulation"
Components to be offered in the Current Semester	**210330** Lecture Microbial Metabolism and Regulation - 2 Hours per Term **210338** Examination Microbial Metabolism and Regulation

Module 11795 Immunology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11795	Compulsory elective

Modul Title	**Immunology** Immunologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Roggenbuck, Dirk
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	At the end of the module, the students are able to create a common understanding of immune responses and their relevance regarding the protection against pathogens. They are able to evaluate cellular and humoral immune mechanisms and to understand and apply immunological tools in diagnostics and therapy. Further, they are able to analyze the main molecular mechanisms of an immune response in the context of pathophysiological processes in immune-mediated disorders. Students are able to evaluate immunological markers within the differential diagnosis of immune-mediated diseases.At the end oh the module students can explain and apply scientific principles as well as specialised and in-depth knowledge. They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	• History of immunology • Innate immune system • Specific acquired immunity • Basic immune protection systems – complement • Dendritic cells and antigen presentation • Apoptosis • Structure and function of antibodies • B-cells and antigen recognition • HLA system – membrane receptors for antigen presentation • T-cells – development and functions • Cytokines • Immune responses • Clinical Immunology – allergy and autoimmunity

Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Immunology, 13th edition, P.J.Delves, S.J. Marting, D.R. Burton, I.M. Roitt, Wiley-Blackwell, corresponding web site with interactive questions, podcasts and videos • Cellular and molecular Immunology: with Student consult online access, 7th edition, A.K. Abbas, A.H. Lichtman, S. Pillai, Elsevier
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Immunology" • Seminar "Immunology" • Examination "Immunology"
Components to be offered in the Current Semester	**210020** Lecture Immunology - 2 Hours per Term **210025** Seminar Immunology - 1 Hours per Term **210028** Examination Immunology

Module 11825 Tissue Engineering

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11825	Compulsory elective

Modul Title	**Tissue Engineering** Entwicklung und Kultivierung von Geweben
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	• Explain and apply fundamental scientific principles as well as advanced, specialized knowledge in tissue engineering and regenerative medicine. • Describe the basic structure of tissues and analyze interactions between cells and the extracellular matrix. • Explain key developmental processes in mammals and relate them to tissue engineering strategies. • Identify and explain the core components of tissue engineering, including cells, signaling molecules, biomaterials, bioreactors, and three-dimensional (3D) cell culture systems. • Distinguish between different cell-based therapies and evaluate their roles as therapeutic concepts in regenerative medicine. • Analyze and discuss 3D cell culture approaches and evaluate their relevance for tissue engineering, disease modeling, toxicology and pharmacology and translational research.

	• Develop independent ideas and concepts for solving scientific problems related to tissue engineering.
Contents	• Basic organisation of tissues: Cells and extracellular matrix (ECM)
	• ECM: Molecular structure & function • Cell-ECM Interaction
	• Cell-Cell interactions • Cellular Development and Fate Decisions (Proliferation, migration, determination, differentiation, cell-cell & cell-matrix interaction, apoptosis)
	• Cells Sources for Tissue Engineering: stem cells, differentiated cells from adult tissues, problem of donor-recipient cell transfer
	• Wound healing as a Natural Model of "Tissue Engineering": Inflammation, tissue formation, tissue remodelling
	• Cell based therapies: Principles and Applications
	• 3D Cell Cultures Systems: Principles and Applications
Recommended Prerequisites	Basic knowledge in cell biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015 • Cell and Molecular Biology. Concepts and experiments. Karp G., John Wiley & Sons, 2008 • Principles of Tissue Engineering, Lanza R. P. et al., Academic Press, 2nd edition 2000 • Methods of Tissue Engineering, Anthony Atala, Robert P. Lanza (eds.), Academic Press, New York, 2002 • Tissue Engineering, Clemens van Blitterswijk (senior editor), Elsevier, Amsterdan,Boston, Heidelberg, … (2008) • Functional Tissue Engineering, Farshid Guilak, David L. Butler, Steven A. Goldstein, David Mooney, C. MacLachlan, Springer, New York, Berlin, 2003 • Specific original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded

Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Tissue Engineering" • Seminar "Tissue Engineering" • Examination "Tissue Engineering"
Components to be offered in the Current Semester	**210728** Examination Tissue Engineering

Module 11858 Proteostasis

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11858	Compulsory elective

Modul Title	**Proteostasis** Proteostase
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	Proteostasis is a concept to summarize the contributions of protein synthesis, folding, modification, trafficking and degradation to steady state maintenance and dynamics of proteomes in cells. Major aim of the module is to deepen mechanistic knowledge in protein structure and function and the contributions of aforementioned processes during regulation of cellular homeostasis. The topic requires confrontation with complexity of living systems and scientific terminology. The consideration of mechanistic details of cellular processes should deepen the comprehension of important principles as foundations of cellular homeostasis and molecular pathology. Based on a mechanistic understanding of cell biological and molecular processes within the concept of protostasis, students are invited to contribute with their future work to progress in the understanding of the molecular pathology, diagnostics and therapy of human diseases (e.g. neurodegeneration, cancer, aging). Apart from these specific topics one major idea of the lecture is to enlighten the philosophy behind the scientific method. Historical milestones during the discovery of proteolytic systems involved in cell cycle control, apoptosis and cell survival signalling pathways, illustrated with original papers and reviews exemplifies deductive strategies and causality within scientific philosophy. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions.
Contents	Central topic of the module are cellular and molecular processes shaping the functionality of cellular proteomes. Protein synthesis,

protein folding and misfolding, protein modification, subcompartimental localization and degradation are interconnected topics central to the understanding of molecular cell biology. The unique feature of this module is to look at these processes from the perspective of distinct proteolytic systems such as ubiquitin-dependent and independent proteasomal proteases, lysosomal proteases in autophagy, or caspases in apoptosis and inflammation and generally protease in antigen processing.
Firstly, basics in protein biochemistry as well as technologies to analyze steady state and turnover of proteins are discussed. Next, the enzymology of proteases (protease families and mechanisms, inhibitors, diseases and therapy), proteolytic systems and protein modifications is a specific focus of this module.
While considering complex proteolytic systems such as those of autophagy, apoptosis and the ubiquitin proteasome system, the module connects the topic of proteostasis specifically with cell survival signaling as exemplified by NFkB or p53 pathways, cell cycle regulation or apoptotic/inflammatory pathways. While emphasizing the role of proteases for cellular homeostasis, peptide generation as a principle of antigen processing should not be neglected. Hence, the discussion of MHC class I and class II pathways demonstrates the roles of proteolytic systems for the immune response.

Recommended Prerequisites

Basic level in biochemistry, cell biology and molecular biology

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

As a starting point textbooks of molecular cell biology and protein biochemistry are recommended:

- Alberts, Johnson, et al. (2008) Molecular Biology of the Cell, 5th Edition (or newer) Garland Science
- Nelson, Cox (2008) Lehninger Principles of Biochemistry 5th Edition
- Lodish, Berk, et al. (2008 or later). Molecular biology of the cell 6th Edition, W.H.Freemann and Company

Reviews as starting point:

- Klaips, C.L., Jayaraj, G.G. and Hartl, F.U. (2017). Pathways of cellular proteostasis in aging and disease. J. Cell Biol. http://doi.org/10.1083/jcb.201709072

Module Examination

Final Module Examination (MAP)

Assessment Mode for Module Examination

Written Examination (120 min)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

none

Module Components	• Lecture "Proteostasis" • Seminar "Proteostasis" • Examination "Proteostasis"
Components to be offered in the Current Semester	**210238** Examination Proteostasis

Module 12175 Molecular Dynamics of the Cell

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12175	Compulsory elective

Modul Title	**Molecular Dynamics of the Cell** Molekulare Prozesse in Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The overall aim of the Module is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected. The lecture focuses on molecular processes that connects DNA damage signalling with cell cycle arrest, DNA repair or apoptosis. Furthermore, the student learns about the dynamics of a particular important cell types, the hepatocyte. Based on a profound understanding of molecular processes, the students will also better understand the molecular pathology of human diseases (e.g. cancer) which occur if there is a defect in one of these processes. Understanding the etiology of such diseases is the prerequisite for specific and effective therapies. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).
Contents	The lecture contains the following topics: • Molecular biology of eucaryotic DNA replication as a prerequisite to understand DNA damage signaling and DNA repair • Spectrum of DNA damages • DNA damage signaling: Molecular DNA damage sensors such as ATM and DNA-Pk, mediators, transducers/ effectors and cellular genotoxic responses such as apoptosis or cell cycle arrest, resp.; human diseases by defects in DNA damage signaling • Human DNA repair pathways: Direct DNA repair, Mismatch Repair, Base- & Nucleotide Excision Repair, Recombination Repair; defects

	in repair pathways leading to defined diseases or syndromes, their specific diagnostics and molecular strategies for therapies if possible • Molecular Dynamics of hepatocytes
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Molecular Dynamics of the Cell" • Seminar "Molecular Dynamics of the Cell" • Examination "Molecular Dynamics of the Cell"
Components to be offered in the Current Semester	**211018** Examination Molecular Dynamics of the Cell

Module 12762 Signal Transduction

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12762	Compulsory elective

Modul Title	**Signal Transduction** Signaltransduktion
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Understanding inter- and intracellular communications is essential when working in life science. Although the complexity of the issue makes the subject almost unmanageable there exist general principles and types of molecules that play a key role in signal transduction. A profound knowledge of these provides the basis to look into any kind of pathway successfully. In addition to understand the concepts it is of the same value to also know key experimental approaches that are applicable to elucidate signal transduction components and networks. It is therefore the aim of the lecture to develop an understanding not only of key signaling pathways (professional competences) but also of the experimental methodology used to study signal transduction in the lab. Summary: At the end of the module students are able to remember general mechanisms and understand the relevant scientific literature. They are able to apply the knowledge to design and perform own experiments. They can analyze and evaluate the data they obtain and should be able to create various new approaches to study and work in the field of signal transduction.
Contents	Due to the importance and the basic student knowledge of G-protein coupled receptors (GPCR) general aspects of ligand-receptor interaction, receptor activation and desensitization are discussed focusing on this subject. The importance of protein translocation and modification is underlined and explained using several examples. Within the same context binding experiments and the analysis of agonists and antagonist are explained. Using the GPCR topic a complete “story” is developed starting with ligand affinity down to the FRET-based

	methods of measuring receptor activation and inactivation. Students understanding is challenged by questions concerning the outline and the execution of relevant experiments to make clear that in general very similar approaches are used to study completely different signaling pathways. Emphasis is placed on experiments based on knock-down, knock-out, overexpression and inhibitors. A seminar is offered to deepen the understanding of the contents of the lecture and to prepare the students for their "working" with current scientific studies. <u>Membrane Receptor mediated</u> • G-protein coupled • Enzyme based (i.e. Receptor Tyrosine Kinase, JAK/STAT, TGFbeta) • Cytokine classes I-IV • Ion channels • Special pathways (Wnt, Hedgehog, Notch, Cholesterol) <u>Non-membrane receptor mediated</u> • Nitric oxide (NO) pathway • Steroid hormone receptors
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Textbook: Signal Transduction, IJisbrand M. Kramer, AP • Signal Transduction Knowledge Environment (stke.sciencemag.org) • Recent original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Signal Transduction" • Seminar "Signal Transduction" • Examination "Signal Transduction"
Components to be offered in the Current Semester	**210460** Lecture Signal Transduction - 2 Hours per Term **210465** Seminar Signal Transduction - 1 Hours per Term

210468 Examination
Signal Transduction

Module 12765 Nanobiotechnology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12765	Compulsory elective

Modul Title	**Nanobiotechnology** Nanobiotechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The goal of the course is to provide a systematic description of nanotechnolgy-driven techniques and approaches that are relevant in biotechnology. By the end of the course, students will be able to (1) explain physical principles governing biological systems at the nanoscale, (2) compare relevant (single-molecule) techniques and evaluate their possibilities and limitations, (3) interpret experimental and computational data, (4) design (thought) experiments to probe biomolecules and their interactions, (5) critically analyze primary literature, and (6) asses the translational potential of the discussed techniques. Short talks will enable students to present state of the art developments with the overall aim to encourage the development of independent ideas and concepts to solve scientific and societal challenges.
Contents	Nanobiotechnology explores biological processes at the nanometer scale and develops technologies to measure, manipulate, and engineer individual biomolecules and ensembles thereof. After introducing the term nanobiotechnology and discussing the physical principles relevant at the nanoscale, the course will introduce key concepts in detection, manipulation, and utilisation of biomolecules. A focus will be set on fluorescence-based, single-molecule detection schemes and the use of RNA/DNA nanotechnology that, taken together, let to breakthroughs in next-generation sequencing technologies and diagnostics. Students will learn, how nanoscale tools reveal hidden biological heterogeneity and how these discoveries can be translated into clinical and industrial innovations.

	The course further includes lectures on (1) (super-resolution) optical microscopy and live-cell imaging, (2) nanoparticles/fluorescent probes and their applications in biology and medicine, (3) applied surface science and nano/micro fluidics (including the basics of surface electrostatics, methods of surface analysis, self-assembled monolayers, covalent immobilization of biomolecules), (4) affinity biosensors (surface plasmon resonance and field-effect biosensors), (5) model lipid systems (liposomes, lipid monolayers, planar lipid bilayers), (6) DNA and nanopore technology. Additionally, the theoretical course includes short presentations of students and subsequent discussions on recent topics of nano(bio)technology, for example: DNA-origami, single-molecule kinetics, self-assembly, etc.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Science.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	In addition to the provided lecture scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	
Module Components	• Lecture "Nanobiotechnology" • Seminar "Nanobiotechnology" • Examination "Nanobiotechnology"
Components to be offered in the Current Semester	**210818** Examination Nanobiotechnology

Module 12766 Bioprocess Development

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12766	Compulsory elective

Modul Title	**Bioprocess Development** Entwicklung von Bioprozessen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. rer. nat. Hansen, Barbara
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	After participating in the module, students are able to apply the basics of heat and mass transport, bioreaction technology to biotechnological processes.
Contents	Use of living cells for the planning and implementation of a process, the development of process control and processing methods for the products, the control of production processes and their continuous optimization.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; 2010
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none

Remarks	No offer from WiSe 2024/25!
Module Components	• Lecture "Bioprocess Development" • Seminar "Bioprocess Development" • Examination "Bioprocess Development"
Components to be offered in the Current Semester	No assignment

Module 12767 Point of Care Diagnostic

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12767	Compulsory elective

Modul Title	**Point of Care Diagnostic** Point-of-Care-Diagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. Dame, Gregory
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The module teaches the basics of point of care diagnostics / point of care analysis, molecular diagnostics, biochip technology and their techniques. The students will be able to explain the term point of care testing using concrete examples and are introduced in scientific thinking. The module teaches special abilities and knowledge in the field of bioanalytics for biotechnologically and biochemically oriented students.After successful participation in the module students are able to explain and apply scientific principles as well as specialised and in-depth knowledge. -They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	In the lecture different bioanalytical detection techniques will be presented, whereby the biosensorics occupy a partly higher importance. Important combinations of biomolecules with sensors and their bioanalytical application are discussed. On the basis of practice-relevant examples, the development of individual biosensors will be presented, as well as their limitations and solutions for optimization discussed. Other topics include biochip technology, molecular diagnostics, point of care testing (POCT), on-site analysis and nanobiotechnology. • Enzymatic sensor concepts and selected examples (glucose oxidase enzyme electrode) • DNA Sensors • Immunosensors • Cell-based biosensors • In vivo Biosensors

- Disposable biosensors in point-of-care applications: concepts and fabrication
- Clinical applications: blood gas analyses, coagulation diagnosis, cardiovascular diseases

Current publications in the field of point-of-care diagnostics and on-site analysis will be presented and discussed with regard to a point-of-care application.

Recommended Prerequisites

none

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

POCT-Patientennahe Labordiagnostik, P. Luppa, R. Junker (eds), ISBN 978-3-662-54195-1, ISBN 978-3-662-54196-8 (ebook)

Publications:
- Khan et al, Diagnostics 2017, 7, 39; doi: 10.3390/diagnostics7030039
- Krampa et al., Diagnostics 2017,7, 54; doi: 10.3390/diagnostics/7030054
- Mashamba-Thompson et al, Diagnostics 2016,6,31;doi: 10.3390/diagnostics6030031

Module Examination

Final Module Examination (MAP)

Assessment Mode for Module Examination

Written Examination (120 min)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course
- Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

"Responsible Staff Member"

1. Prof. Frank Hufert (no)
2. Dr. Gregory Dame (no)

Module Components

- Lecture "Point of Care Diagnostic"
- Seminar "Point of Care Diagnostic"
- Examination "Point of Care Diagnostic"

Components to be offered in the Current Semester

210040 Lecture
Point of Care Diagnostic - 2 Hours per Term
210045 Seminar

Point of Care Diagnostic - 1 Hours per Term
210048 Examination
Point of Care Diagnostic

Module 12768 Introduction to Laboratory Diagnostics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12768	Compulsory elective

Modul Title	**Introduction to Laboratory Diagnostics** Einführung in die Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The aim of the module is to familiarize students with the concepts of laboratory medicine, which focus on screening, diagnosis, risk assessment and therapy monitoring and include tools for routine laboratory diagnostics. In lectures that introduce the basics of laboratory medicine, students are enabled to understand the concept and principles of laboratory medicine. Subsequently, the students will deepen their knowledge of pathophysiology and pathobiochemistry of diseases with a view to characterising the diseases using laboratory medical instruments. In lectures, students learn the methodology of the analytical tools commonly used in laboratory medicine and discuss selected methods in seminars to deepen their understanding. The student learns the specific analytical tools focused on related diseases and students should be able to select analytical tools related to screening, risk assessment, diagnosis and monitoring. Upon completion of the module, students should be able to interpret analytical results for disease screening, risk assessment, diagnosis and monitoring and discuss the results with the applicant. Students should be able to understand and work with the scientific literature of laboratory medicine. Students should be able to design and interpret their own studies of laboratory medicine. A special aspect will be the area of personalised medicine. Personalised medicine distinguishes itself by classifying individuals on the basis of information about genetic, molecular and cellular properties in order to define individual therapies. It comprises products and services based on biomarker-based diagnostics and therapy for small patient groups. The students learn about personalised medicine ideas and learn how

	medical progress can lead to the scientific and technical development of new diagnostics and therapies, especially on the basis of genome and post-genome research.
Contents	• Introduction to laboratory medicine: • Laboratory medicine with emphasis on specific metabolism (lipids, nucleic acids, proteins, trace elements) • Laboratory medicine with focus on specific systems (immune system, exocrine system, endocrine system, neoplasia) • Laboratory medicine with emphasis on specific organs (liver and bile ducts, intestines, kidneys and urinary tract) • Development of strategies for personalized medicine • Definition of a biomarker, definition of biomarker panels • Comparison of strategies of personalised medicine with conventional medicine
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Will be announced during the lecture.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	re-examination oral (30 min)
Module Components	• Lecture "Introduction to Laboratory Diagnostics" • Seminar "Introduction to Laboratory Diagnostics" • Examination "Introduction to Laboratory Diagnostics"
Components to be offered in the Current Semester	**210968** Examination Introduction to Laboratory Diagnostics

Module 12769 Molecular Biotechnology and Society

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12769	Compulsory elective

Modul Title	**Molecular Biotechnology and Society** Molekulare Biotechnologie in der Gesellschaft
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	6
Learning Outcome	This highly interdisciplinary lecture should demonstrate the students that many recent biotechnological developments do not only influence scientific fields, but can also have a clear-cut impact on the whole society. The students learn about biotechnological fields which are relevant for political & ethical issues, medical issues and economical issues, i.e. emerging biotechnological industries. Since biotechnology is a rather broad field, the lecture highlights some “prominent” examples. The lecture is called “Molecular Biotechnology” because of its further focus on molecular principles used in the presented biotechnological fields. For each biotechnological topic, the molecular basics are presented followed by presentation of their respective influences on politics, medicine and / or economy. If applicable, the lecture also covers some basics on relevant “Biotech” laws. The students should learn that although the awareness and knowledge of Biotechnology in society is quite low, it definitely is a key technology of the 21th century influencing many aspects of life. In addition, the students should obtain a deep understanding of the molecular principles presented in the lecture to be competent for future discussions outside the University. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).

Contents	The lecture starts with an introduction into the awareness of people towards biotechnology, importance of biotechnology for medicine & sustainable industry, provide examples of the biotechnological presence. In addition, the lecture contains the following topics: • Forensic DNA science, their techniques, ethical issues and their national regulations (e.g. German DNA Analysedatei) • Medical DNA screening including techniques of genetic tests, examples of single gene disorders and chromosomal disorders, regulations such as the German “Gendiagnostikgesetz” • Special lectures are provided on cell cycle regulation, **Signal Transduction**, cellular mortality/immortality and molecular carcinogenesis to provide the basis for understanding the molecular defects of the discussed diseases and their respective diagnostics. • Stem cells and cloning, including stem cell biology, therapeutic and reproductive cloning, preimplantation diagnostics and their discussions in society as well as national regulations such as the German “Embryonenschutzgesetz”. • Concepts of Personalized Medicine • Biotechnology and Global Warming: This last part of the lecture makes the focus on recent developments in biotechnology that could help to mitigate global warming
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Genetik, Klug et al., Pearson Studium, 8. Auflage (2007) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

Module Components	• Lecture "Molecular Biotechnology and Society" • Seminar "Molecular Biotechnology and Society" • Examination "Molecular Biotechnology and Society"
Components to be offered in the Current Semester	**211030** Lecture Molecular Biotechnology and Society - 2 Hours per Term **211035** Seminar Molecular Biotechnology and Society - 2 Hours per Term **211038** Examination Molecular Biotechnology and Society

Module 12771 Cells and Tissues - Culture and Evaluation

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12771	Compulsory elective

Modul Title	**Cells and Tissues - Culture and Evaluation** Zell- und Gewebekultur
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	• After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities • Acquire theoretical knowledge and practical experience in basic principles of cell culture techniques. • Get familiar with the morpholgy, physiology and way to work with different animal and human cell lines. • Generate awareness for the use of cells in culture (advantages and limitations). • Understand the principles as well as application of cell biological methods to characterise the main parameters of cell behaviour like proliferation, differentiation, and viability. • Engineering artificial tissues (3D-culture) using cell lines. Discriminate the special features of cells cultured in 3D and cells growing as a monolayer in a culture flask (2D-culture). • Applying advanced techniques of cell biological methods to characterise the main parameters of cell behaviour like proliferation, viability, toxicity, and differentiation. • Advanced knowledge and experience in microscopical techniques (Phase contrast, brightfield, fluorescence)
Contents	• Sterile working technique, media preparation

- Routine maintenance of cell lines: Medium replacement, subculture of adherend and suspension cells, cell counting, cryopreservation, contamination control (microscopical observation, mycoplasma screening)
- Cultivation of cells in monolayer (2D) and engineering of in vitro tissues of different cell types (3D-cell culture systems; spheroids)
- Application of special test systems to monitor proliferation, viability, and toxicity in monolayer cells
- Analyses of morphology of cells in 2D- and 3D (preparation of cryosections of spheroids, histological analyses)
- Working with different microscopic techniques: Phase contrast microscopy (basis “life cell” analyses), brightfield microscopy, fluorescence microscopy

Recommended Prerequisites

Basic knowledge in cell culture.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Culture of Animal Cells: A Manual of Basic Technique, Freshney R. I., 6th edition, Wiley-Blackwell, 2010
- Zell- und Gewebekultur. Von den Grundlagen zur Laborbank, Lindl T und Gstraunthaler G., Spektrum Akademischer Verlag, 6. Auflage, 2008
- Der Experimentator: Zellkultur, Spektrum Akademischer Verlag, 3. Auflage 2011
- Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015
- Specific original scientific publications
- Manuals (SOPs) for cell culture & cell analytics of the Lab of Prof. U. Anderer

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

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<p>Lab work: 4 experiments, performance, critical evaluation of data, time management (25%) <p>Presentation (10 min) and discussion (5 min) in the seminar, duration depends on the topic (25%) <p>Protocol: Introduction, Methods, Results and Discussion, 10-15 pages (25%) <p>Written exam, duration: 45 min (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Cells and Tissues – Culture and Evaluation" • Seminar "Cells and Tissues – Culture and Evaluation"
Components to be offered in the Current Semester	No assignment

Module 12772 Bioengineering of Animal/Human Cells

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12772	Compulsory elective

Modul Title	**Bioengineering of Animal/Human Cells** Biotechnologie mit tierischen und menschlichen Zellen
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays. Furthermore they broaden their methodological background in analysis, interpretation, and reporting of lab data. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to sum up and discuss the experimental results train additional soft skills like the ability to communicate orally and written to individuals and groups and to tailor the communication to the level and experience of the audience. The students use appropriate software, graphics, and other tools to clarify complex information. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	Culture of cells in Monolayer (2D) of different cell types (including differentiation). - culture and differentiation of macrophages and monocytes - detection and visualization of inflammasome activation - microscopy of blood smears and immune organs - culture and differentiation of myogenic cells - functional analysis of specific genes in myogenic cells Contents of the seminar: Deepening the knowledge of the theoretical background used in the Labcourse.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry.

	Participation in the laboratory course *12771 - Cells and Tissues - Culture and Evaluation* is highly recommended.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications ; 2010 • Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008 • Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011 • Specific original scientific publications • Manuals (SOPs) for cell culture & cell analytics of the Labs of Prof. U. Anderer, Prof. Manuela Rossol and Prof. Julia von Maltzahn
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	weeks 1-3 (Prof. Manuela Rossol): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min, 10 pages (12.5%) • written exam, duration: 45 min (12.5%) weeks 4-6 (Prof. Julia von Maltzahn): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min. 10 pages (12.5%) • written exam, duration: 45 min (12.5%) The duration of the presentation will be announced at the beginning of the course.
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course (split in 2 parts of 3 weeks duration each).
Module Components	• Lab Course "Bioengineering of Animal/Human Cells" • Seminar "Bioengineering of Animal/Human Cells"

Components to be offered in the Current Semester	No assignment

Module 12773 Genetic Engineering of Eukaryotic Cells

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12773	Compulsory elective

Modul Title	**Genetic Engineering of Eukaryotic Cells** Genetische Veränderung eukaryotischer Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	Based on practical work in the lab, the overall aim is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected, and how they can be manipulated experimentally. Practical Course: Connected to actual scientific research projects of the group, the students work on genetically manipulated mammalian cells. The students learn to analyze consequences of recombinant gene expressions on various cellular responses, being dependent on the research project into which they are integrated. Furthermore, students learn strategies to obtain specific cell types from multipotent and/or pluripotent stem cells. Seminar: The students present and discuss “classical” as well as actual literature on selected topics of the practical course. Competences acquired after successful completion of the course: In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. In addition, the students learn to perform standardized data documentation by using electronic protocols.
Contents	The practical course is integrated into actual research projects of the group and thus contents will vary during time. Generally, the following practical paths will be followed: • Culturing of cell lines and primary cells • Working with genetically engineered mammalian cells, especially with hepatocytes and cancer cells

	• Analsis of gene expressions by e.g. immunofluorescence, Western blotting, flow cytometry and / or PCR • If working on hepatocytes, liver markers such as CYP450 will be analyzed • If working on hepatocytes, conversions with drugs into metabolites and metabolite detection will be performed • Investigation of drug effects on liver and / or cancer cells by means of toxicology analysis with XTT, ATP, membrane integrity tests, apoptosis tests, proliferation analysis etc • Differentiation of multipotent and/or pluripotent stem cells into cardiomyocytes and / or hepatocytes and testing of specific differentiation protocols
Recommended Prerequisites	• 12175 *Molecular Dynamics of the Cell*
Mandatory Prerequisites	• 12771 *Cells and Tissues – Culture and Evaluation* • 12772 *Bioengineering of Animal/Human Cells*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed. • Actual Version of Lab Manual & Standard Operating Procedures in Molecular Cell Biology by Prof. Küpper, BTU Cottbus-Senftenberg
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (30%) • SPresentation and discussion in the seminar, duration depends on the topic (20%) • Presentation of results (20%) • Oral Test, duration: 15 min (15%) • Electronic protocols (15%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course The module takes place as a 6 week block course.
Module Components	• Lab Course "Genetic Engineering of Eukaryotic Cells" • Seminar "Genetic Engineering of Eukaryotic Cells"

Components to be offered in the Current Semester	**211013** Practical training Genetic Engineering of Eukaryotic Cells - 7 Hours per Term **211015** Seminar/Practical training Genetic Engineering of Eukaryotic Cells - 1 Hours per Term

Module 12792 Methods in Nanobiotechnology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12792	Compulsory elective

Modul Title	**Methods in Nanobiotechnology** Methoden der Nanobiotechnology
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Upon successful completion of this course, students will be able to independently design, perform, and critically evaluate experiments in modern nanobiotechnology. They will acquire hands-on experience with single-particle tracking, single-molecule FRET using DNA-based sensors, and super-resolution microscopy in live bacterial cells. Students will learn to prepare samples, operate advanced fluorescence microscopes, and optimize acquisition parameters for reaching single-molecule sensitivity. Students will analyze experimental data using appropriate statistical and computational tools (Python), extracting biologically meaningful parameters such as diffusion coefficients, molecular distances, and nanoscale spatial organization. The course will strengthen the ability to connect physical measurement principles with biological questions. Finally, students will critically assess experimental limitations, sources of artifacts, and the translational relevance of single-molecule and super-resolution approaches.
Contents	The course is organized around a sequence of laboratory modules that introduce experimental strategies in nanobiotechnology. It begins with an overview of fluorescence microscopy setups, optical alignment, and intricate sample preparation required for achieving single-molecule sensitivity. Students then perform single-particle tracking experiments to study nanoscale motion and heterogeneity, followed by single-molecule Fluorescence Resonance Energy Transfer (smFRET) measurements using, e.g., DNA-based sensors to investigate conformational changes in the nanometer range. A dedicated module addresses live-cell imaging in bacteria and the application of single-molecule localization microscopy to resolve subcellular structures beyond the diffraction

	limit. Throughout the course, practical sessions are complemented by guided data processing, including diffusivity analysis, FRET efficiency calculations, and localization reconstructions. The final part of the course focuses on integrating experimental results into a coherent scientific report and discussing biological context and potential applications.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Sciences.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	In addition to the provided scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• presentation of a scientific topic (will be announced at the beginning of the lab course) (20%), 10 slides, 20 min presentation • written test on the content of the course 60 min (20%) • protocol reporting on the experiments and data analysis (40%), 10-12 pages • experimental work (preparation of experiment, performance, discussion, time management) (20%), weekly evaluation by the supervisors on the above described criteria
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Nanobiotechnology" • Seminar "Methods in Nanobiotechnology"
Components to be offered in the Current Semester	No assignment

Module 12793 Purification and Characterisation of Proteins

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12793	Compulsory elective

Modul Title	**Purification and Characterisation of Proteins** Reinigung und Charakterisierung von Proteinen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	**Lab Course** The course is aimed to train master students on basic techniques in protein biochemistry and proteome research. To develop strategies for the purification and characterization of various proteins is the major goal of this course. Another didactic aim is to consolidate problem solving abilities and structured experimental team work as well as individual responsibilities. During a lab course students are working individually or as a team depending on the complexity of the analytic task to strengthen team work, as well as individual responsibility. Technical competences in protein purification are reaching from culturing prokaryotic and eukaryotic cells, providing cell lysates, via enrichment of proteins by subcellular fractionation towards classical strategies of salt precipitation, ultrafiltration and chromatography. Characterization encompasses electrophoreses (NEPHGE, IEF, SDSPAGE) and immune-identification (immunoblotting). Functionality of proteins is accessed by assays for enzymatic activites or protein-protein interaction depending on the specific research task provided. **Seminar** Since each student experiences various purification approaches associated with specific problems, the weekly research seminar provides the opportunity to makes this knowledge available for each participant of the lab course. During oral presentations the participants introduce into relevant literature, covering the theoretical background and principles of methods applied. Scientific questions, experimental approaches and results of individual projects are presented as well.

	These compulsory seminars are strengthening the student´s conceptual skills by planning their experimental activities for the next week, by drawing conclusions from experimental data. Certainly, the seminars are also aimed to promote the development of professional communication skills.
Contents	The experimental work of the students is integrated in actual research projects (proteolytic systems, proteasome regulators, apoptosis, protein modification etc). Basic techniques such as homogenization, centrifugation and salt precipitation, as well as ion exchange chromatography and other FPLC techniques are applied to research topics of the biochemistry unit. In a second step the composition of purified protein fractions is analyzed simply by SDS PAGE and Western blotting or via isoelectric focusing (IEF) and non-equilibrium pH gradient gel electrophoresis (NEPHGE). Enzyme assays and immune-detection methods are applied to monitor the quality of target proteins during protein fractionation. Fractionated salt precipitation, ultracentrifugation and ion exchange chromatography are the basic methods to purify proteasome regulators and their functional mutants. Other proteins may be useful for the standardization of immune-detections.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Practical Approach Series (David Hames, Editor; 185 volumes since 1981; IRL Press; Oxford University Press). Topics: • Coligan, Dunn, Speicher, Wingfield (2002) Short Protocols in Protein Science, Wiley • Barker, Kathy (2005). At the Bench: A Laboratory Navigator ISBN-13: 978-0879697082 • Original publications (depending on the assigned project). • Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request. • To strengthen professional skills, students have do develop their information acquisition strategies. Hence, seminar/lab course participants have to supplement provided information/material by their independent contributions.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Practical laboratory work 50% • Presentation and discussion in the seminar, duration depends on the topic (25%) • Lab work protocol, 10-20 pages (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course “Purification and Characterization of Proteins” • Seminar “Functional Analysis of Proteins”
Components to be offered in the Current Semester	No assignment

Module 12794 Methods in Enzyme Technology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12794	Compulsory elective

Modul Title	**Methods in Enzyme Technology** Methoden der Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	For students the course with complex tasks will enhance key skills such as teamwork, communications, problem-solving and business awareness (professional methodically and social competences). The first step in the development of a new enzyme product is to find the organism that produces the optimal enzyme. Each student should isolate and determinate one fungal strain from natural sources; purify the strain and determine enzyme activities by using several screening methods. Students use well-studied microorganisms from internal strain collection for producing extracellular and intracellular oxidoreductases and hydrolases. The biocatalysts are separated, concentrated and lyophilised and individual enzyme activities, kinetic parameter and stabilities are studied. In the second part, isolated enzyme reactions - as well as bioreactions by cell preparations - will be performed in several application techniques, including analytical product identification, activities in dependence of changing incubation parameters and yields. The main objective is to demonstrate regio- and stereoselective reactions and to analyse the potential applications of oxidoreductases and hydrolases by several analytical methods.
Contents	The course consists of practical exercises for isolation and screening of enzymes from natural habitats (lignocellulose), strain cultivation for fermentative enzyme production, preparation of extra- and intracellular enzymes, enzyme conservation, characterisation of the enzymes' application potential (factors for regulation of enzyme activity, textile bleaching, xenobiotic degradation potential, regioselective halogenation

and hydroxylation). Oxidoreductases and hydrolases will be used for exemplary degradation of xenobiotic organopollutants, e.g. laccase to determine application conditions in washing processes, versatile haloperoxigenase and peroxygenase (catalysing the regiospecific hydroxylation of basic chemical structures) we will investigated and the halogenation potential will be studied. The use of enzymes in technologies for industrial waste treatment is carried out by constitutive and inducible mono- and dioxygenases of imperfect fungi.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

- 12793 *Purification and Characterisation of Proteins*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

Bisswangeer H., Figura R., Möschel K., Nouaimi M: Enzymkinetik, Ligandenbindung und Enzymtechnologie. ISBN 3-8265-7175-4, 2001
Heiden S., Bock A-K., Antranikian G.: Industrielle Nutzung von Biokatalysatoren. ISBN: 3-503-04861-8, 1999
Several current publications e.g.:
Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677).
Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).
Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Individual practical work in the lab: preparation of experiments, performance, discussion, time management (50%)
- Presentation and discussion in seminars, duration depends on the topic (20%)
- Final colloquium, duration: 15 min (20%)
- Final report, approx. 20 pages (10%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The Laboratory course takes place as a 6 week block course. The seminar is an obligatory part of the lab course.
Module Components	• Lab Course "Methods in Enzyme Technology" • Seminar "Methods in Enzyme Technology"
Components to be offered in the Current Semester	**211133** Practical training Methods in Enzyme Technology - 7 Hours per Term **211135** Seminar/Practical training Methods in Enzyme Technology - 1 Hours per Term

Module 12797 Methods in Laboratory Diagnostics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12797	Compulsory elective

Modul Title	**Methods in Laboratory Diagnostics** Methoden der Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities The students are involved in the latest developments in the field of laboratory medicine. Students learn how to use modern technical laboratory diagnostic equipment. Students learn how to plan a strategy for developing a new diagnostic assay or diagnostic instrument. Students will work on and validate aspects of assay or instrument development in practice.
Contents	On the basis of the available literature and publications of the research group, the students design protocols for assay or instrument development, which are discussed in the seminar. The students work mainly in the fields of nucleic acid detection, autoimmunity, infection serology and tumor diagnostics. Mainly cell or microbead-based assays are developed. The students carry out their practical work under the supervision of the members of the research group and are integrated into the current research work of the working group.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:

	Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	Current scientific literature of the own research group and generally accessible literature on the respective subject area.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (30%) • Presentation and discussion in the seminar, duration depends on the topic (25%) • Presentation of results (25%) • Oral Test, duration: 15 min (20%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Laboratory Diagnostics" • Seminar "Methods in Laboratory Diagnostics"
Components to be offered in the Current Semester	No assignment

Module 12798 Methods in Bioanalytics

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12798	Compulsory elective

Modul Title	**Methods in Bioanalytics** Methoden in der Bioanalytik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. PD Dr. rer. nat. habil. Rödiger, Stefan
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	First the students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays (incl. analysis of DNA damage upon treatment with single (etoposide) and multiple chemotherapeutic substances, FISH to asses genomic alterations of cancer cells). In particular, the cell assays have relevance in precision medicine and pharmacology/pharmaceutical research. Furthermore, they broaden their methodological background in analysis, interpretation and reporting of lab data by different methods used in applied statistical bioinformatics, forensics, pharmaceutical research and precision medicine. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to present and discuss the experimental results train additional soft skills like the ability to communicate orally to individuals and groups and to tailor the oral communication to the level and experience of the audience. The students use appropriate scientific open source software (incl. R statistical computing language, Python general purpose programming language), graphics, and other tools to clarify complex information. The analysis of the data includes methods used in applied statistical bioinformatics and bioanalytical pharmacology. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	• Sterile working technique, media preparation • Routine maintenance of cell lines: Medium replacement, subculture of adherent cells

- Cryopreservation: Freezing and thawing of cells
- Contamination control: Microscopical observation, etc.
- Characterization of human (tumor) cells or cell lines
- Morphology: microscopy of cells
- Proliferation: Growth curve, population doubling-time
- Testing of (mouse monoclonal) antibodies ((m)Ab). Immunocytochemistry and immunochemistry with (m)Abs
- Comparison of different cell assays e.g. gamma H2AX-Assays and FISH assays
- Assesment of the effect of chemoterapeutic substances

Contents of the seminar:

Deepening the knowledge of the methods used in the labcourse. Methods in applied statistical bioinformatics, literate programming and report generation (Remarkdown or Jupyter notebook).

Recommended Prerequisites

Basic knowledge in Cell biology, Biochemistry, applied biostatistics and bioinformatics.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications; 2010
- Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008
- Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011
- Logan, M., Biostatistical Design and Analysis Using R: A Practical Guide. 2010
- Selvin, S., 1998. Modern Applied Biostatistical Methods: Using S-Plus, Monographs in Epidemiology and Biostatistics. Oxford University Press, Oxford, New York.
- Lee, J.K., 2010. Statistical Bioinformatics: For Biomedical and Life Science Researchers. Wiley.
- Sencar, H.T., Memon, N. (Eds.), 2013. Digital Image Forensics. Springer New York, New York, NY. https://doi.org/10.1007/978-1-4614-0757-7
- National Research Council (US) Committee on A Framework for Developing a New Taxonomy of Disease, 2011. Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease, The National Academies Collection: Reports funded by National Institutes of Health. National Academies Press (US), Washington (DC).

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	<div id="meta-origin" data-coolorigin="https%3A%2F%2Fwww.b-tu.de%2Forgcloud%2Fapps%2Frichdocumentscode%2Fproxy.php%3Freq%3D%2Fcool%2Fclipboard%3FWOPISrc%3Dhttps%253A%252F%252Fwww.b-tu.de%252Forgcloud%252Findex.php%252Fapps%252Frichdocuments%252Fwopi%252Ffiles%252F9418674_ochtzup9yafk%26ServerId%3Dde63ef99%26ViewId%3D7%26Tag%3D0de54f906567e99d"> <p>Laboratory Work – design, execution, in–lab discussion, and time management (55 %) <p>Presentation & Discussion (Journal Club of a Research Paper) - each student selects one current research paper from the field of bioanalytics; 15–minute presentation followed by a 10–minute group discussion (15 %) <p>Written Tests – 3 separate tests (each 30 min.),(15 %) <p>General knowledge about Methods in Bioanalytics and related topics <p>Knowledge of statistical bioinformatics and associated methods <p>Lab–course–specific content <p>Presentation of Lab–Course Results – two components (15 %) <p>Lab report (10 pages) produced from a reproducible document (e.g., Quarto, RMarkdown), due at the end of the course <p>Oral presentation using that reproducible document: 10 minutes for the presentation followed by a 10–minute group discussion <p class="western">
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Bioanalytics" • Seminar "Methods in Bioanalytics"
Components to be offered in the Current Semester	No assignment

Module 12799 Molecular Biology: Principles, Methods and Applications

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Mikrobiologie

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12799	Compulsory elective

Modul Title	**Molecular Biology: Principles, Methods and Applications** Molekularbiologie: Grundlagen, Methoden und Anwendung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	It is the aim of this laboratory course to provide basic molecular biology techniques in the first place. Students should experience isolation and manipulation of DNA and RNA in a way that they understand the underlying principles of these fundamental methods. In a second step, students have to learn different techniques used to transfect pro- and eukaryotic cells as these are important methods in biotechnology. Therefore, the course provides the complete scenario from the preparation of DNA up to the functional analysis of different expression plasmids. Third, students will become familiar with viruses, as these biological agents are important "work horses“ in different areas of molecular biology. Working with microbeads to detect nucleic acids and proteins in a multiplex format provides the opportunity for state of the art bioanalytical methods. This part is complemented by genome editing experiments. Students will get in touch with a state of the art complex methodology and get hands-on experience. The seminar has the task of broadening the theoretical basis of the methods used in the practical course. Presentations and enhanced discussions will provide the stage for a fruitful enhancement of molecular biology knowledge. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to train their practical lab skills and generic competences as they have to solve scientific problems.

All these projects require search and understanding of relevant scientific literature, design of experimental protocols, documentation and a critical discussion of results.

Contents

Students will isolate expression vector DNA using different protocols and reagents and will later on compare the influence of these different procedures on transfection efficiency again applying different gene transfer methodologies. Here the students will perform the complete set of steps necessary for eukaryotic cell transfection. These experiments form the basis for the central part of the course the genome editing. Students will use the CRISPR/Cas system to induce genome mutations and create site directed specific sequence alteration. The analysis of the cell physiological effects of these editings will be performed using cell culture experiments. In addition little projects will be given to students including the following methods: coupling of nucleic acids and proteins to fluorescence coded microbeads: detection of the protein targets by antibody detection; nucleic acids are detected on the bead surface via hybridization or PCR; expression and purification of recombinant proteins; design of primers for qPCR, PCR and PCR based cloning. Because the master course is integrated into the scientific research of the group experiments will be adapted accordingly.

Recommended Prerequisites

none

Mandatory Prerequisites

- 12797 *Methods in Laboratory Diagnostics*
- 12798 *Methods in Bioanalytics*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- iGenetics: A Molecular Approach. Peter J. Russell. ISBN 10: 0805346651
- Molecular Biology of the Gene. James D. Watson, Tania A. Baker, Stephen P. Bell et al. ISBN-13: 9780321507815
- Molecular biotechnology / by Carolyn A. Dehlinger; Jones & Bartlett Learning, ISBN 978-1-284-05783-6
- Variable original publications depending on the project given.
- Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request.
- On the other hand it is part of the seminar that students have to search for appropriate information and to develop different information acquisition strategies.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Practical laboratory work-preparation of experiment, performance, discussion, time management (50%)
- Presentation and discussion in the seminar; duration depends on the topic (25%)
- Lab report (including title, abstract, introduction, methods and materials, results, discussion, conclusion, and references; 15-20 pages) (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course The module takes place as a 6 week block course.
Module Components	• Lab Course "Molecular Biology: Principles, Methods and Applications" • Seminar "Molecular Biology: Principles, Methods and Applications"
Components to be offered in the Current Semester	**210413** Practical training Molecular Biology: Principles, Methods and Applications - 7 Hours per Term **210415** Seminar/Practical training Molecular Biology: Principles, Methods and Applications - 1 Hours per Term

Module 11795 Immunology

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11795	Mandatory

Modul Title	**Immunology** Immunologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Roggenbuck, Dirk
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	At the end of the module, the students are able to create a common understanding of immune responses and their relevance regarding the protection against pathogens. They are able to evaluate cellular and humoral immune mechanisms and to understand and apply immunological tools in diagnostics and therapy. Further, they are able to analyze the main molecular mechanisms of an immune response in the context of pathophysiological processes in immune-mediated disorders. Students are able to evaluate immunological markers within the differential diagnosis of immune-mediated diseases.At the end oh the module students can explain and apply scientific principles as well as specialised and in-depth knowledge. They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	• History of immunology • Innate immune system • Specific acquired immunity • Basic immune protection systems – complement • Dendritic cells and antigen presentation • Apoptosis • Structure and function of antibodies • B-cells and antigen recognition • HLA system – membrane receptors for antigen presentation • T-cells – development and functions • Cytokines • Immune responses • Clinical Immunology – allergy and autoimmunity

Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Immunology, 13th edition, P.J.Delves, S.J. Marting, D.R. Burton, I.M. Roitt, Wiley-Blackwell, corresponding web site with interactive questions, podcasts and videos • Cellular and molecular Immunology: with Student consult online access, 7th edition, A.K. Abbas, A.H. Lichtman, S. Pillai, Elsevier
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Immunology" • Seminar "Immunology" • Examination "Immunology"
Components to be offered in the Current Semester	**210020** Lecture Immunology - 2 Hours per Term **210025** Seminar Immunology - 1 Hours per Term **210028** Examination Immunology

Module 12767 Point of Care Diagnostic

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12767	Mandatory

Modul Title	**Point of Care Diagnostic** Point-of-Care-Diagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. Dame, Gregory
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The module teaches the basics of point of care diagnostics / point of care analysis, molecular diagnostics, biochip technology and their techniques. The students will be able to explain the term point of care testing using concrete examples and are introduced in scientific thinking. The module teaches special abilities and knowledge in the field of bioanalytics for biotechnologically and biochemically oriented students.After successful participation in the module students are able to explain and apply scientific principles as well as specialised and in-depth knowledge. -They can develop independent ideas and concepts to solve scientific and professional problems.
Contents	In the lecture different bioanalytical detection techniques will be presented, whereby the biosensorics occupy a partly higher importance. Important combinations of biomolecules with sensors and their bioanalytical application are discussed. On the basis of practice-relevant examples, the development of individual biosensors will be presented, as well as their limitations and solutions for optimization discussed. Other topics include biochip technology, molecular diagnostics, point of care testing (POCT), on-site analysis and nanobiotechnology. • Enzymatic sensor concepts and selected examples (glucose oxidase enzyme electrode) • DNA Sensors • Immunosensors • Cell-based biosensors • In vivo Biosensors

- Disposable biosensors in point-of-care applications: concepts and fabrication
- Clinical applications: blood gas analyses, coagulation diagnosis, cardiovascular diseases

Current publications in the field of point-of-care diagnostics and on-site analysis will be presented and discussed with regard to a point-of-care application.

Recommended Prerequisites

none

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

POCT-Patientennahe Labordiagnostik, P. Luppa, R. Junker (eds), ISBN 978-3-662-54195-1, ISBN 978-3-662-54196-8 (ebook)

Publications:
- Khan et al, Diagnostics 2017, 7, 39; doi: 10.3390/diagnostics7030039
- Krampa et al., Diagnostics 2017,7, 54; doi: 10.3390/diagnostics/7030054
- Mashamba-Thompson et al, Diagnostics 2016,6,31;doi: 10.3390/diagnostics6030031

Module Examination

Final Module Examination (MAP)

Assessment Mode for Module Examination

Written Examination (120 min)

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course
- Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

"Responsible Staff Member"

1. Prof. Frank Hufert (no)
2. Dr. Gregory Dame (no)

Module Components

- Lecture "Point of Care Diagnostic"
- Seminar "Point of Care Diagnostic"
- Examination "Point of Care Diagnostic"

Components to be offered in the Current Semester

210040 Lecture
Point of Care Diagnostic - 2 Hours per Term
210045 Seminar

Point of Care Diagnostic - 1 Hours per Term
210048 Examination
Point of Care Diagnostic

Module 12768 Introduction to Laboratory Diagnostics

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12768	Mandatory

Modul Title	**Introduction to Laboratory Diagnostics** Einführung in die Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The aim of the module is to familiarize students with the concepts of laboratory medicine, which focus on screening, diagnosis, risk assessment and therapy monitoring and include tools for routine laboratory diagnostics. In lectures that introduce the basics of laboratory medicine, students are enabled to understand the concept and principles of laboratory medicine. Subsequently, the students will deepen their knowledge of pathophysiology and pathobiochemistry of diseases with a view to characterising the diseases using laboratory medical instruments. In lectures, students learn the methodology of the analytical tools commonly used in laboratory medicine and discuss selected methods in seminars to deepen their understanding. The student learns the specific analytical tools focused on related diseases and students should be able to select analytical tools related to screening, risk assessment, diagnosis and monitoring. Upon completion of the module, students should be able to interpret analytical results for disease screening, risk assessment, diagnosis and monitoring and discuss the results with the applicant. Students should be able to understand and work with the scientific literature of laboratory medicine. Students should be able to design and interpret their own studies of laboratory medicine. A special aspect will be the area of personalised medicine. Personalised medicine distinguishes itself by classifying individuals on the basis of information about genetic, molecular and cellular properties in order to define individual therapies. It comprises products and services based on biomarker-based diagnostics and therapy for small patient groups. The students learn about personalised medicine ideas and learn how

	medical progress can lead to the scientific and technical development of new diagnostics and therapies, especially on the basis of genome and post-genome research.
Contents	• Introduction to laboratory medicine: • Laboratory medicine with emphasis on specific metabolism (lipids, nucleic acids, proteins, trace elements) • Laboratory medicine with focus on specific systems (immune system, exocrine system, endocrine system, neoplasia) • Laboratory medicine with emphasis on specific organs (liver and bile ducts, intestines, kidneys and urinary tract) • Development of strategies for personalized medicine • Definition of a biomarker, definition of biomarker panels • Comparison of strategies of personalised medicine with conventional medicine
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Will be announced during the lecture.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	re-examination oral (30 min)
Module Components	• Lecture "Introduction to Laboratory Diagnostics" • Seminar "Introduction to Laboratory Diagnostics" • Examination "Introduction to Laboratory Diagnostics"
Components to be offered in the Current Semester	**210968** Examination Introduction to Laboratory Diagnostics

Module 12797 Methods in Laboratory Diagnostics

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12797	Mandatory

Modul Title	**Methods in Laboratory Diagnostics** Methoden der Labordiagnostik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities The students are involved in the latest developments in the field of laboratory medicine. Students learn how to use modern technical laboratory diagnostic equipment. Students learn how to plan a strategy for developing a new diagnostic assay or diagnostic instrument. Students will work on and validate aspects of assay or instrument development in practice.
Contents	On the basis of the available literature and publications of the research group, the students design protocols for assay or instrument development, which are discussed in the seminar. The students work mainly in the fields of nucleic acid detection, autoimmunity, infection serology and tumor diagnostics. Mainly cell or microbead-based assays are developed. The students carry out their practical work under the supervision of the members of the research group and are integrated into the current research work of the working group.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:

	Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	Current scientific literature of the own research group and generally accessible literature on the respective subject area.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (30%) • Presentation and discussion in the seminar, duration depends on the topic (25%) • Presentation of results (25%) • Oral Test, duration: 15 min (20%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Laboratory Diagnostics" • Seminar "Methods in Laboratory Diagnostics"
Components to be offered in the Current Semester	No assignment

Module 12798 Methods in Bioanalytics

assign to: Mandatory Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12798	Mandatory

Modul Title	**Methods in Bioanalytics** Methoden in der Bioanalytik
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. PD Dr. rer. nat. habil. Rödiger, Stefan
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	First the students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays (incl. analysis of DNA damage upon treatment with single (etoposide) and multiple chemotherapeutic substances, FISH to asses genomic alterations of cancer cells). In particular, the cell assays have relevance in precision medicine and pharmacology/pharmaceutical research. Furthermore, they broaden their methodological background in analysis, interpretation and reporting of lab data by different methods used in applied statistical bioinformatics, forensics, pharmaceutical research and precision medicine. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to present and discuss the experimental results train additional soft skills like the ability to communicate orally to individuals and groups and to tailor the oral communication to the level and experience of the audience. The students use appropriate scientific open source software (incl. R statistical computing language, Python general purpose programming language), graphics, and other tools to clarify complex information. The analysis of the data includes methods used in applied statistical bioinformatics and bioanalytical pharmacology. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	• Sterile working technique, media preparation • Routine maintenance of cell lines: Medium replacement, subculture of adherent cells

- Cryopreservation: Freezing and thawing of cells
- Contamination control: Microscopical observation, etc.
- Characterization of human (tumor) cells or cell lines
- Morphology: microscopy of cells
- Proliferation: Growth curve, population doubling-time
- Testing of (mouse monoclonal) antibodies ((m)Ab). Immunocytochemistry and immunochemistry with (m)Abs
- Comparison of different cell assays e.g. gamma H2AX-Assays and FISH assays
- Assesment of the effect of chemoterapeutic substances

Contents of the seminar:

Deepening the knowledge of the methods used in the labcourse. Methods in applied statistical bioinformatics, literate programming and report generation (Remarkdown or Jupyter notebook).

Recommended Prerequisites

Basic knowledge in Cell biology, Biochemistry, applied biostatistics and bioinformatics.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications; 2010
- Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008
- Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011
- Logan, M., Biostatistical Design and Analysis Using R: A Practical Guide. 2010
- Selvin, S., 1998. Modern Applied Biostatistical Methods: Using S-Plus, Monographs in Epidemiology and Biostatistics. Oxford University Press, Oxford, New York.
- Lee, J.K., 2010. Statistical Bioinformatics: For Biomedical and Life Science Researchers. Wiley.
- Sencar, H.T., Memon, N. (Eds.), 2013. Digital Image Forensics. Springer New York, New York, NY. https://doi.org/10.1007/978-1-4614-0757-7
- National Research Council (US) Committee on A Framework for Developing a New Taxonomy of Disease, 2011. Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease, The National Academies Collection: Reports funded by National Institutes of Health. National Academies Press (US), Washington (DC).

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	<div id="meta-origin" data-coolorigin="https%3A%2F%2Fwww.b-tu.de%2Forgcloud%2Fapps%2Frichdocumentscode%2Fproxy.php%3Freq%3D%2Fcool%2Fclipboard%3FWOPISrc%3Dhttps%253A%252F%252Fwww.b-tu.de%252Forgcloud%252Findex.php%252Fapps%252Frichdocuments%252Fwopi%252Ffiles%252F9418674_ochtzup9yafk%26ServerId%3Dde63ef99%26ViewId%3D7%26Tag%3D0de54f906567e99d"> <p>Laboratory Work – design, execution, in–lab discussion, and time management (55 %) <p>Presentation & Discussion (Journal Club of a Research Paper) - each student selects one current research paper from the field of bioanalytics; 15–minute presentation followed by a 10–minute group discussion (15 %) <p>Written Tests – 3 separate tests (each 30 min.),(15 %) <p>General knowledge about Methods in Bioanalytics and related topics <p>Knowledge of statistical bioinformatics and associated methods <p>Lab–course–specific content <p>Presentation of Lab–Course Results – two components (15 %) <p>Lab report (10 pages) produced from a reproducible document (e.g., Quarto, RMarkdown), due at the end of the course <p>Oral presentation using that reproducible document: 10 minutes for the presentation followed by a 10–minute group discussion <p class="western">
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Bioanalytics" • Seminar "Methods in Bioanalytics"
Components to be offered in the Current Semester	No assignment

Module 12799 Molecular Biology: Principles, Methods and Applications

assign to: Mandatory Modules

Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12799	Mandatory

Modul Title	**Molecular Biology: Principles, Methods and Applications** Molekularbiologie: Grundlagen, Methoden und Anwendung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. med. vet. Schierack, Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	It is the aim of this laboratory course to provide basic molecular biology techniques in the first place. Students should experience isolation and manipulation of DNA and RNA in a way that they understand the underlying principles of these fundamental methods. In a second step, students have to learn different techniques used to transfect pro- and eukaryotic cells as these are important methods in biotechnology. Therefore, the course provides the complete scenario from the preparation of DNA up to the functional analysis of different expression plasmids. Third, students will become familiar with viruses, as these biological agents are important "work horses“ in different areas of molecular biology. Working with microbeads to detect nucleic acids and proteins in a multiplex format provides the opportunity for state of the art bioanalytical methods. This part is complemented by genome editing experiments. Students will get in touch with a state of the art complex methodology and get hands-on experience. The seminar has the task of broadening the theoretical basis of the methods used in the practical course. Presentations and enhanced discussions will provide the stage for a fruitful enhancement of molecular biology knowledge. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to train their practical lab skills and generic competences as they have to solve scientific problems.

All these projects require search and understanding of relevant scientific literature, design of experimental protocols, documentation and a critical discussion of results.

Contents

Students will isolate expression vector DNA using different protocols and reagents and will later on compare the influence of these different procedures on transfection efficiency again applying different gene transfer methodologies. Here the students will perform the complete set of steps necessary for eukaryotic cell transfection. These experiments form the basis for the central part of the course the genome editing. Students will use the CRISPR/Cas system to induce genome mutations and create site directed specific sequence alteration. The analysis of the cell physiological effects of these editings will be performed using cell culture experiments. In addition little projects will be given to students including the following methods: coupling of nucleic acids and proteins to fluorescence coded microbeads: detection of the protein targets by antibody detection; nucleic acids are detected on the bead surface via hybridization or PCR; expression and purification of recombinant proteins; design of primers for qPCR, PCR and PCR based cloning. Because the master course is integrated into the scientific research of the group experiments will be adapted accordingly.

Recommended Prerequisites

none

Mandatory Prerequisites

- 12797 *Methods in Laboratory Diagnostics*
- 12798 *Methods in Bioanalytics*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- iGenetics: A Molecular Approach. Peter J. Russell. ISBN 10: 0805346651
- Molecular Biology of the Gene. James D. Watson, Tania A. Baker, Stephen P. Bell et al. ISBN-13: 9780321507815
- Molecular biotechnology / by Carolyn A. Dehlinger; Jones & Bartlett Learning, ISBN 978-1-284-05783-6
- Variable original publications depending on the project given.
- Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request.
- On the other hand it is part of the seminar that students have to search for appropriate information and to develop different information acquisition strategies.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Practical laboratory work-preparation of experiment, performance, discussion, time management (50%)
- Presentation and discussion in the seminar; duration depends on the topic (25%)
- Lab report (including title, abstract, introduction, methods and materials, results, discussion, conclusion, and references; 15-20 pages) (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course The module takes place as a 6 week block course.
Module Components	• Lab Course "Molecular Biology: Principles, Methods and Applications" • Seminar "Molecular Biology: Principles, Methods and Applications"
Components to be offered in the Current Semester	**210413** Practical training Molecular Biology: Principles, Methods and Applications - 7 Hours per Term **210415** Seminar/Practical training Molecular Biology: Principles, Methods and Applications - 1 Hours per Term

Module 11825 Tissue Engineering

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11825	Compulsory elective

Modul Title	**Tissue Engineering** Entwicklung und Kultivierung von Geweben
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	• Explain and apply fundamental scientific principles as well as advanced, specialized knowledge in tissue engineering and regenerative medicine. • Describe the basic structure of tissues and analyze interactions between cells and the extracellular matrix. • Explain key developmental processes in mammals and relate them to tissue engineering strategies. • Identify and explain the core components of tissue engineering, including cells, signaling molecules, biomaterials, bioreactors, and three-dimensional (3D) cell culture systems. • Distinguish between different cell-based therapies and evaluate their roles as therapeutic concepts in regenerative medicine. • Analyze and discuss 3D cell culture approaches and evaluate their relevance for tissue engineering, disease modeling, toxicology and pharmacology and translational research.

	• Develop independent ideas and concepts for solving scientific problems related to tissue engineering.
Contents	• Basic organisation of tissues: Cells and extracellular matrix (ECM)
	• ECM: Molecular structure & function • Cell-ECM Interaction
	• Cell-Cell interactions • Cellular Development and Fate Decisions (Proliferation, migration, determination, differentiation, cell-cell & cell-matrix interaction, apoptosis)
	• Cells Sources for Tissue Engineering: stem cells, differentiated cells from adult tissues, problem of donor-recipient cell transfer
	• Wound healing as a Natural Model of "Tissue Engineering": Inflammation, tissue formation, tissue remodelling
	• Cell based therapies: Principles and Applications
	• 3D Cell Cultures Systems: Principles and Applications
Recommended Prerequisites	Basic knowledge in cell biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015 • Cell and Molecular Biology. Concepts and experiments. Karp G., John Wiley & Sons, 2008 • Principles of Tissue Engineering, Lanza R. P. et al., Academic Press, 2nd edition 2000 • Methods of Tissue Engineering, Anthony Atala, Robert P. Lanza (eds.), Academic Press, New York, 2002 • Tissue Engineering, Clemens van Blitterswijk (senior editor), Elsevier, Amsterdan,Boston, Heidelberg, … (2008) • Functional Tissue Engineering, Farshid Guilak, David L. Butler, Steven A. Goldstein, David Mooney, C. MacLachlan, Springer, New York, Berlin, 2003 • Specific original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded

Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Tissue Engineering" • Seminar "Tissue Engineering" • Examination "Tissue Engineering"
Components to be offered in the Current Semester	**210728** Examination Tissue Engineering

Module 11858 Proteostasis

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	11858	Compulsory elective

Modul Title	**Proteostasis** Proteostase
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	Proteostasis is a concept to summarize the contributions of protein synthesis, folding, modification, trafficking and degradation to steady state maintenance and dynamics of proteomes in cells. Major aim of the module is to deepen mechanistic knowledge in protein structure and function and the contributions of aforementioned processes during regulation of cellular homeostasis. The topic requires confrontation with complexity of living systems and scientific terminology. The consideration of mechanistic details of cellular processes should deepen the comprehension of important principles as foundations of cellular homeostasis and molecular pathology. Based on a mechanistic understanding of cell biological and molecular processes within the concept of protostasis, students are invited to contribute with their future work to progress in the understanding of the molecular pathology, diagnostics and therapy of human diseases (e.g. neurodegeneration, cancer, aging). Apart from these specific topics one major idea of the lecture is to enlighten the philosophy behind the scientific method. Historical milestones during the discovery of proteolytic systems involved in cell cycle control, apoptosis and cell survival signalling pathways, illustrated with original papers and reviews exemplifies deductive strategies and causality within scientific philosophy. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions.
Contents	Central topic of the module are cellular and molecular processes shaping the functionality of cellular proteomes. Protein synthesis,

	protein folding and misfolding, protein modification, subcompartimental localization and degradation are interconnected topics central to the understanding of molecular cell biology. The unique feature of this module is to look at these processes from the perspective of distinct proteolytic systems such as ubiquitin-dependent and independent proteasomal proteases, lysosomal proteases in autophagy, or caspases in apoptosis and inflammation and generally protease in antigen processing. Firstly, basics in protein biochemistry as well as technologies to analyze steady state and turnover of proteins are discussed. Next, the enzymology of proteases (protease families and mechanisms, inhibitors, diseases and therapy), proteolytic systems and protein modifications is a specific focus of this module. While considering complex proteolytic systems such as those of autophagy, apoptosis and the ubiquitin proteasome system, the module connects the topic of proteostasis specifically with cell survival signaling as exemplified by NFkB or p53 pathways, cell cycle regulation or apoptotic/inflammatory pathways. While emphasizing the role of proteases for cellular homeostasis, peptide generation as a principle of antigen processing should not be neglected. Hence, the discussion of MHC class I and class II pathways demonstrates the roles of proteolytic systems for the immune response.
Recommended Prerequisites	Basic level in biochemistry, cell biology and molecular biology
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	As a starting point textbooks of molecular cell biology and protein biochemistry are recommended: • Alberts, Johnson, et al. (2008) Molecular Biology of the Cell, 5th Edition (or newer) Garland Science • Nelson, Cox (2008) Lehninger Principles of Biochemistry 5th Edition • Lodish, Berk, et al. (2008 or later). Molecular biology of the cell 6th Edition, W.H.Freemann and Company Reviews as starting point: • Klaips, C.L., Jayaraj, G.G. and Hartl, F.U. (2017). Pathways of cellular proteostasis in aging and disease. J. Cell Biol. http://doi.org/10.1083/jcb.201709072
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none

Module Components	• Lecture "Proteostasis" • Seminar "Proteostasis" • Examination "Proteostasis"
Components to be offered in the Current Semester	**210238** Examination Proteostasis

Module 12175 Molecular Dynamics of the Cell

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12175	Compulsory elective

Modul Title	**Molecular Dynamics of the Cell** Molekulare Prozesse in Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The overall aim of the Module is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected. The lecture focuses on molecular processes that connects DNA damage signalling with cell cycle arrest, DNA repair or apoptosis. Furthermore, the student learns about the dynamics of a particular important cell types, the hepatocyte. Based on a profound understanding of molecular processes, the students will also better understand the molecular pathology of human diseases (e.g. cancer) which occur if there is a defect in one of these processes. Understanding the etiology of such diseases is the prerequisite for specific and effective therapies. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).
Contents	The lecture contains the following topics: • Molecular biology of eucaryotic DNA replication as a prerequisite to understand DNA damage signaling and DNA repair • Spectrum of DNA damages • DNA damage signaling: Molecular DNA damage sensors such as ATM and DNA-Pk, mediators, transducers/ effectors and cellular genotoxic responses such as apoptosis or cell cycle arrest, resp.; human diseases by defects in DNA damage signaling • Human DNA repair pathways: Direct DNA repair, Mismatch Repair, Base- & Nucleotide Excision Repair, Recombination Repair; defects

	in repair pathways leading to defined diseases or syndromes, their specific diagnostics and molecular strategies for therapies if possible • Molecular Dynamics of hepatocytes
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	none
Module Components	• Lecture "Molecular Dynamics of the Cell" • Seminar "Molecular Dynamics of the Cell" • Examination "Molecular Dynamics of the Cell"
Components to be offered in the Current Semester	**211018** Examination Molecular Dynamics of the Cell

Module 12762 Signal Transduction

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12762	Compulsory elective

Modul Title	**Signal Transduction** Signaltransduktion
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Understanding inter- and intracellular communications is essential when working in life science. Although the complexity of the issue makes the subject almost unmanageable there exist general principles and types of molecules that play a key role in signal transduction. A profound knowledge of these provides the basis to look into any kind of pathway successfully. In addition to understand the concepts it is of the same value to also know key experimental approaches that are applicable to elucidate signal transduction components and networks. It is therefore the aim of the lecture to develop an understanding not only of key signaling pathways (professional competences) but also of the experimental methodology used to study signal transduction in the lab. Summary: At the end of the module students are able to remember general mechanisms and understand the relevant scientific literature. They are able to apply the knowledge to design and perform own experiments. They can analyze and evaluate the data they obtain and should be able to create various new approaches to study and work in the field of signal transduction.
Contents	Due to the importance and the basic student knowledge of G-protein coupled receptors (GPCR) general aspects of ligand-receptor interaction, receptor activation and desensitization are discussed focusing on this subject. The importance of protein translocation and modification is underlined and explained using several examples. Within the same context binding experiments and the analysis of agonists and antagonist are explained. Using the GPCR topic a complete “story” is developed starting with ligand affinity down to the FRET-based

	methods of measuring receptor activation and inactivation. Students understanding is challenged by questions concerning the outline and the execution of relevant experiments to make clear that in general very similar approaches are used to study completely different signaling pathways. Emphasis is placed on experiments based on knock-down, knock-out, overexpression and inhibitors. A seminar is offered to deepen the understanding of the contents of the lecture and to prepare the students for their "working" with current scientific studies. <u>Membrane Receptor mediated</u> • G-protein coupled • Enzyme based (i.e. Receptor Tyrosine Kinase, JAK/STAT, TGFbeta) • Cytokine classes I-IV • Ion channels • Special pathways (Wnt, Hedgehog, Notch, Cholesterol) <u>Non-membrane receptor mediated</u> • Nitric oxide (NO) pathway • Steroid hormone receptors
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Textbook: Signal Transduction, IJisbrand M. Kramer, AP • Signal Transduction Knowledge Environment (stke.sciencemag.org) • Recent original scientific publications
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Signal Transduction" • Seminar "Signal Transduction" • Examination "Signal Transduction"
Components to be offered in the Current Semester	**210460** Lecture Signal Transduction - 2 Hours per Term **210465** Seminar Signal Transduction - 1 Hours per Term

210468 Examination
Signal Transduction

Module 12763 Enzyme Technology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12763	Compulsory elective

Modul Title	**Enzyme Technology** Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The use of catalysts, and particularly of their biological version (enzymes), has recently been the subject of increased debate in research, technology and environmental policy. Enzyme technology is regarded as a key technology for a sustainable future; it renders possible the manufacturing of innovative products (e.g. pharmaceuticals, fine chemicals, flavors, food and feed ingredients) and opens new doors for the application of biological agents in chemical processes, which leads to positive environmental effects and energy savings. Enzyme technology has a great potential for breaking down the boundaries between individual scientific disciplines (biotechnology, chemistry, microbiology, etc.) and between fundamental and applied research. Aims of this teaching unit are - to provide a basic knowledge of relevant protein structures, to acquire an understanding of the principles by which enzymes catalyse biochemical reactions, and - to provide a comprehensive overview of enzyme applications to introduce economic and sustainable goals associated with enzyme technologies, historical background and modern approaches of enzyme application (e.g. nanobiotechnology, biofuels, protein production, extremophiles, biopharmaceutical production, microbial natural products). For students the lecture and seminar will provide an understanding of scientific principles and will provide practice of advanced white biotechnology (professional competences) and its exploitation in commercial practice (methodic competences) for get individual orientation skills e.g. concerning an career as scientist, PhD studend or to understand how to create and manage a biotech business).

Contents	An instructive and comprehensive overview of the current enzyme applications in the so-called White, Red and Green Biotechnology. Basic Tools: Biocatalysts, Advantages & Disadvantages of Enzyme Processes, Aspects of Enzyme Application, Protein Structure, Enzyme Classification, Enzyme Kinetics, Sources of Enzymes, Search and Screening for New Biocatalysts, Protein Engineering, Enzyme Production, Advanced Tool: Enzymes in Food Industry (e.g. Baking, Brewing, Dairy, Saccharification), Enzymes in Non-Food Applications (e.g. Detergents, Pulp and Paper, Textile Industry), Enzymes in Chemical Production Processes (Organic Synthesis, Chiral Molecules, Drugs), Perspectives of Enzyme Exploration and Application, Current Research Activities (e.g. National and European Research Programs), New/Own Research Activities (e.g. Fungal Oxidoreductases for Industrial Processes, Biocatalysts for Refinement of Renewable Polymers) Scientific Seminar: present and discuss published current experimental findings and contemporary issues
Recommended Prerequisites	Multidisciplinary cross section require basic knowledge in biochemistry, microbiology, molecular biology, chemistry and engineering sciences.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	• Hofrichter, M., K. Esser, The Mycota: Industrial Applications, 2010, Springer-Verlag Berlin Heidelberg • Fessner, W., Anthonsen, T.: Modern Biocatalysis, 2008, Wiley-VCH, Weinheim • Illanes, A.: Enzyme Biocatalysis, Principles and Application, 2008, Springer • Liese, A., Seelbach, K., Wandrey, C, Industrial Biotransformations, 2006, Wiley-VCH, Weinheim • Buchholz, K., Kasche, V., Bornscheuer, U. T., Biocatalysts and Enzyme Technology, 2005, Wiley-VCH, Weinheim • Bommarius, A.S., Riebel, B.R.: Biocatalysis, Fundamentals & Application, 2004, Wiley-VCH, Weinheim • Aehle, W., Enzymes in Industry, 2004, Wiley-VCH, Weinheim Several current publications e.g.: • Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677). • Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).

	• Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Module Examination	Prerequisite + Final Module Examination (MAP)
Assessment Mode for Module Examination	• Requirements: Successful participation at the seminar including a 30 min presentation and 15 min discussion. • Final written examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	The module is only offered in the winter semester.
Module Components	• Lecture "Enzyme Technology" in winter semester • Seminar "Enzyme Technology" in winter semester • Examination "Enzyme Technology"
Components to be offered in the Current Semester	**211110** Lecture Enzyme Technology - 2 Hours per Term **211115** Seminar Enzyme Technology - 1 Hours per Term **211118** Examination Enzyme Technology

Module 12764 Synthetic Microbiology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12764	Compulsory elective

Modul Title	**Synthetic Microbiology** Synthetische Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	The "Synthetic Microbiology" module promotes the interactive work and learning of the participating students by combining different teaching disciplines such as a lecture series, a seminar and a practical course. The ability of the students to work in teams will be stimulated by discussing current literature in the context of the lecture content. After successfully completing the module, the students will have acquired competences in terms of self-organization and communication skills in addition to the acquired specialized scientific knowledge. Moreover, the use of a correct scientific language for communication and the presentation of scientific data will be trained.
Contents	After an introduction to the microbial world, the course will provide an overview of the diversity, structure, and functioning of microbial communities. Particular emphasis will be placed on understanding microorganisms as members of complex and dynamic communities rather than as isolated organisms. Students will learn how microbial interactions shape community composition, stability, and function, and how these interactions influence ecosystem processes in environmental, agricultural, and host-associated habitats. The lecture series will introduce the principles and methodologies used to investigate microbial communities, including cultivation-dependent and cultivation-independent approaches, high-throughput sequencing technologies, and multi-omics methods. Concepts for the characterization of microbial diversity, community structure, microbial

interactions, and community function will be presented, together with approaches for the analysis and interpretation of microbiome data.

Furthermore, the course will explore the ecological and biotechnological relevance of microbiomes and discuss how microbial communities contribute to ecosystem functioning, human and environmental health, and sustainable biotechnological applications. Building on this knowledge, students will be introduced to emerging concepts in synthetic microbiology, including the design, engineering, and manipulation of microbial communities for specific functions.

Recommended Prerequisites

Basic knowledge in genetics, microbiology, biochemistry and molecular biology.

Mandatory Prerequisites

none

Forms of Teaching and Proportion

Lecture - 2 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 105 hours

Teaching Materials and Literature

Teaching material such as lecture slides and study questions as well as the relevant literature will be provided to the students *via* a the moodle learning platform.
Recommended scientific literature:

- Juhas *et al.* 2014. *Bacillus subtilis* and *Escherichia coli* essential genes and minimal cell factories after one decade of genome engineering. *Microbiology.* 160: 2341-2351.
- Reuß *et al.* 2016. The blueprint of a minimal cell: *MiniBacillus*. *Microbiol Mol Biol Rev.* 80: 955-987.
- Hutchison *et al*. 2016. Design and synthesis of a minimal bacterial genome. *Science* 351: aad6253.
- Reuß *et al.* 2017. The contribution of bacterial genome engineering to sustainable development. *Microb Biotechnol*. 10: 1259-1263.
- Reuß *et al.* 2017. Large-scale reduction of the *Bacillus subtilis* genome: Consequences for the transcriptional network, resource allocation, and metabolism. *Genome Res.* 27: 289-299.
- Brock Biology of Microorganisms, 15th edition, 2019, Pearson. ISBN.10: 1292235101.
- Microbes and evolution - The world that Darwin never saw. Essays on microbes and evolution. 2012. ASM press.ISBN: 978-1-55581-540-0.

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

The final module grade is composed of a written module examination (60%) and a continuous assessment component (40%).

Written Module Examination (60%)

Written examination (90 minutes).

Continuous Assessment (40%)

The continuous assessment component consists of three practical data analysis assignments and one oral presentation.

Students will complete three practical exercises covering key aspects of microbiome data analysis. Each exercise will involve the analysis of a provided dataset using R and the submission of a short report (2–3 pages) summarizing the analytical approach, results, and interpretation. Topics may include microbial community composition, diversity metrics, ordination methods, statistical analysis, data visualization, and the ecological interpretation of microbiome data.

The results of the assignments will be presented in a short oral presentation (15 minutes) followed by a discussion and questions (10 minutes).

Weighting of the Continuous Assessment:

- Practical assignments (three reports): 20%
- Oral presentation and discussion: 20%

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

none

Remarks

none

Module Components

- Lecture "Synthetic Microbiology" only in summer semester
- Seminar "Synthetic Microbiology" only in summer semester
- Examination "Synthetic Microbiology"

Components to be offered in the Current Semester

210130 Lecture
Synthetic Microbiology - 2 Hours per Term
210136 Seminar
Synthetic Microbiology - 1 Hours per Term
210138 Examination
Synthetic Microbiology

Module 12765 Nanobiotechnology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12765	Compulsory elective

Modul Title	**Nanobiotechnology** Nanobiotechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	5
Learning Outcome	The goal of the course is to provide a systematic description of nanotechnolgy-driven techniques and approaches that are relevant in biotechnology. By the end of the course, students will be able to (1) explain physical principles governing biological systems at the nanoscale, (2) compare relevant (single-molecule) techniques and evaluate their possibilities and limitations, (3) interpret experimental and computational data, (4) design (thought) experiments to probe biomolecules and their interactions, (5) critically analyze primary literature, and (6) asses the translational potential of the discussed techniques. Short talks will enable students to present state of the art developments with the overall aim to encourage the development of independent ideas and concepts to solve scientific and societal challenges.
Contents	Nanobiotechnology explores biological processes at the nanometer scale and develops technologies to measure, manipulate, and engineer individual biomolecules and ensembles thereof. After introducing the term nanobiotechnology and discussing the physical principles relevant at the nanoscale, the course will introduce key concepts in detection, manipulation, and utilisation of biomolecules. A focus will be set on fluorescence-based, single-molecule detection schemes and the use of RNA/DNA nanotechnology that, taken together, let to breakthroughs in next-generation sequencing technologies and diagnostics. Students will learn, how nanoscale tools reveal hidden biological heterogeneity and how these discoveries can be translated into clinical and industrial innovations.

	The course further includes lectures on (1) (super-resolution) optical microscopy and live-cell imaging, (2) nanoparticles/fluorescent probes and their applications in biology and medicine, (3) applied surface science and nano/micro fluidics (including the basics of surface electrostatics, methods of surface analysis, self-assembled monolayers, covalent immobilization of biomolecules), (4) affinity biosensors (surface plasmon resonance and field-effect biosensors), (5) model lipid systems (liposomes, lipid monolayers, planar lipid bilayers), (6) DNA and nanopore technology. Additionally, the theoretical course includes short presentations of students and subsequent discussions on recent topics of nano(bio)technology, for example: DNA-origami, single-molecule kinetics, self-assembly, etc.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Science.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	In addition to the provided lecture scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	
Module Components	• Lecture "Nanobiotechnology" • Seminar "Nanobiotechnology" • Examination "Nanobiotechnology"
Components to be offered in the Current Semester	**210818** Examination Nanobiotechnology

Module 12766 Bioprocess Development

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12766	Compulsory elective

Modul Title	**Bioprocess Development** Entwicklung von Bioprozessen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Dr. rer. nat. Hansen, Barbara
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	After participating in the module, students are able to apply the basics of heat and mass transport, bioreaction technology to biotechnological processes.
Contents	Use of living cells for the planning and implementation of a process, the development of process control and processing methods for the products, the control of production processes and their continuous optimization.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 105 hours
Teaching Materials and Literature	Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; 2010
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none

Remarks	No offer from WiSe 2024/25!
Module Components	• Lecture "Bioprocess Development" • Seminar "Bioprocess Development" • Examination "Bioprocess Development"
Components to be offered in the Current Semester	No assignment

Module 12769 Molecular Biotechnology and Society

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12769	Compulsory elective

Modul Title	**Molecular Biotechnology and Society** Molekulare Biotechnologie in der Gesellschaft
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	6
Learning Outcome	This highly interdisciplinary lecture should demonstrate the students that many recent biotechnological developments do not only influence scientific fields, but can also have a clear-cut impact on the whole society. The students learn about biotechnological fields which are relevant for political & ethical issues, medical issues and economical issues, i.e. emerging biotechnological industries. Since biotechnology is a rather broad field, the lecture highlights some “prominent” examples. The lecture is called “Molecular Biotechnology” because of its further focus on molecular principles used in the presented biotechnological fields. For each biotechnological topic, the molecular basics are presented followed by presentation of their respective influences on politics, medicine and / or economy. If applicable, the lecture also covers some basics on relevant “Biotech” laws. The students should learn that although the awareness and knowledge of Biotechnology in society is quite low, it definitely is a key technology of the 21th century influencing many aspects of life. In addition, the students should obtain a deep understanding of the molecular principles presented in the lecture to be competent for future discussions outside the University. In addition to specialized knowledge (professional competences), the students will train social competences because of being stimulated for contributions and critical discussions. Methodical competences are developed as well because students have to use different sources to collect informations and facts (e.g. text books, internet searches, peer-reviewed journals, newspapers).

Contents	The lecture starts with an introduction into the awareness of people towards biotechnology, importance of biotechnology for medicine & sustainable industry, provide examples of the biotechnological presence. In addition, the lecture contains the following topics: • Forensic DNA science, their techniques, ethical issues and their national regulations (e.g. German DNA Analysedatei) • Medical DNA screening including techniques of genetic tests, examples of single gene disorders and chromosomal disorders, regulations such as the German “Gendiagnostikgesetz” • Special lectures are provided on cell cycle regulation, **Signal Transduction**, cellular mortality/immortality and molecular carcinogenesis to provide the basis for understanding the molecular defects of the discussed diseases and their respective diagnostics. • Stem cells and cloning, including stem cell biology, therapeutic and reproductive cloning, preimplantation diagnostics and their discussions in society as well as national regulations such as the German “Embryonenschutzgesetz”. • Concepts of Personalized Medicine • Biotechnology and Global Warming: This last part of the lecture makes the focus on recent developments in biotechnology that could help to mitigate global warming
Recommended Prerequisites	none
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Seminar - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Genetik, Klug et al., Pearson Studium, 8. Auflage (2007) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed.
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course

Module Components	• Lecture "Molecular Biotechnology and Society" • Seminar "Molecular Biotechnology and Society" • Examination "Molecular Biotechnology and Society"
Components to be offered in the Current Semester	**211030** Lecture Molecular Biotechnology and Society - 2 Hours per Term **211035** Seminar Molecular Biotechnology and Society - 2 Hours per Term **211038** Examination Molecular Biotechnology and Society

Module 12771 Cells and Tissues - Culture and Evaluation

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12771	Compulsory elective

Modul Title	**Cells and Tissues - Culture and Evaluation** Zell- und Gewebekultur
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Schubert, Kristin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	• After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities • Acquire theoretical knowledge and practical experience in basic principles of cell culture techniques. • Get familiar with the morpholgy, physiology and way to work with different animal and human cell lines. • Generate awareness for the use of cells in culture (advantages and limitations). • Understand the principles as well as application of cell biological methods to characterise the main parameters of cell behaviour like proliferation, differentiation, and viability. • Engineering artificial tissues (3D-culture) using cell lines. Discriminate the special features of cells cultured in 3D and cells growing as a monolayer in a culture flask (2D-culture). • Applying advanced techniques of cell biological methods to characterise the main parameters of cell behaviour like proliferation, viability, toxicity, and differentiation. • Advanced knowledge and experience in microscopical techniques (Phase contrast, brightfield, fluorescence)
Contents	• Sterile working technique, media preparation

- Routine maintenance of cell lines: Medium replacement, subculture of adherend and suspension cells, cell counting, cryopreservation, contamination control (microscopical observation, mycoplasma screening)
- Cultivation of cells in monolayer (2D) and engineering of in vitro tissues of different cell types (3D-cell culture systems; spheroids)
- Application of special test systems to monitor proliferation, viability, and toxicity in monolayer cells
- Analyses of morphology of cells in 2D- and 3D (preparation of cryosections of spheroids, histological analyses)
- Working with different microscopic techniques: Phase contrast microscopy (basis “life cell” analyses), brightfield microscopy, fluorescence microscopy

Recommended Prerequisites

Basic knowledge in cell culture.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module
- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Culture of Animal Cells: A Manual of Basic Technique, Freshney R. I., 6th edition, Wiley-Blackwell, 2010
- Zell- und Gewebekultur. Von den Grundlagen zur Laborbank, Lindl T und Gstraunthaler G., Spektrum Akademischer Verlag, 6. Auflage, 2008
- Der Experimentator: Zellkultur, Spektrum Akademischer Verlag, 3. Auflage 2011
- Molecular Biology of The Cell, Alberts et al., 5th/6th edition, Garland Sciences, 2008/2015
- Specific original scientific publications
- Manuals (SOPs) for cell culture & cell analytics of the Lab of Prof. U. Anderer

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

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<p>Lab work: 4 experiments, performance, critical evaluation of data, time management (25%) <p>Presentation (10 min) and discussion (5 min) in the seminar, duration depends on the topic (25%) <p>Protocol: Introduction, Methods, Results and Discussion, 10-15 pages (25%) <p>Written exam, duration: 45 min (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Cells and Tissues – Culture and Evaluation" • Seminar "Cells and Tissues – Culture and Evaluation"
Components to be offered in the Current Semester	No assignment

Module 12772 Bioengineering of Animal/Human Cells

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12772	Compulsory elective

Modul Title	**Bioengineering of Animal/Human Cells** Biotechnologie mit tierischen und menschlichen Zellen
Department	Faculty GW - Faculty of Health Sciences Brandenburg
Responsible Staff Member	Prof. Dr. rer. nat. habil. Rossol, Manuela
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Students expand their professional competencies in training the skills in sterile cell culture techniques and practice the performance of special cell assays. Furthermore they broaden their methodological background in analysis, interpretation, and reporting of lab data. By working in small groups the students train also soft skills like the ability to work and communicate in a team. The special task to sum up and discuss the experimental results train additional soft skills like the ability to communicate orally and written to individuals and groups and to tailor the communication to the level and experience of the audience. The students use appropriate software, graphics, and other tools to clarify complex information. Moreover, the accompanying seminar will train methodological competencies (e.g. media skills), and soft skills like presenting special facts and data and to communicate in a group.
Contents	Culture of cells in Monolayer (2D) of different cell types (including differentiation). - culture and differentiation of macrophages and monocytes - detection and visualization of inflammasome activation - microscopy of blood smears and immune organs - culture and differentiation of myogenic cells - functional analysis of specific genes in myogenic cells Contents of the seminar: Deepening the knowledge of the theoretical background used in the Labcourse.
Recommended Prerequisites	Basic knowledge in Cell biology and Biochemistry.

	Participation in the laboratory course *12771 - Cells and Tissues - Culture and Evaluation* is highly recommended.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Freshney, Ian: Culture of Animal Cells: A Manual of Basic Technique and Specialized A pplications ; 2010 • Lindl, Toni.; Gstraunthaler G.: Zell- und Gewebekultur. Von den Grundlagen zur Laborbank; Spektrum Akademischer Verlag, 6. Auflage, 2008 • Schmitz, Sabine: Der Experimentator Zellkultur, Spektrum Akademischer Verlag 2011 • Specific original scientific publications • Manuals (SOPs) for cell culture & cell analytics of the Labs of Prof. U. Anderer, Prof. Manuela Rossol and Prof. Julia von Maltzahn
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	weeks 1-3 (Prof. Manuela Rossol): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min, 10 pages (12.5%) • written exam, duration: 45 min (12.5%) weeks 4-6 (Prof. Julia von Maltzahn): • Lab work: 2 experiments, performance, time managment, critical evaluation of data (12.5%) • Presentation and discussion in the seminar, duration depends on the topic (12.5%) • Protocol: Introduction, Methods, Results and Discussion, min. 10 pages (12.5%) • written exam, duration: 45 min (12.5%) The duration of the presentation will be announced at the beginning of the course.
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course (split in 2 parts of 3 weeks duration each).
Module Components	• Lab Course "Bioengineering of Animal/Human Cells" • Seminar "Bioengineering of Animal/Human Cells"

Components to be offered in the Current Semester	No assignment

Module 12773 Genetic Engineering of Eukaryotic Cells

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12773	Compulsory elective

Modul Title	**Genetic Engineering of Eukaryotic Cells** Genetische Veränderung eukaryotischer Zellen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Küpper, Jan-Heiner
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	Based on practical work in the lab, the overall aim is to deepen the understanding how molecular processes in eukaryotic cells are regulated and connected, and how they can be manipulated experimentally. Practical Course: Connected to actual scientific research projects of the group, the students work on genetically manipulated mammalian cells. The students learn to analyze consequences of recombinant gene expressions on various cellular responses, being dependent on the research project into which they are integrated. Furthermore, students learn strategies to obtain specific cell types from multipotent and/or pluripotent stem cells. Seminar: The students present and discuss “classical” as well as actual literature on selected topics of the practical course. Competences acquired after successful completion of the course: In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. In addition, the students learn to perform standardized data documentation by using electronic protocols.
Contents	The practical course is integrated into actual research projects of the group and thus contents will vary during time. Generally, the following practical paths will be followed: • Culturing of cell lines and primary cells • Working with genetically engineered mammalian cells, especially with hepatocytes and cancer cells

	• Analsis of gene expressions by e.g. immunofluorescence, Western blotting, flow cytometry and / or PCR • If working on hepatocytes, liver markers such as CYP450 will be analyzed • If working on hepatocytes, conversions with drugs into metabolites and metabolite detection will be performed • Investigation of drug effects on liver and / or cancer cells by means of toxicology analysis with XTT, ATP, membrane integrity tests, apoptosis tests, proliferation analysis etc • Differentiation of multipotent and/or pluripotent stem cells into cardiomyocytes and / or hepatocytes and testing of specific differentiation protocols
Recommended Prerequisites	• 12175 *Molecular Dynamics of the Cell*
Mandatory Prerequisites	• 12771 *Cells and Tissues – Culture and Evaluation* • 12772 *Bioengineering of Animal/Human Cells*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Molecular Biology of the Gene, Watson et al., Pearson International Edition, Sixth Ed (2008) or newer ones • Molecular Biology of the Cell, Alberts et al., Garland Science, 5th edition (2008) or newer ones • Selected original scientific journal articles and reviews on the fields discussed. • Actual Version of Lab Manual & Standard Operating Procedures in Molecular Cell Biology by Prof. Küpper, BTU Cottbus-Senftenberg
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (30%) • SPresentation and discussion in the seminar, duration depends on the topic (20%) • Presentation of results (20%) • Oral Test, duration: 15 min (15%) • Electronic protocols (15%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	"Recommended Placement in the Study Plan" • Biotechnology (Master of Science, 3 Semester Version): Master 1st year course • Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course The module takes place as a 6 week block course.
Module Components	• Lab Course "Genetic Engineering of Eukaryotic Cells" • Seminar "Genetic Engineering of Eukaryotic Cells"

Components to be offered in the Current Semester	**211013** Practical training Genetic Engineering of Eukaryotic Cells - 7 Hours per Term **211015** Seminar/Practical training Genetic Engineering of Eukaryotic Cells - 1 Hours per Term

Module 12776 Eukaryotic Microorganisms/Microalgae

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12776	Compulsory elective

Modul Title	**Eukaryotic Microorganisms/Microalgae** Eukaryotische Mikroorganismen/Mikroalgen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	In the laboratory course the practical skills of the students by applying different methods for the classification and cultivation of eukaryotic microorganisms (e.g. heterotrophic marine dinoflagellates, algae-like peronosporomycetes, lower and higher fungi), for the development of culture conditions, the quantitative and qualitative analysis of cell growth, the extraction of natural substances (e.g. fatty acids, enzymes) and the analytical product identification with chromatographic methods are trained. Herein each student should isolate and determine eukaryotic microorganisms from natural sources, purify one strain and determine contents and activities by using screening techniques. The students work in small teams (2-3 persons) and coordinate the approaches/practical work between the different group members. In this way, the students improve their soft skills in terms of communication and coordination of the work flow. Additionally, the laboratory course will strengthen the students competencies in the interpretation, evaluation and presentation of lab data by summarizing the results in a final report and by an oral presentation at the end of the course. The accompanying seminar intents to train the scientific competencies of the students by searching for and presenting relevant literature focusing on the topics of the practical course.
Contents	<u>Contents of the Lab Course:</u> • preparation of labware and cultivation media • inoculation of eukaryotic microorganism cultures using culture flask/ bioreactors • monitoring of culture parameters (pH, OD, biomass dry weight, enzyme activities)

- sampling at different time points during the cultivation
- sample preparation: cell disintegration (e.g. french press), hydrolysis, dialysis, micro-/ultrafiltration, freeze-drying
- liquid extraction of lipophilic compounds (e.g. PUFA´s)
- photometric assays for the determination of protein content and enzyme activity
- protein purification using FPLC
- compound analysis with HPLC/ELSD/DAD and LCMS
- data evaluation, presentation, report

Contents of the Seminar:

- The seminar course will give a current overview to the state of the art of science in those topics and microorganisms which are in the focus of the practical course.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

Only applies to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study:
Successfull completion of module

- 12739 - *Research Internship*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

- Madigan M. T., Martinko J. M., Bender K.: Brock Biology of Microorganisms. Pearson 2018, ISBN 9781292235103
- Esser K., Hofrichter M.: The Mycota - A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research, Industrial Application X. Springer 2010, ISBN 9783642114571
- Dörfelt H., Jetschke G.: Wörterbuch der Mycologie. Spektrum 2001, ISBN 9783827409201
- Bucholz K., Kasche V., Bornscheuer U. T.: Biocatalysts and Enzyme Technology. Wiley-Blackwell, 2012, ISBN: 9783527329892

Several publications e.g.:

- Yue Jiang, Feng Chen, Shi-Zhong Liang (1996). Production potential of docosahexaenoic acid by the heterotrophic marine dinoflagellate *Crypthecodinium cohnii.* Process Biochemistry 34: 633–637
- Blackman, L.M., Cullerne, D.P. & Hardham, A.R. (2014) Bioinformatic characterisation of genes encoding cell wall degrading enzymes in the Phytophthora parasitica genome. BMC Genomics 15, 785 (2014). https://doi.org/10.1186/1471-2164-15-785
- Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi:10.1002/anie.201605430)
- C. André Lévesque (2011). Fifty years of oomycetes—from consolidation to evolutionary and genomic exploration. Fungal Diversity 50:35–46 DOI 10.1007/s13225-011-0128-7

- Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)
- Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677)

Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Lab work-preparation of experiment, performance, discussion, time management (50%) • Presentation and discussion in the seminar, duration depends on the topic (20%) • Oral Test/ final colloquium, duration: 15 min (20%) • Report, c. 20 pages (10%)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	none
Module Components	• Lab Course "Eukaryotic Microorganisms" • Seminar "Eukaryotic Microorganisms"
Components to be offered in the Current Semester	No assignment

Module 12777 Methods in Synthetic Microbiology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12777	Compulsory elective

Modul Title	**Methods in Synthetic Microbiology** Methoden der synthetischen Mikrobiologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Worrich, Anja
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	After completing the module, the students will be able to present the current literature on a research area in a summarized form. By presenting and discussing their results from the laboratory course they are able to critically question research results. In the practical course, students have to work on sophisticated projects which need competences such as teamwork, organized project planning (project management) and analytical abilities. This course aims to teach diverse techniques and methods used for genetic engineering, molecular cloning, expression in procaryotic or eucaryotic systems, conceptional thinking, independent preparation, execution, evaluation of experiments, and adequate documentation.
Contents	• cultivation of Microorganisms under suitable conditions • isolation and modification of DNA • constructing genetic tools or overexpression vectors • create relevant synthetic microorganisms such as genetically modified strains for biotechnological purposes or further investigations
Recommended Prerequisites	Basic lab experience; basis knowledge in molecular biology, biochemistry, microbiology.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester

	Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	1. Campbell Biologie (ISBN-10: 3868943668) 2. Brock Biology of Microorganisms (ISBN-10: 1292404795) 3. Der Experimentator Molekularbiologie / Genomics (ISBN-10: 3642346359) 4. Molecular Cloning: A Laboratory Manual (ISBN-10: 1936113422)
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	After completing the experiments, each student submits a manuscript about the experimental results and give an oral presentation and discussion. • lab performance: 20% • manuscript (max. 10 pages): 40 % • oral presentation and discussion (15 min): 40 %
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The lab performance (theoretical preparation, organization and execution in the lab, time management) of each student will be observed. For safety reasons we will evaluate the theoretical preparation of each student occasionally. We therefore reserve the right to interrupt laboratory work and experiments can be continued when successful background knowledge is confirmed.
Module Components	• Lab Course "Methods in Synthetic Microbiology" • Seminar "Methods in Synthetic Microbiology"
Components to be offered in the Current Semester	No assignment

Module 12791 Metabolic Analysis and Engineering

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12791	Compulsory elective

Modul Title	**Metabolic Analysis and Engineering** Metabolische Analyse und Entwicklung
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	**Lab Course** Provide the student with an understanding of metabolic pathways and networks, the roles of enzymes and their regulation. The student will learn to estimate the power of tools, e.g. growth of designed mutants disrupted in single genes, and will get experience with different analytical methods. Communication between the students is stimulated by dividing them into four TEAMs, each responsible for a different system. In the first and second week each TEAM can focus on its system understanding methods, theoretical background and the objective. In the following weeks each TEAM is supervising one of the other three TEAMs in the performance of the experiment. That means from the third week on each TEAM is involved in parallel in two experiments, one as supervisor and a second as trainee. **Seminar** Each students has to present the scientific question, the experimental approach, results and conclusions of a original paper which was publised by the host father recently. Communication skills are trained by presention and discussion. The students introduce each other. They learn to ask questions and one of them has to summarize the main points of the discussion.
Contents	The module takes place as a 6 week block course. The seminar is a compulsory part of the module. Each TEAM is supervised by a PhD student. This means that the subjects are adapted for each course to the current state of their scientific work. The following systems are examples:

- System 1: Chemostatic cultivation as a tool to study regulation; a promotor::lacZ reporter strain of *A.gossypii* is cultivated; down-shifts in dilution rate stimulate reporter expression detectable *via* beta-galactosidase assay and riboflavin production; several online parameter are controlled, e.g. pH, and/or determined, e.g. CO2 in the exhaust *via* IR spectrometry;
- System 2: Feeding studies in shaking flasks or on agar plates; the uptake of amino acids in a defined medium is monitored by HPLC; Auxotrophy of *S. cerevisiae* mutants disrupted in *GLY1*, *SHM1*, *SHM2* and/or *AGX1* is studied on glucose or ethanol as sole carbon source plus/minus glycine;
- System 3: Kinetic studies on a Michaelis-Menten in comparison with an allosterically regulated enzyme; impact of ATP or AMP on NAD-dependent ICDH is compared with the NADP-dependent peroxisomal isoenzyme;
- System 4: Transformation and genotype analysis; fungal cells are transformed with DNA *via* electroporation; replacement with a marker by homologous recombination is studied by locus specific PCR with genomic DNA;

Recommended Prerequisites

Three months lab experience; basic knowledge in microbiology, biochemistry, molecular biology.

Mandatory Prerequisites

- 12777 - *Methods in Synthetic Microbiology*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

The students receive original scientific literature for each experimental system e.g.
- System 1: Microbiology 147: 3377-3386; Environmental Microbiology 3: 545-550
- System 2: Yeast 21: 63-73
- System 3: Journal of Molecular Catalysis 10: 335-343
- System 4: Biochemical Journal 369: 263-273

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

Each TEAM (2 student) will take part in an oral presentation and discussion (15 min); furthermore a short manuscript about results of the experiments has to be submitted; presentation and quality of the manuscript will be scored each 50 % for the final mark.

Evaluation of Module Examination

Performance Verification – graded

Limited Number of Participants

8

Remarks

"Recommended Placement in the Study Plan"
- Biotechnology (Master of Science, 3 Semester Version): Master 1st year course

	• Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lab Course "Metabolic Analysis and Engineering" • Seminar "Metabolic Analysis and Engineering"
Components to be offered in the Current Semester	**210343** Practical training Metabolic Analysis and Engineering - 7 Hours per Term **210345** Seminar/Practical training Metabolic Analysis and Engineering - 1 Hours per Term

Module 12792 Methods in Nanobiotechnology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12792	Compulsory elective

Modul Title	**Methods in Nanobiotechnology** Methoden der Nanobiotechnology
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Hohlbein, Johannes
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	Upon successful completion of this course, students will be able to independently design, perform, and critically evaluate experiments in modern nanobiotechnology. They will acquire hands-on experience with single-particle tracking, single-molecule FRET using DNA-based sensors, and super-resolution microscopy in live bacterial cells. Students will learn to prepare samples, operate advanced fluorescence microscopes, and optimize acquisition parameters for reaching single-molecule sensitivity. Students will analyze experimental data using appropriate statistical and computational tools (Python), extracting biologically meaningful parameters such as diffusion coefficients, molecular distances, and nanoscale spatial organization. The course will strengthen the ability to connect physical measurement principles with biological questions. Finally, students will critically assess experimental limitations, sources of artifacts, and the translational relevance of single-molecule and super-resolution approaches.
Contents	The course is organized around a sequence of laboratory modules that introduce experimental strategies in nanobiotechnology. It begins with an overview of fluorescence microscopy setups, optical alignment, and intricate sample preparation required for achieving single-molecule sensitivity. Students then perform single-particle tracking experiments to study nanoscale motion and heterogeneity, followed by single-molecule Fluorescence Resonance Energy Transfer (smFRET) measurements using, e.g., DNA-based sensors to investigate conformational changes in the nanometer range. A dedicated module addresses live-cell imaging in bacteria and the application of single-molecule localization microscopy to resolve subcellular structures beyond the diffraction

	limit. Throughout the course, practical sessions are complemented by guided data processing, including diffusivity analysis, FRET efficiency calculations, and localization reconstructions. The final part of the course focuses on integrating experimental results into a coherent scientific report and discussing biological context and potential applications.
Recommended Prerequisites	Knowledge in Biotechnology, Chemistry, Physics, Engineering Sciences.
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	In addition to the provided scripts, students will work primarily with scientific reviews, original scientific publications, as well as with protocols and application notes of devices provided by manufactures. Students are expected to resource information from Internet including the critical assessment of information provided by large language models such as chatGPT.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• presentation of a scientific topic (will be announced at the beginning of the lab course) (20%), 10 slides, 20 min presentation • written test on the content of the course 60 min (20%) • protocol reporting on the experiments and data analysis (40%), 10-12 pages • experimental work (preparation of experiment, performance, discussion, time management) (20%), weekly evaluation by the supervisors on the above described criteria
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course "Methods in Nanobiotechnology" • Seminar "Methods in Nanobiotechnology"
Components to be offered in the Current Semester	No assignment

Module 12793 Purification and Characterisation of Proteins

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12793	Compulsory elective

Modul Title	**Purification and Characterisation of Proteins** Reinigung und Charakterisierung von Proteinen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stohwasser, Ralf
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every summer semester
Credits	8
Learning Outcome	**Lab Course** The course is aimed to train master students on basic techniques in protein biochemistry and proteome research. To develop strategies for the purification and characterization of various proteins is the major goal of this course. Another didactic aim is to consolidate problem solving abilities and structured experimental team work as well as individual responsibilities. During a lab course students are working individually or as a team depending on the complexity of the analytic task to strengthen team work, as well as individual responsibility. Technical competences in protein purification are reaching from culturing prokaryotic and eukaryotic cells, providing cell lysates, via enrichment of proteins by subcellular fractionation towards classical strategies of salt precipitation, ultrafiltration and chromatography. Characterization encompasses electrophoreses (NEPHGE, IEF, SDSPAGE) and immune-identification (immunoblotting). Functionality of proteins is accessed by assays for enzymatic activites or protein-protein interaction depending on the specific research task provided. **Seminar** Since each student experiences various purification approaches associated with specific problems, the weekly research seminar provides the opportunity to makes this knowledge available for each participant of the lab course. During oral presentations the participants introduce into relevant literature, covering the theoretical background and principles of methods applied. Scientific questions, experimental approaches and results of individual projects are presented as well.

	These compulsory seminars are strengthening the student´s conceptual skills by planning their experimental activities for the next week, by drawing conclusions from experimental data. Certainly, the seminars are also aimed to promote the development of professional communication skills.
Contents	The experimental work of the students is integrated in actual research projects (proteolytic systems, proteasome regulators, apoptosis, protein modification etc). Basic techniques such as homogenization, centrifugation and salt precipitation, as well as ion exchange chromatography and other FPLC techniques are applied to research topics of the biochemistry unit. In a second step the composition of purified protein fractions is analyzed simply by SDS PAGE and Western blotting or via isoelectric focusing (IEF) and non-equilibrium pH gradient gel electrophoresis (NEPHGE). Enzyme assays and immune-detection methods are applied to monitor the quality of target proteins during protein fractionation. Fractionated salt precipitation, ultracentrifugation and ion exchange chromatography are the basic methods to purify proteasome regulators and their functional mutants. Other proteins may be useful for the standardization of immune-detections.
Recommended Prerequisites	none
Mandatory Prerequisites	**Only applies** to the **Master Biotechnology PO 2018 with 4 semesters** standard period of study: Successfull completion of module • 12739 - *Research Internship*
Forms of Teaching and Proportion	Laboratory training - 7 hours per week per semester Seminar - 1 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	• Practical Approach Series (David Hames, Editor; 185 volumes since 1981; IRL Press; Oxford University Press). Topics: • Coligan, Dunn, Speicher, Wingfield (2002) Short Protocols in Protein Science, Wiley • Barker, Kathy (2005). At the Bench: A Laboratory Navigator ISBN-13: 978-0879697082 • Original publications (depending on the assigned project). • Protocols and manuals of the manufacturers of reagents and kits used during the lab course are provided as pdf-files using the university intranet. Seminar literature will be provided upon request. • To strengthen professional skills, students have do develop their information acquisition strategies. Hence, seminar/lab course participants have to supplement provided information/material by their independent contributions.
Module Examination	Continuous Assessment (MCA)
Assessment Mode for Module Examination	• Practical laboratory work 50% • Presentation and discussion in the seminar, duration depends on the topic (25%) • Lab work protocol, 10-20 pages (25%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The module takes place as a 6 week block course.
Module Components	• Lab Course “Purification and Characterization of Proteins” • Seminar “Functional Analysis of Proteins”
Components to be offered in the Current Semester	No assignment

Module 12794 Methods in Enzyme Technology

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12794	Compulsory elective

Modul Title	**Methods in Enzyme Technology** Methoden der Enzymtechnologie
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. Scheibner, Katrin
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	8
Learning Outcome	For students the course with complex tasks will enhance key skills such as teamwork, communications, problem-solving and business awareness (professional methodically and social competences). The first step in the development of a new enzyme product is to find the organism that produces the optimal enzyme. Each student should isolate and determinate one fungal strain from natural sources; purify the strain and determine enzyme activities by using several screening methods. Students use well-studied microorganisms from internal strain collection for producing extracellular and intracellular oxidoreductases and hydrolases. The biocatalysts are separated, concentrated and lyophilised and individual enzyme activities, kinetic parameter and stabilities are studied. In the second part, isolated enzyme reactions - as well as bioreactions by cell preparations - will be performed in several application techniques, including analytical product identification, activities in dependence of changing incubation parameters and yields. The main objective is to demonstrate regio- and stereoselective reactions and to analyse the potential applications of oxidoreductases and hydrolases by several analytical methods.
Contents	The course consists of practical exercises for isolation and screening of enzymes from natural habitats (lignocellulose), strain cultivation for fermentative enzyme production, preparation of extra- and intracellular enzymes, enzyme conservation, characterisation of the enzymes' application potential (factors for regulation of enzyme activity, textile bleaching, xenobiotic degradation potential, regioselective halogenation

and hydroxylation). Oxidoreductases and hydrolases will be used for exemplary degradation of xenobiotic organopollutants, e.g. laccase to determine application conditions in washing processes, versatile haloperoxigenase and peroxygenase (catalysing the regiospecific hydroxylation of basic chemical structures) we will investigated and the halogenation potential will be studied. The use of enzymes in technologies for industrial waste treatment is carried out by constitutive and inducible mono- and dioxygenases of imperfect fungi.

Recommended Prerequisites

Techniques in microbiological isolation and cultivation; protein purification; analytical photometric and chromatographic methods.

Mandatory Prerequisites

- 12793 *Purification and Characterisation of Proteins*

Forms of Teaching and Proportion

Laboratory training - 7 hours per week per semester
Seminar - 1 hours per week per semester
Self organised studies - 120 hours

Teaching Materials and Literature

Bisswangeer H., Figura R., Möschel K., Nouaimi M: Enzymkinetik, Ligandenbindung und Enzymtechnologie. ISBN 3-8265-7175-4, 2001
Heiden S., Bock A-K., Antranikian G.: Industrielle Nutzung von Biokatalysatoren. ISBN: 3-503-04861-8, 1999
Several current publications e.g.:
Kiebist, J., Schmidtke, K.-U., Zimmermann, J., Kellner, H., Jemlich, N., Ulrich, R., Zänder, D., Hofrichter, M. & Scheibner, K. (2017). A peroxygenase from Chaetomium globosum catalyzes the selective oxygenation of testosterone. ChemBioChem, Vol. 18: 563-569 (doi: 10.1002/cbic.201600677).
Olmedo, A., Aranda, C., del Rio, J. C., Kiebist, J., Scheibner, K., Martínez, A. T. & Gutiérrez, A. (2016). From Alkanes to Carboxylic Acids: Terminal Oxygenation by a Fungal Peroxygenase. Angewandte Chemie International Edition, Vol. 55(40): 12248-51 (doi: 10.1002/anie.201605430).
Kiebist, J., Holla, W., Heidrich J., Poraj-Kobielska, M., Sandvoss, M., Simonis, R., Gröbe, G., Atzrodt, J., Hofrichter, M. & Scheibner, K. (2015). One-pot synthesis of Human Metabolites of SAR548304 by fungal peroxygenases. Bioorganic & Medicinal Chemistry, Vol. 23(15): 4324-32 (doi:10.1016/j.bmc.2015.06.035)
Friedrich, S., Gröbe, G., Kluge, M., Brinkmann, T., Hofrichter, M. & Scheibner, K. (2014). Optimization of a biocatalytic process to gain (R)-1-phenylethanol by applying the software tool Sabento for ecological assessment during the early stages of development. Journal of Molecular Catalysis B: Enzymatic, Vol. 103: 36-40. (doi:10.1016/j.molcatb.2013.10.002)

Module Examination

Continuous Assessment (MCA)

Assessment Mode for Module Examination

- Individual practical work in the lab: preparation of experiments, performance, discussion, time management (50%)
- Presentation and discussion in seminars, duration depends on the topic (20%)
- Final colloquium, duration: 15 min (20%)
- Final report, approx. 20 pages (10%)

Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	8
Remarks	The Laboratory course takes place as a 6 week block course. The seminar is an obligatory part of the lab course.
Module Components	• Lab Course "Methods in Enzyme Technology" • Seminar "Methods in Enzyme Technology"
Components to be offered in the Current Semester	**211133** Practical training Methods in Enzyme Technology - 7 Hours per Term **211135** Seminar/Practical training Methods in Enzyme Technology - 1 Hours per Term

Module 12800 Microbial Metabolism

assign to: Compulsory Elective Modules
Studienrichtung / Vertiefung:Labordiagnostik

Study programme Biotechnology

Degree	Module Number	Module Form
Master of Science	12800	Compulsory elective

Modul Title	**Microbial Metabolism** Stoffwechsel der Mikroorganismen
Department	Faculty 2 - Environment and Natural Sciences
Responsible Staff Member	Prof. Dr. rer. nat. habil. Stahmann, Klaus-Peter
Language of Teaching / Examination	English
Duration	1 semester
Frequency of Offer	Every winter semester
Credits	5
Learning Outcome	Goal of the lecture is 1. repetition of basics in bacterial and fungal metabolism and its regulation 2. in depth understanding of selected topics based on recent original papers and current reviews 3. to understand how conclusions are drawn from data, especially experimental data 4. to understand how independent research strategies can lead to overlapping evidences 5. to understand the difference qualitative and quantitative experimental approaches 6. to understand the route starting from a scientific question over experimental data to a model explaining complex phenomena of microbiology 7. to become able to work as a PhD student
Contents	**Microbial Metabolism and Regulation** As a general principle all statements presented in the lectures are based on conclusions drawn from original data. Topics: a) Mutations affecting metabolic pathways: (conditional) auxotrophy; supplementation; glycine biosynthesis; definded growth media; b) Isoenzymes: isocitrate DHs; serine hydroxymethyltransferases; carbon flux analysis; subcellular compartmentation; aspartate kinases of *E. coli* c) Regulation of metabolism: lac, ara, trp operon; repression, induction, attenuation, mRNA half-life control;; adenylation of glutamine synthetase; phosphorylation; feed back inhibition

	d) Circadian clocks: control of photosynthesis and nitrogenase in *Synechococcus* and *Anabaena*; sporulation in *Neurospora* e) Reporter systems: *lacZ*; green fluorescent protein; organelle targeting; f) Quorum sensing: biofilms; signal systems in Gram-positive and Gram-negative bacteria;
Recommended Prerequisites	Basic knowledge in biochemistry, molecular biology, microbiology.
Mandatory Prerequisites	none
Forms of Teaching and Proportion	Lecture - 2 hours per week per semester Self organised studies - 120 hours
Teaching Materials and Literature	About 30 pdf-files of original research reports, review articles, PhD theses are available for the students e.g. Biochem J 369: 263-73; PNAS 100: 5914-9; Genes Develop 15:1468-80; YEAST 21: 63-73; EMBO J 22: 2127-34; J Bacteriol 185: 2066-79; Schlüpen C Diss Uni Düsseldorf; PNAS 90: 5672-6; PNAS 99: 9697-702; Microbiology 154: 2184-94; Mol Cell Biol 6221-8; BBA 1577: 240-50; J Mol Cat 10: 335-43; PNAS 98: 12221-6; J Bacteriol 182: 1-8; J Biol Chem 271: 11113-9; Microbiol 147: 3377-86; PNAS 107: 2043-47
Module Examination	Final Module Examination (MAP)
Assessment Mode for Module Examination	Written Examination (120 min)
Evaluation of Module Examination	Performance Verification – graded
Limited Number of Participants	none
Remarks	"Recommended Placement in the Study Plan" Biotechnology (Master of Science, 3 Semester Version): Master 1st year course Biotechnology (Master of Science, 4 Semester Version): Master 2nd year course
Module Components	• Lecture "Microbial Metabolism and Regulation" • Examination "Microbial Metabolism and Regulation"
Components to be offered in the Current Semester	**210330** Lecture Microbial Metabolism and Regulation - 2 Hours per Term **210338** Examination Microbial Metabolism and Regulation

Erläuterungen

Das Modulhandbuch bildet als Teil der Prüfungsordnung die Rechtsgrundlage für ein ordnungsgemäßes Studium. Darüber hinaus soll es jedoch auch Orientierung bei der Gestaltung des Studiums geben.

Dieses Modulhandbuch wurde am 18. September 2026 automatisch für den Master (anwendungsbezogen)-Studiengang Biotechnology (anwendungsbezogenes Profil), PO-Version 2018, aus dem Prüfungsverwaltungssystem auf Basis der Prüfungsordnung generiert. Es enthält alle zugeordneten Module einschließlich der ausführlichen Modulbeschreibungen mit Stand vom 18. September 2026. Neben der Zusammensetzung aller Veranstaltungen zu einem Modul wird zusätzlich das Veranstaltungsangebot für das jeweils aktuelle Semester gemäß dem Veranstaltungsverzeichnis der BTU ausgegeben.

The module catalogue is part of the examination regulation and as such establishes the legal basis for studies according to the rules. Furthermore, it should also give orientation for the organisation of the studies.

This module catalogue was generated automatically by the examination administration system on the base of the examination regulation on the 18 September 2026, for the Master (anwendungsbezogen) of Biotechnology (applied profile). The examination version is the 2018, Catalogue contains all allocated modules including the detailed module descriptions from 18 September 2026. Apart from the composition of all components of a module, the list of lectures, seminars and events for the current semester according to the catalogue of lectures of the BTU is displayed.