UNIVERSITÄT BONN

Module handbook

Master study course

Biochemistry

LIMES
Life & Medical Sciences Institute

published Oct. 2021

Modul: **Methods in life sciences and statistics**				
Module Number LIMES-001	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Christoph Thiele Prof. Dr. Matthias Schmid			

	Study course	Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc) Medical Immunosciences and Infections (MSc)	P	1.

Learning objective	Students should learn theoretical background of common techniques and methodological approaches from the area of life sciences. Additionally, students will gain an understanding of hypothesis testing and correct interpretation of different types of test statistics. They will improve their skills in statistical calculations and adequate planning of experiments.				
Skills	Profound knowledge on methodology in life sciences Being able to perform statistical analysis of obtained results				
Content	Dealing with DNA, RNA, proteins and lipids, electrophoresis, western blotting, RT-PCR, protein purification, cloning technologies, analysis of lipids, immunoprecipitation, histology, ELISA, Flow cytometry, FRET, microscopy Statistics: Basic test theory, Chi²-tests for contingency tables, t-tests, Non-parametric tests, Power calculations, Calculation rules for probabilities, Correlation, Regression, Software implementations, Graphics and visualization				
Requirements	None				
Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture	Methods in Life sciences and statistics	85	2	90
Examinations	Type of examination			graded/ungraded	
	Written exam			Graded	
Requirements for admission to exam					
Miscellaneous					

Modul: **Methods course I**				
Module Number LIMES-002	Workload 450 h	CP 15	Duration 1 Semester	Cycle Annual
Person responsible Deputy	PD Dr. Anne Gäbler Prof. Dr. Günter Mayer			

	Study course	Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)	P	1.

Learning objective	Students should learn to plan and conduct basic biochemical and immunological experiments either on their own or within groups based on a simple task.
Skills	By the end of the course, students should understand the conducted methods in life science research. They should be able to apply the principles of planning and performing an experiment, searching for references and literature, reading, understanding and discussing the content of primary research papers. Students should be able to document and analyze experimental data and present them in a written form after completing the course.
Content	Photometric, fluorometric and luminometric measurements, including underlying physical principles, instrumentation and calculations. Enzyme kinetics. Enzyme inhibitors. Performing and designing enzymatic assays. Fluorescence resonance energy transfer (FRET). Generation and purification of antibodies. Basic cell culture techniques. Limiting dilution in hybridoma cells. Protein gel electrophoresis and Western Blotting. Bioinformatical tools and analyses in the Life Sciences.
Requirements	None

Courses	Kind	Subject	Group size	SWS	Workload [h]
	Practical course	Methods in Life sciences	65	10	450

Examinations	Type of examination	Graded/ungraded
	Written exam Protocol	Graded (50%) Graded (50%)
Requirements for admission to exam	Active participation in practical course, Records of conducted experiments	Ungraded
Miscellaneous		

Modul: **Introduction in experimental animal techniques and bioethics**				
Module Number LIMES-003	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual
Person responsible Deputy	PD Dr. Heike Weighardt Prof. Dr. Waldemar Kolanus			

	Study course	Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)	P	2.

Learning objective	Students should obtain a comprehensive overview of available animal models and be acquainted with the relevant legal and bioethical guidelines of animal experimentation, as well as general rules for good scientific practice.
Skills	Understanding the advantages and disadvantages of different animal models and their possible application in biomedical research; knowledge of the methodology of animal experimentation and gene targeting techniques; ability to observe animal protection laws and to apply 3R strategies.
Content	Common laboratory animal models (drosophila; zebra fish, mouse); breeding requirements and animal welfare; importance of genetic background and environmental influences (nutrition; microbiota); in vivo studies of development, metabolism, immunology, neurobiology and behavior; anesthesia and analgesia; gene targeting techniques (homologous recombination in embryonic stem cells; TALEN and CRISPR-Cas technology); German/European legislation for the protection of animals; bioethics and the 3Rs; experimental design and good scientific practice.
Requirements	None

Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture	Experimental animals and statistics	65	2	90

Examinations	Type of examination	graded/ungraded
	Written exam	Graded
Requirements for admission to exam	None	graded/ungraded
Miscellaneous		

Modul: **Methods course II**				
Module Number LIMES-004	Workload 180 h	CP 6	Duration 1 Semester	Cycle Annual
Person responsible Deputy	PD Dr. Anne Gäbler Prof. Dr. Günter Mayer			
	Study course		Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)		P	2.
Learning objective	Students should learn to plan and conduct basic biochemical, immunological and molecular biological experiments within groups based on a simple task.			
Skills	By the end of the course, students should understand the conducted methods in life science research. They should be able to apply the principles of planning and performing an experiment, searching for references and literature, reading, understanding and discussing the content of primary research papers. Students should be able to document and analyze experimental data and present them in a written form after completing the course.			
Content	Molecular cloning: Using molecular biology software and databases for in silico analysis of gene sequences, gene cloning strategies, practical cloning workflow. Yeast Two Hybrid Screen: Preparation of competent yeast cells and their transformation with reporter-, bait- and prey plasmids. Interaction tests of two proteins using appropriate selective media. Autoactivation test of the bait protein choosing selective media and genetic controls. DNA gel electrophoresis. Protein purification: Purification of recombinant and endogenous proteins from *E.coli*. Monitoring protein purification (yield/ purity/ function).			
Requirements	None			
Courses	Kind	Subject	Group size	SWS / Workload [h]
	Practical course	Methods in Life sciences	65	4 / 180
Examinations	Type of examination			graded/ungraded
	Written exam Protocol			Graded (50%) Graded (50%)
Requirements for admission to exam	Active participation in practical course, Records of conducted experiments			ungraded
Miscellaneous				

Modul: **Good Scientific Practice**				
Module Number LIMES-005	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Michael Famulok Dr. Martina van Uelft			
	Study course		Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)		P	2.
Learning objective	Students should get insight into aspects of scientific integrity in various practices of daily laboratory work documentations, publications, theses, mentoring, data treatment etc.			
Skills	Being able to understand, judge, and apply ethics and good scientific practice in all aspects of science at all levels of scientific education, with a focus on biochemistry, systems immunology or related life sciences. Being able to spot and identify examples of fraudulent science (e.g. unethical image manipulation, plagiarism, fraudulent application of statistics, cherry-picking etc.). Learning about the consequences of unethical behavior in scientific practice. Post-publication review. Handling misconduct.			
Content	Students will be introduced into: The rules of good scientific practice according to the guidelines of the DFG and other agencies; Examples of data manipulation and research misconduct; Keeping a laboratory notebook; Digital image ethics; Differences between honest errors, differences of opinion, and misconduct; Discussion of case studies; Interactive movie “The Lab” (https://ori.hhs.gov/TheLab/ ; https://www.science.org/content/article/interactive-film-misconduct-infiltrates-lab-rev2)			
Requirements	None			
Courses	Kind	Subject	Group size	SWS / Workload [h]
	Lecture	Scientific Integrity	≤65	1 / 90
Examinations	Type of examination			graded/ungraded
	Written exam			Ungraded
Requirements for admission to exam	None			graded/ungraded
Miscellaneous				

Modul: **Cellular Biochemistry**				
Module Number Biochem-001	Workload 180 h	CP 6	Duration 2 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Christoph Thiele PD Dr. Lars Kürschner			
	Study course		Category	Semester
	Biochemistry (MSc)		P	1+2.
Learning objective	Students should learn the biochemical basis of complex cellular function with a focus on major metabolic functions and their pathological aberrations.			
Skills	Detailed knowledge of biochemical pathways and their integration into cellular and tissue homeostasis Knowledge of organelle structure and function, and of compartmentalization of biochemical pathways Knowledge of regulatory elements to maintain metabolic homeostasis Be able to read, understand and present advanced issues in biochemistry and metabolism.			
Content	Organelles and their metabolic pathways (membranes, nucleus, ER, lipid droplets, peroxisomes, mitochondria, endosomes, cytoplasm) Regulation and Signalling (Basic receptors and signal transduction mechanisms, glucose and cholesterol homeostasis) Biochemical basis of disease (ER stress, metabolic overload, protein aggregation, ABC transporter dysfunction).			
Requirements	This lecture does not repeat basic knowledge that is a prerequisite to its understanding: Basic protein structure and folding, DNA structure and replication, Michaelis-Menten-type kinetics, basic metabolic pathways (Glycolysis, gluconeogenesis, TCA cycle, glyoxalate cycle, pentose phosphate pathway, glycogen metabolism, respiratory chain and ATP synthase, amino acid synthesis and degradation, fatty acid synthesis and beta-oxidation)			
Requirements	None			
Courses	Kind	Subject	Group size	SWS / Workload [h]
	Lecture	Cellular Biochemistry	40	2 / 90
	Tutorial			1 / 45
	Seminar			1 / 45
Examinations	Type of examination			graded/ungraded
	Written exam			Graded
Requirements for admission to exam	Participation to seminars			graded/ungraded ungraded
Miscellaneous				

Modul: **Biophysics**				
Module Number Biochem-002	Workload 180 h	CP 6	Duration 2 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Thorsten Lang Prof. Dr. Micheal Pankratz			
	Study course		Category	Semester
	Biochemistry (MSc)		P	1+2.
Learning objective	Students should obtain advanced knowledge about biophysical methods for studying biochemical reactions and macromolecular complexes.			
Skills	Being capable of understanding how biophysical techniques currently used in life sciences work, what are their strengths and limitations.			
Content	Molecular structure (protein crystallography, NMR-spectroscopy, cryo-EM), mobility (fluorescence correlation spectroscopy, SPT, FRAP), interactions (CD-spectroscopy, dynamic light scattering, microscale thermophoresis, isothermal titration calorimetry, surface plasmin resonance, EPR), ultrastructure of the cell (TEM), light microscopy for studying macromolecular complexes, cellular structure and dynamics (SIM, PALM/STORM, STED microscopy, LSM, MPM, TIRFM), and electrophysiology (Patch-clamp, amperometry).			
Requirements	None			

Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture	Biophysics	40	2	90
	Tutorial			1	45
	Seminar			1	45

Examinations	Type of examination	graded/ungraded
	Written exam	Graded
Requirements for admission to exam	Participation to seminars	graded/ungraded
		ungraded
Miscellaneous		

Modul: **Biochemistry and Organic Chemistry**				
Module Number Biochem-003	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Christoph Thiele Prof. Dr. Michael Famulok			
	Study course		Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)		WP	1.
Learning objective	Students should learn the basic structures and pathways in biochemistry and the key organic reactions and reaction mechanisms of relevance for understanding how some biochemical processes work on a chemical basis, in particular enzymatic reactions.			
Skills	Basic knowledge of biochemical pathways Knowledge protein structure and function Knowledge of basic regulatory elements to regulate enzyme activity Understanding the key principles of Organic Chemistry, particularly activation of chemical bonds and reaction mechanisms. Being able to read and understand and present fundamental issues in biochemistry and organic chemistry.			
Content	Basic protein structure and folding, DNA structure and replication, Michaelis-Menten-type kinetics, basic metabolic pathways (Glycolysis, gluconeogenesis, TCA cycle, glyoxalate cycle, pentose phosphate pathway, glycogen metabolism, respiratory chain and ATP synthase, amino acid synthesis and degradation, fatty acid synthesis and beta-oxidation) Key principles of organic reaction mechanisms, key organic reactions of relevance for biological systems with an emphasis on enzymatic mechanisms, basic principles of activation / deactivation of chemical bond breakage and formation, basic principles of some synthetic procedures with emphasis on biological molecules such as DNA, RNA, and peptides.			
Requirements	None			
Courses	Kind	Subject	Group size	SWS / Workload [h]
	Lecture	Biochemistry and organic chemistry	65	2 / 90
Examinations	Type of examination			graded/ungraded
	Written exam			Graded, but not included in the calculation of GPA
Requirements for admission to exam	None			graded/ungraded
Miscellaneous				

Modul: **Cell Biology and Immunology**					
Module Number Immuno-002	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual	
Person responsible Deputy	Prof. Dr. Sven Burgdorf PD Dr. Marc Beyer				
	Study course			Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)			WP	1.
Learning objective	Students should apply fundamental knowledge on basic cell-biological and immunological topics on a cellular and molecular level.				
Skills	Understanding the key principles in cell biology and immunology.				
Content	Molecular biology of the cell, cellular compartments, biological membranes, nucleic acids, protein synthesis and degradation, post-translational trafficking of proteins, post-translational modifications of proteins, signaling mechanisms and second messengers, cytoskeleton, endocytosis, energy metabolism in mitchondria, extracellular matrix, cells of the immune system, basic principles of the immune system.				
Requirements	None				
Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture	Cell Biology and Immunology	65	2	90
Examinations	Type of examination			graded/ungraded	
	Written exam			Graded, but not included in the calculation of GPA	
Requirements for admission to exam	None			graded/ungraded	
Miscellaneous					

Modul: **Genetics and Molecular Biology**				
Module Number Immuno-003	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Michael Pankratz PD Dr. Reinhard Bauer			
	Study course		Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)		WP	1.
Learning objective	Students learn general concepts of the interactions between various systems of cell and gene regulation and how they can be studied.			
Skills	Understanding the principles of molecular biology and genetics, and combining this knowledge with biology, biochemistry, advanced genetics (genetic engineering) and genomics/bioinformatics.			
Content	Organization of eukaryotic cells and their dynamic functions. Molecular structure and function of DNA and RNA and the mechanisms of replication and transcription. Design and cloning of expression vectors and monitoring gene expression experimentally in whole animals and through quantitative PCR. Description of major mechanisms of signal transduction and how to study such mechanisms by using transgenic animals and forward and reverse genetic methods.			
Requirements	None			
Courses	Kind	Subject	Group size	SWS / Workload [h]
	Lecture	Genetics and Molecular Biology	65	2 / 90
Examinations	Type of examination			graded/ungraded
	Written exam			Graded, but not included in the calculation of GPA
Requirements for admission to exam	None			graded/ungraded
Miscellaneous				

Modul: **Inorganic Chemistry and Physical Chemistry**					
Module Number Biochem-004	Workload 90 h	CP 3	Duration 1 Semester	Cycle Annual	
Person responsible Deputy	Prof. Dr. Thorsten Lang Prof. Dr. Micheal Famulok				
	Study course			Category	Semester
	Biochemistry (MSc) Immunobiology: from molecules to integrative systems (MSc)			WP	1.
Learning objective	Basic understanding of atoms, molecule structure, types of reactions, types of bonding, driving force of a chemical reaction and its velocity.				
Skills	Being capable of understanding fundamental mechanisms on the level of single atoms or small molecules.				
Content	Inorganic chemistry: atomic structure, molecular structure and bonding, acids and bases, oxidation and reduction, coordination compounds. Physical chemistry: thermodynamics (kinetic gas theory, internal energy, enthalpy, entropy, free enthalpy/Gibbs energy, thermochemistry) and kinetics (reaction order, transition states, catalysis).				
Requirements	None				
Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture	Inorganic and Physical Chemistry	65	2	90
Examinations	Type of examination			graded/ungraded	
	Written exam			Graded, but not included in the calculation of GPA	
Requirements for admission to exam	None			graded/ungraded	
Miscellaneous					

Modul: **Labrotation 1: Biochemistry and Chemical Biology**				
Module Number Biochem-005	Workload 360 h	CP 12	Duration (weeks) 8	Cycle Every semester
Representative	Prof. Dr. Thorsten Lang			
	Study Course		Category	Semester
	Biochemistry (MSc)		WP	2.
Learning Objective	Students should acquire hands-on experience in scientific research by joining ongoing research projects in the working groups of Biochemistry or chemical biology at the LIMES Institute. They should be able to design, conduct and evaluate specific biochemical experiments. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.			
Skills	Experimental skills in state-of-the-art techniques used in biochemistry and chemical biology; ability to design scientific experiments and to critically evaluate scientific data; Soft skills in written and oral presentation of scientific results; ability to work in a team.			
Content	The scientific topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.			
Requirements				
Courses	Kind	subject	group size	SWS / Workload [h]
	Laboratory course	Biochemistry or chemical biology	1	8 / 360
Examinations	Type of examination			Graded/Ungraded
	- Publication-like written summary of results obtained, data interpretation and discussion - Lab course			Graded (40%) Graded (60%)
Requirements for admission to exam	Lab journal regular participation Data presentation in the group seminar			Graded/Ungraded ungraded ungraded ungraded
Miscellaneous				

Modul: **Labrotation 1: Biophysics and Physiology**				
Module Number Biochem-006	Workload 360 h	CP 12	Duration (weeks) 8	Cycle Every semester
Representative	Prof. Dr. Thorsten Lang			
	Study Course		Category	Semester
	Biochemistry (MSc)		WP	2.
Learning Objective	Students should acquire hands-on experience in scientific research by joining ongoing research projects in the working groups of Biophysics or Physiology at the LIMES Institute. They should be able to design, conduct and evaluate specific scientific experiments. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.			
Skills	Experimental skills in state-of-the-art techniques; ability to design scientific experiments and to critically evaluate scientific data; Soft skills in written and oral presentation of scientific results; ability to work in a team.			
Content	The scientific topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.			
Requirements				

Courses	Kind	Subject	Group size	SWS	Workload [h]
	Laboratory course	Biochemistry	1	8	360

Examinations	Type of examination	Graded/Ungraded
	- Publication-like written summary of results obtained, data interpretation and discussion - Lab course	Graded (40%) Graded (60%)

Requirements for admission to exam		Graded/Ungraded
	Lab journal regular participation Data presentation in the group seminar	ungraded ungraded ungraded
miscellaneous		

Modul: **Chemical Biology**				
Module Number Biochem-007	Workload 180 h	CP 6	Duration 1 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Günter Mayer Prof. Dr. Michael Famulok			
	Study course		Category	Semester
	Biochemistry (MSc)		P	3.
Learning objective	Students should learn the principles of Chemical Biology and underlying chemical, biological and molecular working mechanisms. They also learn the relevant methodology applied in the field.			
Skills	Understanding the principles of Chemical Biology. Know the key methods and their applications. Be able to read, understand and present fundamental issues in Chemical Biology.			
Content	Chemical Biology of different compound classes (e.g., proteins, nucleic acids, small molecules), target structures and model organisms (e.g., bacteria, eukaryotic cells, animals). Basic principles of Chemical Biology, basic methods on synthesizing compounds (nucleic acids, proteins, peptides, DNA nanoarchitectures) by means of chemical and semi-synthetic approaches, investigation and characterization of molecular properties of small molecules and macromolecules, measuring molecular interactions in vitro, in cells, and in vivo. Basic principles in molecular evolution techniques.				
Requirements	None				
Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture Tutorial Seminar	Chemical Biology	40	2 1 1	90 45 45
Examinations	Type of examination			graded/ungraded	
	Written exam			Graded	
Requirements for admission to exam	Participation to seminars			graded/ungraded ungraded	
Miscellaneous					

Modul: **Physiology**				
Module Number Biochem-008	Workload 180 h	CP 6	Duration 1 Semester	Cycle Annual
Person responsible Deputy	Prof. Dr. Michael Pankratz PD Dr. Reinhard Bauer			
	Study course		Category	Semester
	Biochemistry (MSc)		P	3.
Learning objective	Students should learn how cells function in different cellular contexts and the interplay between different tissue and organ systems.			
Skills	Understanding basic principles in neural, endocrine and metabolic systems in health and disease.			
Content	Basic organization and comparison of nervous system in different organisms, tools to study function and structure of neural circuits, neuropeptides and hormonal control of physiology. Molecular basis of cellular regulation of lipid homeostasis and pathophysiology of lipid metabolism and animal models to study metabolic diseases.			
Requirements	None			

Courses	Kind	Subject	Group size	SWS	Workload [h]
	Lecture	Physiology	40	2	90
	Tutorial			1	45
	Seminar			1	45

Examinations	Type of examination	graded/ungraded
	Written exam	Graded
Requirements for admission to exam	Participation to seminars	graded/ungraded
		ungraded
Miscellaneous		

Modul: **Oral examination Master of Biochemistry**					
Module Number Biochem-009	Workload 180 h	CP 6	Duration (weeks)	Cycle Annual	
Representative	Prof. Dr. Thorsten Lang				
	Study Course			Category	Semester
	Biochemistry (MSc)			P	3.
Learning Objective	Students should acquire profound and comprehensive knowledge on biochemical topics, making interconnections between the contents of individual modules on biochemistry.				
Skills	Profound knowledge on biochemistry Making interconnections between different areas of biochemistry				
Content	Oral examination on content and interconnection of modules Biochem-004, Biochem-005, Biochem-007 and Biochem-008				
Requirements	Biochem-001, -002, -007, -008				
Courses	Kind	Subject	Group size	SWS	Workload [h]
	Examination	Cellular Biochemistry, Chemical Biology, Biophysics, Physiology	1		180
Examinations	Type of examination			Graded/Ungraded	
	Oral exam			graded	
Requirements for admission to exam				Graded/Ungraded	
Miscellaneous					

Modul: **Labrotation 2: Biochemistry and Chemical biology**				
Module Number Biochem-010	Workload 360 h	CP 12	Duration (weeks) 8	Cycle Every semester
Representative	Prof. Dr. Thorsten Lang			
	Study Course		Category	Semester
	Biochemistry (MSc)		WP	3.
Learning Objective	Students should acquire hands-on experience in scientific research by joining ongoing research projects in the working groups of Biochemistry or chemical biology at the LIMES Institute. They should be able to design, conduct and evaluate specific biochemical experiments. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.			
Skills	Experimental skills in state-of-the-art techniques used in biochemistry and chemical biology; ability to design scientific experiments and to critically evaluate scientific data; Soft skills in written and oral presentation of scientific results; ability to work in a team.			
Content	The scientific topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.			
Requirements				
Courses	Kind	Subject	Group size	SWS / Workload [h]
	Laboratory course	Biochemistry or Chemical Biology	1	8 / 360
Examinations	Type of examination			Graded/Ungraded
	- Publication-like written summary of results obtained, data interpretation and discussion - Lab course			Graded (40%) Graded (60%)
Requirements for admission to exam	Lab journal regular participation Data presentation in the group seminar			Graded/Ungraded ungraded ungraded ungraded
Miscellaneous				

Modul: **Labrotation 2: Biophysics and Physiology**				
Module Number Biochem-011	Workload 360 h	CP 12	Duration (weeks) 8	Cycle Every semester
Representative	Prof. Dr. Thorsten Lang			
Institution	LIMES-Institute			
	Study Course		Category	Semester
	Biochemistry (MSc)		WP	3.
Learning Objective	Students should acquire hands-on experience in scientific research by joining ongoing research projects in the working groups of Biophysics or Physiology at the LIMES Institute. They should be able to design, conduct and evaluate specific scientific experiments. The project should be presented in a written report in analogy to a scientific publication, including an informative introduction, comprehensive and logical presentation of the data, as well as a critical discussion and interpretation of the results in light of the relevant literature.			
Skills	Experimental skills in state-of-the-art techniques; ability to design scientific experiments and to critically evaluate scientific data; Soft skills in written and oral presentation of scientific results; ability to work in a team.			
Content	The scientific topic of the lab rotation always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.			
Requirements				

Courses	Kind	Subject	Group size	SWS	Workload [h]
	Laboratory course	Biophysics, Physiology	1	8	360

Examinations	Type of examination	Graded/Ungraded
	- Publication-like written summary of results obtained, data interpretation and discussion - Lab course	Graded (40%) Graded (60%)

Requirements for admission to exam		Graded/Ungraded
	Lab journal regular participation Data presentation in the group seminar	ungraded ungraded ungraded
Miscellaneous		

Modul: **Master Thesis**				
Module Number Biochem-012	Workload 750 h	CP 30	Duration 1 Semester	Cycle Every semester
Representative	Prof. Dr. Thorsten Lang			
	Study Course		Category	Semester
	Biochemistry (MSc)		P	4.
Learning objective	Aim of the master thesis is to demonstrate how scientific questions can be answered using experimental approaches. They will collect and get an overview of project-relevant literature and identify the remaining open scientific questions for a specific topic. They will develop experimental strategies to answer these questions and plan and conduct own experiments. They will apply the state of the art methodology and will gather hands-on experience using these techniques. During these experiments, the students will learn which (positive and negative) controls should be included in their experiments and which conclusions can (and cannot) be drawn from a given experimental setup. They will design an experiment in such a way that a correct and precise answer to a specific question can be given. They will interpret scientific experiments and, given a specific result from their experiments, identify the next steps to continue the project. During the implementation of their master thesis, the students are supervised by a principle investigator from the hosting group. At the end of their thesis, students will describe their project in a scientific way. Students will write a master thesis, from which the text part is in between 30 and 80 pages including • A title, which should be focused but still should contain all project-relevant information • An abstract, in which the scientific topic, the most important findings and resulting conclusions will be summarized briefly. • An introduction, in which general information to understand the scientific project is provided, an overview of the current literature is given and the aim of the study is pointed out clearly • A material and methods section, in which the experimental procedures are explained precisely • The results of the scientific project, presented in clear and accurate figures • A discussion, in which the results are interpreted and in which is described, which consequences can be drawn from the project • A reference section, in which all cited literature is listed			
Skills	• Planning and implementation of a scientific project • Design of scientific experiments • Hand-on experience in state-of-the-art methodology • Collecting and interpretation of project-relevant literature • Interpretation of obtained results • Generation of clear and informative figures • Detailed report of experimental protocols • Writing of a scientific report • Extracting the most important information for a summary			

	• Pointing out the impact of the obtained results for the scientific community				
Content	The scientific topic of the master thesis always lies within the scientific scope of the supervisor. By this means, an optimal supervision can be guaranteed.				
Requirements	Minimum 60 CP				
Courses	Kind	Subject	Group Size	SWS	Workload [h]
	Master Thesis	Individual research project	1		750
Examination	Type of examination			Graded/ungraded	
	Evaluation of the Master Thesis by two examiners			graded	
Requirements for admission to exam	Attendance of at least 20 scientific talks in the field of biomedicine			Graded/ungraded	
				ungraded	
Miscellaneous					