

Master's degree course Molecular Biotechnology at the Johannes Gutenberg University Mainz

1st semester:

Module: Molecular Biotechnology				
ID-Number (JOGU-StI/Ne)	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
	450 h	1 Semester	1. Semester	15 CP
1.	Courses/forms of teaching	Contact time	Self-study	Credit points
	a) Lecture: Molecular Biotechnology	2 SWS / 21 h	69 h	3 CP
	b) Practical training: Molecular Biotechnology	8 SWS / 84 h	216 h	10 CP
	c) Seminar: Current Developments in Molecular Biotechnology	1 SWS / 21 h	39 h	2 CP
2.	Forms of teaching			
	c) Seminar with lectures by students			
	b) Practical exercises			
3.	Qualification goals/competences			
	<p>In this module genes will be heterologously expressed in microorganisms to produce proteins with interesting properties for biotechnological applications. For this purpose, students will be provided with extensive knowledge and methods of modern microbiological/biotechnological laboratories. In the exercises the students will learn how to clone genes, transform recombinant nucleic acids into microorganisms and produce mutants including the proof of successful integration/recombination. In addition, the students learn to cultivate microorganisms submers and to purify proteins from these cultures. In addition to classical methods, modern methods with "tags" and specific columns will be discussed. Finally, the produced proteins are analysed e.g. via SDS-Page and by chromatography and the activity of the formed enzymes is checked in suitable biochemical systems.</p> <p>In addition to the exercises, in which biochemical methods for protein purification and activity determination are taught, as well as molecular biological methods for the molecular manipulation of microorganisms, the students present current work from the field of molecular biotechnology in a seminar.</p>			
4.	Content			
	Molecular biotechnology with microorganisms; fermentation of microorganisms; heterologous expression of genes; protein purification and analysis			
5.	Availability of the module			
	M. Sc. Molecular Biotechnology			
6.	Recommended prerequisite(s) for participation			
	a) and c) Lecture „Mikrobiologie“ (Microbiology)			
7.	Access requirement(s)			
	None			
8.	Types of examination			
	8.1 <i>Study performance(s)</i>			
	c) Lecture in seminar			
	(b) Protocols			
	8.2 Module examination			
	(a) written test (120 min) or oral test (30 min)			
9.	Prerequisite(s) for the award of credit points			
	Oral final report (presentation), internship protocol, if necessary oral supplementary examination (§13[5])			
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes			
	15 of 120 credit points			
11.	Frequency of the offer			
	1x per academic year, only in the winter semester; exercises during the lecture-free time between winter semester and summer semester			
12.	Module representatives and full-time lecturers			
	Prof. Dr. Eckhard Thines; NN			

Module: Biochemistry 3 - Bioanalytics				
ID-Number (JOGU-StIne)	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
	450 h	1 Semester	1. Semester	15 CP
1.	Courses/forms of teaching	Contact time	Self-study	Credit points
	a) Lecture: Biochemistry 3 b) Seminar: Biochemistry 3 c) Bioanalytical practical course for advanced students d) Introduction and seminar to the Bioanalytical Practical Course	2 SWS / 21 h 2 SWS / 21 h 12 SWS / 126 h 2 SWS / 21 h	69 h 69 h 84 h 39 h	3 CP 3 CP 7 CP 2 CP
2.	Forms of teaching			
	a) and b) Lecture and seminar with presentations given by the students c) practical training (laboratory) d) Seminar accompanying the practical training			
3.	Qualification goals/competences			
	(a) and (b) The students are able <ul style="list-style-type: none"> - to assign suitable methods to typical questions arising in the fields of protein and membrane biochemistry. - to properly analyze data gained with biochemical/biophysical methods. - to evaluate the results of bioanalytical experiments. - to understand the limitations of the introduced methods based on their physical principles. - to assess the applicability of the methods to new problems. - to critically assess the significance of experimental set ups in publications in international journals. - to acquire independently a deepened knowledge of current topics in biochemical analytics and related fields. - to analyze and evaluate scientific literature from a scientific point of view. - to independently prepare a scientific presentation on a (given) current biochemical/-analytical topic. - to discuss and evaluate scientific presentations. c) and d) The students are able <ul style="list-style-type: none"> - to apply biochemical-analytical techniques. - to carry out experiments independently and on their own responsibility based on written course instructions. - to assess the applicability of the methods to the problems. - to work carefully and in a coordinated manner. - to interpret the results of their experiments correctly and to document them in an appropriate form. The documentation should correspond in structure and form to the presentation in the biochemical primary literature. - to analyze typical data of selected biophysical methods and to evaluate them appropriately. - to plan experiments in small teams, to discuss and coordinate individual work steps and to implement them. - to effectively manage time and resources. 			
4.	Content			
	- a) and b): <ul style="list-style-type: none"> - Methods of protein expression - Principles and methods of protein isolation and identification - Immunological techniques in biochemistry - Spectroscopic methods in biochemistry - Protein structure analysis - Protein stability - Protein dynamics - Chemical modification of proteins - Biochemistry and biophysics of lipid membranes - Membrane proteins - <i>In vivo</i> and <i>in vitro</i> studies of protein-protein and protein-lipid interactions - Microscopic techniques - Expression and protein characterization <i>in vivo</i> b): The student develops and presents a given, contemporary biochemical/biophysical topic. The student analyses and discusses topics in the seminar.			

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	<p>c) and d)</p> <ul style="list-style-type: none"> - Protein isolation and characterization - Activity test (enzyme kinetics) - Spectroscopic methods of biochemistry (circular dichroism spectroscopy, fluorescence spectroscopy, ...) - Protein fluorescence - Phase transitions of lipid membranes - Density gradient centrifugation (protein-membrane interaction) - Stopped-Flow (kinetics of protein folding and unfolding) - Data analysis, error calculation, statistics - Thermodynamic basics in the application (equilibria, kinetics)
5.	<p>Qualification goals/competences</p> <p>M. Sc. Biomedical Chemistry, M. Sc. Biotechnology</p>
6.	<p>Recommended prerequisite(s) for participation</p> <p>a) and b) lecture Biochemistry 2</p>
7.	<p>Access requirement(s)</p> <p>Basic lecture "Biochemistry" (e.g. BC I) and basic practical course in biochemistry or equivalent</p>
8.	<p>Types of examination</p> <p>8.1 <i>Study performance(s)</i></p> <p>b) Seminar presentation</p> <p>8.2 Module examination</p> <p>a-d) Written exam (120 min) or oral exam (30 min)</p>
9.	<p>Prerequisite(s) for the award of credit points</p> <p>a) and b) active participation in seminar with presentations, passed final module examination</p> <p>c) and d) regular and active participation</p>
10.	<p>Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes</p>
11.	<p>Frequency of the offer</p> <p>1x per year in winter semester</p>
12.	<p>Module representatives and full-time lecturers</p> <p>Prof. Dr. Dirk Schneider, Prof. Dr. Ute Hellmich, Prof. Dr. Gerald Gimpl, PD Rolf Postina, Prof. N. Hellmann, N.N.</p>

2nd semester:

Module: Microbiology I - Fungal Molecular Physiology				
ID-Number (JOGU-StINe)	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
	450 h	1 Semester	2. Semester	15 CP
1.	<i>Courses/forms of teaching</i>	<i>Contact time</i>	<i>Self-study</i>	<i>Credit points</i>
	a) Lecture: Fungal Physiology	2 SWS / 21h	69 h	3 CP
	b) Practical exercises: Fungal Molecular Physiology	8 SWS / 84 h	216 h	10 CP
	c) Seminar: Recent Advances in Fungal Physiology	1 SWS / 10.5 h	49.5 h	2 CP
2.	Forms of teaching			
	c) Seminar with lectures given by students			
	b) practical exercises			
3.	Qualification goals/competences			
	<p>In this module, students will acquire the basic knowledge required to study the physiological function of proteins in filamentous fungi. These organisms are manipulated with molecular biological methods, e.g. to generate mutants in which genes have been inactivated. With these "loss-of-function" mutants it should then be possible to conduct further experiments. For example, components of signal recognition and signal transmission can be specifically switched off to investigate whether the organisms are still able to adapt to changing environmental conditions. Such studies are not only of interest for understanding the adaptability and ecology of eukaryotic microorganisms, but also for the investigation of the molecular basis of host-pathogen interactions, host recognition, differentiation, propagation and vitality of fungi. The aim of the module is to give students a profound insight into methods and basics of modern molecular biology and physiology laboratories.</p> <p>Besides the lecture, the module includes a practical part in which "loss-of-function" mutants are generated in filamentous fungi for use in physiological studies. Current molecular biological methods are taught and applied. In addition to the exercises, the students will give lectures on current topics of molecular physiology in fungi.</p>			
4.	Content			
	Molecular manipulation of higher/filamentous fungi; molecular biological methods of the modern microbiological laboratory; physiological studies			
5.	Qualification goals/competences			
	Master's programmes in "Biology" and "Molecular Biotechnology"			
6.	Recommended prerequisite(s) for participation			
	a) and c) Lecture Microbiology			
7.	Access requirement(s)			
	acquired at least 30 LP, (1 double module completed)			
8.	Types of examination			
	8.1 <i>Study performance(s)</i>			
	c) Lecture in seminar			
	8.2 Module examination			
	a) written test (120 min) or oral test (30 min)			
9.	Prerequisite(s) for the award of credit points			
	Regular, active participation in the courses; successful module examination			
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes			
	15 out of 120 credit points			
11.	Frequency of the offer			
	1x per academic year, only in the summer semester; exercises during the lecture-free time between summer semester and winter semester			
12.	Module representatives and full-time lecturers			
	Prof. Dr. Eckhard Thines, Dr. Karsten Andresen, Dr. Luis Antelo, Dr. Stefan Jacob, Dr. Anja Schüffler			

Module Microbiology II - Biomolecular Interactions				
ID-Number (JOGU-StIne)	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
	450 h	1 Semester	2. Semester	15 CP
1.	Courses/forms of teaching	Contact time	Self-study	Credit points
	a) Lecture: Biomolecular Interactions	2 SWS / 21 h	69 h	3 CP
	b) Practical exercises: Biomolecular Interactions	8 SWS / 84 h	216 h	10 CP
	c) Seminar: Biomolecular Interactions	1 SWS / 10.5 h	49.5 h	2 CP
2.	Forms of teaching			
	c) Seminar with lectures by students			
	b) practical exercises			
3.	Qualification goals/competences			
	In this module comprehensive knowledge of biomolecular interactions is imparted. Biomolecular interactions play a central role in almost every cellular process. These can be interactions from protein to protein, but also from protein to DNA, antibody antigen, lipid to protein or protein to low molecular weight substances such as secondary messengers, hormones or drugs. It is therefore of crucial importance in biology, medicine and biotechnology to analyse and quantify these processes. The aim of this module is therefore to give an overview of the different methods used in modern biology to study and quantify various biomolecular interactions. The functioning as well as the application possibilities of the methods will be explained in an eLecture using video clips, animation films and software applications. The learning success can be checked by the students in small quizzes. In an accompanying seminar, in which the students prepare and present a scientific lecture, selected techniques that have been successfully applied in current research are then discussed. Finally, the module contains an exercise in which a selection of techniques are trained, including the high-end technique of surface plasmon resonance spectroscopy. This module does not currently exist in this form at any other German university and therefore represents a unique selling point for the biotechnology and biology master's program at JGU.			
4.	Content			
	Biomolecular interactions of protein/protein; protein-DNA, protein-lower molecular substances; quantification of interactions			
5.	Qualification goals/competences			
	Master's programmes in "Biology" and "Molecular Biotechnology"			
6.	Recommended prerequisite(s) for participation			
	a) and c) Lecture Microbiology			
7.	Access requirement(s)			
	acquired at least 30 LP, (1 double module completed)			
8.	Types of examination			
	8.1 <i>Study performance(s)</i>			
	c) Lecture in seminar			
	8.2 Module examination			
	a) written test (120 min) or oral test (30 min)			
9.	Prerequisite(s) for the award of credit points			
	Regular, active participation in the courses; passed module examination			
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes			
	15 out of 120 credit points			
11.	Frequency of the offer			
	1x per academic year, only in the summer semester; exercises during the lecture-free time between summer semester and winter semester			
12.	Module representatives and full-time lecturers			
	Prof. Prof. Dr. Ralf Heermann			

The duration of an external internship determines whether the internship can be recognized as an additional qualification or even as project work. For external internships, recognition must be given by one of the module supervisors in the Master's programme before starting such a work.

Module: Extended Qualifications				
ID-Number (JOGU-StI/Ne)	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
	180 h	1 Semester	3. Semester	6 CP
1.	Courses/forms of teaching	Contact time	Self-study	Credit points
	The following options are available			
	a) VL Studium generale: Scientific principles and basic competences	2 SWS / 21 h	69 h	3 CP
	b) VL of the Studium generale	2 SWS / 21 h	69 h	3 CP
	c) (ZWW) VL/Ü project manager for genetic engineering in accordance with § 15 (2) sentence 1 no. 3 of the Genetic Engineering Safety Ordinance *	2 SWS / 21 h	69 h	3 CP
	d) (ZWW) VL/Ü Strahlenschutz Further training for the certificate of competence according to § 47 of the Radiation Protection Ordinance *	4 SWS / 42 h	138 h	6 CP
	e) internship in a partner university (Erasmus or Forthem) or in the industry	4 SWS / 42 h	138 h	6 CP
	* external chargeable offer			
	The students put together a scope of 6 CP according to their individual interests.			
2.	Forms of teaching			
	None			
3.	Qualification goals/competences			
	Students acquire additional skills in areas that go beyond pure technical knowledge. Here, students can choose from a range of topics with a scientific theoretical and ethical-philosophical orientation ("Studium generale"), as well as decidedly application-oriented courses with regard to additional professional qualifications. The wide range of elective courses enables students to pursue personal interests and to set corresponding priorities.			
4.	Content			
	- VL/Ü Studium generale: Students are introduced to interdisciplinary basics and basic problems of science as well as to interdisciplinary and transdisciplinary approaches and methods. Central questions of science theory, philosophy, ethics and cultural studies are discussed and illustrated by means of current developments in science, society and culture. The following four topics are offered alternately: (1) Fundamentals of scientific knowledge, (2) Basic questions of ethics, (3) Culture and cultural encounters, (4) Argumentation, logic, rhetoric.			
	- VL/Ü project manager genetic engineering according to §15 GenTSV: The participants gain knowledge in questions of biological safety. The course content is taught in accordance with §15 Paragraph 2 of the Genetic Engineering Safety Ordinance and is a prerequisite for professional activities as a genetic engineering project manager.			
	- VL/Ü Radiation protection course: Acquisition of the certificate of competence according to §30 Radiation Protection Ordinance. Enables professional activity as radiation protection officer.			
5.	Qualification goals/competences			
	Master's programmes in "Biology" and "Molecular Biotechnology"			
6.	Recommended prerequisite(s) for participation			
	None			
7.	Access requirement(s)			
	None			
8.	Types of examination			
	depending on the activity oral, written or practical (computer), no grading			

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9.	Prerequisite(s) for the award of credit points Proof of participation in the courses or passed examinations. In case of an internship, a written protocol/report.
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes 6 out of 120 CP
11.	Frequency of the offer 1x per academic year, only in the summer semester; exercises during the semester breaks between summer semester and winter semester
12.	Module representatives and full-time lecturers full-time teachers: Staff of the Studium Generale, the Centre for Scientific Continuing Education (ZWW) and the Department of Biology

Project work I and II must not be carried out in the same working group.

Module: Scientific project I				
ID-Number (JOGU-StI/Ne)	Workload	Duration of the module (according to study scedule)	Regular semester (according to study scedule)	Credit points (CP)
	360 h	1 Semester	3. Semester	12 CP
1.	Courses/forms of teaching Scientific project	Contact time 12 SWS / 126 h	Self-study 234 h	Credit points 12 CP
2.	Forms of teaching None			
3.	Qualification goals/competences Students can demonstrate a deeper understanding and knowledge in a subfield of molecular biotechnology or applied microbiology/biochemistry on a research-related topic and put it into practice. They are able to familiarize themselves with the scientific basis of the project with the help of specialist literature and to prepare a written project outline (proposal). After a methodical and practical introduction to their special topic, they are able to plan and conduct scientific experiments independently; to present the results; to interpret them. In particular, they can critically evaluate the significance of their results; assess the significance of the controls with certainty; independently extract the essential findings from their data; present their project and the results in a scientific poster. They are able to work as team members of a research group.			
4.	Content In-depth scientific treatment of a selected special topic within the chosen area of focus. Planning in the form of a proposal (1 to 2 pages); implementation and evaluation (with test protocol); presentation of the results in the form of a poster.			
5.	Qualification goals/competences Master's courses in "Biology" and "Molecular Biotechnology"			
6.	Recommended prerequisite(s) for participation None			
7.	Access requirement(s) The student has acquired at least 60 CP (2 double modules completed)			
8.	Types of examination Evaluation of proposal (2 CP), practical work plus minutes (14 CP) , presentation and poster (3 CP)			
9.	Prerequisite(s) for the award of credit points Completed project work with minutes, poster, proposal and presentation			
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes 12 out of 120 credit points			
11.	Frequency of the offer Each semester			
12.	Module representatives and full-time lecturers full-time lecturers: all lecturers from the fields of molecular biotechnology, biochemistry and microbiology			

Module: Scientific project II				
ID-Number (JOGU-StINe)	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
	360 h	1 Semester	3. Semester	12 CP
1.	Courses/forms of teaching	Contact time	Self-study	Credit points
	Scientific project	12 SWS / 126 h	234 h	12 CP
2.	Forms of teaching			
	None			
3.	Qualification goals/competences			
	Students can demonstrate a deeper understanding and knowledge in a subfield of molecular biotechnology or applied microbiology/biochemistry on a research-related topic and put it into practice. They are able to familiarize themselves with the scientific basis of the project with the help of specialist literature and to prepare a written project outline (proposal). After a methodical and practical introduction to their special topic, they are able to plan and conduct scientific experiments independently; to present the results; to interpret them. In particular, they can critically evaluate the significance of their results; assess the significance of the controls with certainty; independently extract the essential findings from their data; present their project and the results in a scientific poster. They are able to work as team members of a research group.			
4.	Content			
	In-depth scientific treatment of a selected special topic within the chosen area of focus. Planning in the form of a proposal (1 to 2 pages); implementation and evaluation (with test protocol); presentation of the results in the form of a poster.			
5.	Qualification goals/competences			
	Master's courses in "Biology" and "Molecular Biotechnology"			
6.	Recommended prerequisite(s) for participation			
	None			
7.	Access requirement(s)			
	The student has acquired at least 60 CP (2 double modules completed)			
8.	Types of examination			
	Evaluation of proposal (2 CP), practical work plus minutes (14 CP) , presentation and poster (3 CP)			
9.	Prerequisite(s) for the award of credit points			
	Completed project work with minutes, poster, proposal and presentation			
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes			
	12 out of 120 credit points			
11.	Frequency of the offer			
	Each semester			
12.	Module representatives and full-time lecturers			
	full-time lecturers: all lecturers from the fields of molecular biotechnology, biochemistry and microbiology			

4th semester:

Module: Master Thesis				
ID-Number (JOGU-StI(Ne))	Workload	Duration of the module (according to study schedule)	Regular semester (according to study schedule)	Credit points (CP)
		1 Semester	4. Semester	35 CP
1.	Courses/forms of teaching	Contact time	Self-study	Credit points
	Master thesis			30 CP
2.	Forms of teaching			
	None			
3.	Qualification goals/competences	The students are qualified to work on a (self-selected) scientific topic. They are able to properly introduce this topic, to describe and document their results and to interpret and discuss them in the light of relevant literature in a written Masters´s thesis. They are also capable of presenting and defending their Master's thesis and, in doing so, answering questions on the specific scientific topic of their thesis as well as on connected fields (final examination).		
4.	Content	Master's thesis: scientific writing on the topic, consisting of the following parts: Summary (max. 1 page), introduction including objectives, material & methods as well as results, discussion, bibliography; an appendix can be added to document further primary data. Presentation of the results as a lecture (length approx. 20 minutes), oral defence and answering of even marginal questions, max. 45 min.		
5.	Qualification goals/competences	Master's Degree Programme "Molecular Biotechnology"		
6.	Recommended prerequisite(s) for participation	Two completed scientific projects in the Master's programme "Molecular Biotechnology"		
7.	Access requirement(s)	Module "Scientific Project" successfully completed, already at least 60 CP acquired		
8.	Types of examination	Evaluation of the Master's thesis (see §17 of the MSc Biology Examination Regulations)		
9.	Prerequisite(s) for the award of credit points	Completed Master Thesis		
10.	Significance of the grade in the final grade for single-subject programmes or subject grade for multi-subject programmes	30 out of 120 credit points		
11.	Frequency of the offer	Anytime		
12.	Module representatives and full-time lecturers	full-time lecturers: all lecturers from the fields of molecular biotechnology, biochemistry and microbiology		