



MODULE MANUAL

for the Master's programme

Molecular medicine

Goethe University Frankfurt am Main

(Study regulations 2025)

Study plan M.Sc. Molecular Medicine

1. Semester			2. Semester		3. Semester			4. Semester	
Nov-Dec	Jan	Feb-Mar	Apr-Jul	Jul-Sep	Oct-Nov	Nov-Jan	Jan-Mar	Apr-Jul	Jul-Sep
Molecular Pharmacology V			Frankfurt Research V + S		Excellence Track S + P			Methods in Molecular Medicine II S	
Molecular Oncology and Immunology V			Methods in Molecular Medicine I S			Research Internship B		Master Thesis + Seminar	
Cardiovascular Research V + S			Bioinformatics and Data Analysis V + Ü				Research Internship C		
Laboratory Practice and Experiments in vivo S + V			Biostatistics V + Ü				Project Development		
	Cardiovascular Research P	Molecular Pharmacology P	Stem Cell Biology, Cell and Gene Therapy V						
		Molecular Oncology and Immunology P		Research Internship A					

FB 16	Individual internship
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Overview of tests and certificates

	Module	Semester	Module coordinator	Evidence	Examination	Grade
1	Molecular Pharmacology (MP)	1	Mühl, Niederberger	P: RT (Pk)	V: K P: Pr	X
2	Cardiovascular Research (CR)	1	Dimmeler, Fleming	S: AT (Rf), P: AT	V: K P: 4 Pk	X
3	Molecular Oncology and Immunology (MOI)	1	Steinle	P: AT (Pk)	V: K P: Pr	X
4	Laboratory Practice and Experiments in vivo (LEIV)	1	Wagenblast, Fleming	S: AT	V: K	X
5	Frankfurt Research (FR)	2	Fleming	S: RT (1 Rf)	-	-
6	Bioinformatics and Data Analysis (BI)	2	Schulz, Abplanalp	Ü: AT	V: K	X
7	Biostatistics (BS)	2	Herrmann	Ü: AT	V: K	X
8	Stem Cell Biology, Cell and Gene Therapy (SCG)	2	Schulte, Ullrich	-	V: K	X
9-10	Excellence Track I oder II	3	Fleming, Münch	S: AT	P: Pr S: Pp	X
11	Methods in Molecular Medicine (M ³)	2,4	Fleming	RT (2 Rf)	-	-
12-14	Research Internship A, B, C	2,3	Fleming	P: RT (Pk), S: RT (Rf)	-	-
15	Completion Module (CM) Project Development (PD) + Master Thesis (MT)	3,4	Fleming	PD: Ps, S: RT (2 Rf)	MT	X

P: Internship

S: Seminar

Ü: Exercise

V: Lecture

Pr: Oral examination

K: Written exam

MT: Master thesis

AT: active participation

RT: Regular participation

Pk: Protocol

Rf: Presentation

PD: Project development

Pp: Poster presentation

Timetables

1st Semester

Module	Type	Oct		Nov		Dec		Jan		Feb		Mar		Module coordinator
CR	V						K							Dimmeler, Fleming
CR	S													Dimmeler, Fleming
MP	V							K						Mühl, Niederberger
MOI	V							K						Steinle
LEIV	S													Fleming
LEIV	V								K					Wagenblast
CR	P								Pk					Dimmeler, Fleming
MP	P										Pr			Mühl, Niederberger
MOI	P											Pr		Steinle

Abbreviations: see p. 11

Colour coding: **yellow**: lecture/seminar

blue: Course internship

green: Research internship

orange: Project development

2nd semester

Module	Type	Apr		May		Jun		Jul		Aug		Sep		Module coordinator
BI	V/Ü								K					Schulz, Abplanalp
BS	V/Ü								K					Herrmann
FR	V/S													Fleming
M³ I	S													Fleming
SCG	V			K										Schulte
RI A	P/S													Fleming

3rd semester

Module	Type	Oct		Nov		Dec		Jan		Feb		Mar		Module coordinator
ExT I / II	P/S													Fleming, Münch
RI B	P/S													Fleming
RI C	P/S													Fleming
CM	PD												Ps	Fleming

4th semester

Module	Type	Apr		May		Jun		Jul		Aug		Sep		Module coordinator
CM	P/S													Fleming
M ³ II	S													Fleming

Compulsory module / Compulsory elective module (PF / WPF)

Credit points (CP)

Basic phase	PF	43
Modul CR	PF	9
Modul MP	PF	9
Modul MOI	PF	9
Modul LEIV	PF	5
Modul BS	PF	5
Modul BI	PF	6
Preparation phase		46
Modul FR	PF	4
Modul M ³	PF	4
Modul SCG	PF	3
Modul ExT I	WPF	8
Modul ExT II	WPF	8
Modul RI A	PF	9
Modul RI B	PF	9
Modul RI C	PF	9
Finalisation phase		31
Completion Module /Master's thesis	PF	31
Total		120

Module descriptions

CR	Cardiovascular Research	Compulsory module	9 CP (total) = 270 h		5.5 SWS
			Contact hours 5.5 SWS / 83 h	Self-study 187 h	
Contents					
	As an introduction to the physiology/pathophysiology of the cardiovascular system and vascular biology, the anatomy, development and function of the blood and lymph vessels are explained. Building on this, important signalling cascades for the regulation of vascular homeostasis are discussed. This is followed by a discussion of the pathophysiology of metabolic syndrome, vascular remodelling/ischaemia, cardiac hypertrophy and its consequences as well as atherosclerosis and its causes. Modern regenerative therapies (therapeutic angiogenesis; cell therapy; anti-angiogenic strategies) for cardiovascular diseases as well as cancer will be explained. In the subsequent block practical course, subject-specific methods for investigating angiogenesis, platelet activation, monocyte adhesion, cardiac development, vascular reactivity and intracellular metabolites are taught and practised.				
Learning outcomes / competence objectives					
	Students gain an understanding of vascular function and learn about the underlying molecular regulatory mechanisms. Causes of various cardiovascular diseases are discussed as well as different (pharmacological) therapy options. The explanation of modern research results and current regenerative therapies, their effects and (failures) success should encourage students to develop innovative ideas and train their ability to critically assess current studies.				
Participation requirements for the module or for individual courses in the module					
	Lecture: none Practical course: A passed exam (lecture Cardiovascular Research) entitles the student to participate in the practical course.				
Recommended prerequisites					
	Comprehensive knowledge of physiology, cell biology and anatomy				
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every winter semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Seminar: regular and active participation Practical course: regular participation		
Academic performance			none		
Teaching / learning methods			Lecture, seminar, practical course		
Language of instruction / examination			English		

Module examination					Form / duration / content if applicable					
Final module examination consisting of:										
Cumulative module examination consisting of:					90-minute final exam for the lecture Practical course protocols (2 weeks processing time; max. 20 pages)					
Formation of the module grade for cumulative module examinations:					weighted by CP according to § 37 paragraph 4					
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Cardiovascular research lecture series	V	2	4	x					
	Seminar cardiovascular research	S	0,5	2	x					
	Block practical course in cardiovascular research	P	3	3	x					
	Total		5,5	9						

MP	Molecular Pharmacology	Compulsory module	9 CP (total) = 270 h		6 SWS
			Contact hours 6 SWS / 90 h	Self-study 180 h	
Contents					
	General and special pharmacology: drug development, pharmacokinetics, pharmacodynamics, pharmacological treatment of selected important diseases (e.g. cardiovascular diseases, lipometabolic disorders, diabetes, infections, rheumatoid arthritis, neurodegenerative diseases, autoimmune diseases, asthma/COPD, tumour diseases, etc.). Block practical course with teaching of methods relevant to molecular drug research such as: analysis of the molecular effect of anti-inflammatory drugs demonstration of human and mouse pain models, calcium imaging in primary neurones, detection of apoptosis as well as real-time PCR, immunoblotting, immunofluorescence, ELISA.				
Learning outcomes / competence objectives					
	Knowledge of pharmacological treatments for various important and frequently occurring diseases. Students will have an overview of drug groups and their mechanisms of action, as well as their side effects, interactions and contraindications. After completing the practical course, students will have mastered important methods in the field of molecular biology/biochemistry and their possible application in the field of inflammation pharmacology.				
Participation requirements for the module or for individual courses in the module					
	<u>The following applies to the MSc Molecular Medicine:</u> Lecture: none Practical course: A passed exam for the lecture Molecular Pharmacology entitles the student to participate in the practical course. <u>The following applies to the MSc Bioinformatics:</u> Lecture: A successfully completed module Animal Physiology or Physiology entitles the student to participate in the lecture.				
Recommended prerequisites					
	Comprehensive knowledge of physiology and biochemistry				
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes			MSc Bioinformatik (modified module – only lecture and written exam)		
Frequency of the offer			every winter semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Lecture: none Internship: regular participation		
Academic performance			none		
Teaching / learning methods			Lecture, practical course		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		

Final module examination consisting of:										
Cumulative module examination consisting of:					90-minute final exam for the lecture Oral examination on the practical course (approx. 30-45 minutes per candidate)					
Formation of the module grade for cumulative module examinations:					weighted by CP according to § 37 paragraph 4					
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Molecular	V	3	6	x					
	Drug research									
	Block practical course in molecular drug research	P	3	3	x					
Total			6	9						

MOI	Molecular oncology and immunology	Compulsory module	9 CP (in total) = 278 h		6,5
			Contact hours 6,5 SWS / 98 h	Self-study 180 h	SWS
Contents					
	The module consists of a lecture series followed by a block practical course. The lectures focus on: molecular and cell biological mechanisms of tumour development and growth; oncogenes; tumour suppressor genes; tumour genetics; tumour metabolism; tumour environment; tumour markers; tumour immunosurveillance; molecular targets of tumour therapies; modern tumour therapeutics (kinase inhibitors; biologicals); tumour immunotherapy. The block practical course teaches methods from oncological and immunological research and practical insights into both basic research and translational research into tumour therapy. The range of methods includes multiparametric flow cytometry, immunohistochemistry, the cultivation of cells, the isolation of immune cells and various assays for analysing immune cell function in vitro. Students are given an overview of the current state of immunology as well as the various causes of tumour development, the molecular diversity of tumours, tumour immune defence and the latest developments in tumour therapeutics based on current results of oncological and immunological basic research.				
Learning outcomes / competence objectives					
	Students learn about the molecular mechanisms of carcinogenesis and modern, molecularly oriented approaches to tumour therapy. In the practical course, they learn the theoretical background of complex methods in the fields of oncology, cell biology, biochemistry and immunology. They learn to apply these methods and to assess their use and benefits for their own research projects.				
Participation requirements for the module or for individual courses in the module					
	<u>The following applies to the MSc Molecular Medicine:</u> Lecture: none Practical course: A passed exam for the lecture Molecular Oncology and Immunology entitles the student to participate in the practical course. <u>The following applies to the MSc Bioinformatics:</u> Lecture: To participate in the lecture, students must provide proof of knowledge in cell biology and genetics.				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes			MSc Bioinformatics (Modified module - only lecture and written exam)		
Frequency of the offer			every winter semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		

Semester-related certificates										
Proof of participation					Lecture: none Practical course: regular and active participation					
Academic performance					none					
Teaching / learning methods					Lecture, practical course					
Language of instruction / examination					English					
Module examination					Form / duration / content if applicable					
Final module examination consisting of:										
Cumulative module examination consisting of:					90-minute final exam for the lecture Oral examination on the practical course (approx. 30-45 minutes per candidate)					
Formation of the module grade for cumulative module examinations:					weighted by CP according to § 37 paragraph 4					
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Molecular oncology/ Tumour immunology	V	3,5	6	x					
	Block practical course in molecular oncology/tumour immunology	P	3	3	x					
	Total		6,5	9						

LEIV	Laboratory practice and experiments in vivo	Compulsory module	5 CP (total) = 135 h		3
			Contact hours 3 SWS / 45 h	Self-study 90 h	
Contents					
	Lecture on laboratory animal science: replacement and supplementary methods; biology of the most important laboratory animal species; care and husbandry of the most important laboratory animal species; hygiene in laboratory animal husbandry; ethical principles for animal experimentation; legal principles for animal experimentation; animal protection law; performance of animal experiments. Scientific work seminar: Teaching general knowledge for carrying out scientific-experimental work; occupational health and safety; biological safety; working with radioactive isotopes; working with human pathogenic material; requirements for working with human material (ethics committee); guidelines for good scientific practice; ethical issues in molecular medicine.				
Learning outcomes / competence objectives					
	Students acquire the expertise for the theoretical part of conducting animal experiments. Knowledge of the legal basis for animal experiments and legal requirements/regulations for submitting applications; performance and documentation of animal experiments. Knowledge of legal framework regulations relevant to day-to-day experimental research in molecular medicine. Awareness of responsible scientific and experimental activities.				
Participation requirements for the module or for individual courses in the module					
	none				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every winter semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Lecture: none Seminar: regular and active participation		
Academic performance			none		
Teaching / learning methods			Lecture, seminar		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		
Final module examination consisting of:			90-minute final exam for the lecture Laboratory Animal Science		

Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Experiments in vivo	V	1,5	3	x					
	Scientific work: Framework conditions, ethics and law	S	1,5	2	x					
	Total		3	5						

FR	Frankfurt Research	Compulsory module	4 CP (total) = 120 h		4 SWS
			Contact hours 4 SWS / 60 h	Self-study 60 h	
Contents					
	Lecture series with presentations of research projects in the field of molecular medicine by scientists from the Faculty of Medicine at Goethe University. Students will gain detailed first-hand insights into modern research in various areas of molecular medicine and into the research processes, from hypotheses and experimental approaches to published results and open questions. The presentation of specific research projects is preceded by an in-depth theoretical introduction to the respective field of research. In the subsequent literature seminar, current specialist publications in the respective field of research are presented by the students and discussed with the lecturer.				
Learning outcomes / competence objectives					
	Students gain in-depth knowledge of current issues and research topics in the field of molecular medicine. Using concrete examples, they learn how scientific questions are addressed experimentally and conceptually in practice. You will learn how to apply the knowledge you have acquired to the development of creative problem-solving strategies in your own research projects. As part of their own seminar presentations, students learn how to present new research results clearly and concisely and how to critically analyse specialist publications. They also acquire skills in presentation techniques.				
Participation requirements for the module or for individual courses in the module					
	none				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Lecture: none Seminar: regular attendance		
Academic performance			1 presentation (10-15 min)		
Teaching / learning methods			Lecture, seminar		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		
Final module examination consisting of:			none		
Cumulative module examination consisting of:					

Formation of the module grade for cumulative module examinations:

		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Lecture series Frankfurt Research	V	2	2		x				
	Seminar Frankfurt Research	S	2	2		x				
	Total		4	4						

M ³	Methods in Molecular Medicine	Compulsory module	4 CP (total) = 120 h		4 SWS
			Contact hours 4 SWS / 60 h	Self-study 60 h	
Contents					
	Presentation and critical discussion of current specialist publications on new findings from the entire field of molecular medicine; presentation of novel and complex methods currently used in research into molecular medical issues; teaching of the associated theoretical background on the basis of specialist publications and review articles, including demonstration experiments or equipment instruction where appropriate. Focus in the 2nd semester: Presentation of a methodological publication. Focus in the 4th semester: Presentation of the own Master's thesis or, if the project outline for the Master's thesis has not yet been completed, a research internship.				
Learning outcomes / competence objectives					
	Students learn how to access and adequately process scientific information sources and gain an understanding of scientific knowledge processes. They deepen their knowledge of the latest methods in the field of molecular medicine and are able to critically assess the significance, possible applications and limitations of these methods. This enables them to assess the use and benefits of these methods for answering scientific questions in the context of their own experimental work. Students learn how to present and critically analyse scientific publications in a concise manner and thus acquire skills in presentation techniques.				
Participation requirements for the module or for individual courses in the module					
	none				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every summer semester		
Duration of the module			3 semesters		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Regular participation		
Academic performance			2 presentations (1 presentation each in FS 2 and FS 4, 10-15 min each)		
Teaching / learning methods			Seminar		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		
Final module examination consisting of:			none		
Cumulative module examination consisting of:					

Formation of the module grade for cumulative module examinations:

		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Methods in Molecular Medicine I	S	2	2		x				
	Methods in Molecular Medicine II	S	2	2				x		
	Total		4	4						

BS	Biostatistics	Compulsory module	5 CP (in total) = 150 h		3 SWS
			Contact hours 3 SWS / 45 h	Self-study 105 h	
Contents					
	Important aspects of biostatistic experimental and study design and brief repetition of descriptive statistical methods; additions to probabilities and probability theory; brief repetition of statistical concepts of statistical significance tests and confidence intervals (significance and confidence level; p-value; null and alternative hypothesis as well as first and second type errors). Application of standard tests to compare mean values and non-parametric statistical test procedures as well as more complex test procedures for contingency tables; regression and correlation calculation including dose-response analyses; multiple and logistic regression analysis and multi-factorial analysis of variance; methods for testing the preconditions; procedures for "time-to-event" analysis as well as procedures for illustrating multiple test procedures and for significance correction.				
Learning outcomes / competence objectives					
	Students acquire knowledge of selected areas of biostatistics that are of particular importance for experimental work in molecular medicine. The aim is to convey an understanding of the correct selection and interpretation of statistical analyses and to achieve sufficient confidence in the application of the most important procedures and the avoidance of typical errors.				
Participation requirements for the module or for individual courses in the module					
	none				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every summer semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Lecture: none Exercises: regular and active participation		
Academic achievements			7 Homework for the "Exercise" teaching mode		
Teaching / learning methods			Lecture, exercise		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		
Final module examination consisting of:			90-minute final exam for lecture and exercise		
Cumulative module examination consisting of:					

Formation of the module grade for cumulative module examinations:

		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Biostatistics for molecular physicians	V	2	3		x				
	Exercise	Ü	1	2		x				
	Total		3	5						

BI	Bioinformatics and Data Analysis	Compulsory module	6 CP (total) = 180 h		4 SWS
			Contact hours 4 SWS / 60 h	Self-study 120 h	
Contents					
	Bioinformatics and its fields of application: Biological databases; introduction to sequence alignment; analysis of phylogeny; algorithms for dimensional reduction and clustering methods; methods for analyzing genomic data (DNA, RNA, epigenome, proteome); algorithms and methods for differential analysis of genes and pathways, and MultiOmics integration; introduction to programming with R; current applications; case studies.				
Learning outcomes / competence objectives					
	In modern research, special equipment is used to measure DNA, the transcriptome, proteome and epigenome. These measurements are the basis for important new findings in biomedical and pharmaceutical research. The complexity of the resulting data requires specific algorithms and analysis methods, which bioinformatics deals with. Bioinformatics combines questions, methods and concepts from biology, computer science and statistics. This module teaches important methods for analyzing genomic data as well as the underlying types of experiments for genome-wide measurements. Competence objectives: Students acquire selected knowledge of bioinformatics, which includes important basics and is helpful in everyday research. They will become familiar with the associated algorithms from both a theoretical and an application perspective. You will be able to implement simple data analyses in the R programming language. You will develop the ability to assess procedures and apply them in a differentiated way, depending on the data situation. They are able to analyze new data independently and can evaluate and critically question analysis results.				
Participation requirements for the module or for individual courses of the module					
	none				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every summer semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Lectures: none Exercises: regular and active participation		
Academic achievements			6 exercises for the “Exercise” teaching mode		
Teaching / learning methods			Lecture, exercise		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		
Final module examination consisting of:			90-minute final exam for lecture and exercise		

Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Basics of bioinformatics	V	2	3		x				
	Exercise for the lecture	Ü	2	3		x				
	Total		4	6						

RI A	Research Internship A	Compulsory module	9 CP (total) = 270 h		15 SWS
			Contact hours 15 SWS / 225 h	Self-study 45 h	
Contents					
	Full-day, six-week individual internship in a research-active working group from the field of molecular medicine in the Faculty of Medicine; the criteria for participating research groups are defined and transparently communicated on OLAT by the examination board. Work on a narrowly defined scientific question under the guidance of research-active scientists; establishment and increasingly independent conception and implementation of experimental approaches to address the question; involvement of students in research and meetings of the working group and participation in internal working group seminars. Presentation in the internal working group seminar on current scientific publications or the results achieved during the research internship; written summary of the internship content and the results achieved in a protocol in the style of scientific publications.				
Learning outcomes / competence objectives					
	Students will be able to scientifically design and plan experiments (time management), carry them out and adequately interpret the results obtained. They acquire additional methods and/or deepen their knowledge of already known methods. Students learn how to conduct scientific discussions, use scientific literature for their own experimental approaches and become familiar with research practice. They learn to summarise a small-scale research project in a scientific publication style.				
Participation requirements for the module or for individual courses in the module					
	Successfully completed LEIV module two successfully completed modules from the area of MP, MOI, CR				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every semester		
Duration of the module			1 semester (6 weeks, full-time)		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Practical course: regular and active participation Seminar: regular and active participation (usually presentation)		
Academic achievements			Protocol of the internship (12-30 pages excluding cover sheet, table of contents and bibliography).		
Teaching / learning methods			internship, seminar		
Language of instruction / examination			English		

Module examination				Form / duration / content if applicable						
Final module examination consisting of:				none						
Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Internship	P	14	8		x				
	Seminar	S	1	1		x				
	Total		15	9						

SCG	Stem Cell Biology, Cell and Gene Therapy	Compulsory module	3 CP (total) = 90 h		2 SWS
			Contact hours 2 SWS / 30 h	Self-study 60 h	
Contents					
	Current aspects of stem cell research and their experimental use in cell therapy and gene therapy are presented and deepened. Key learning content: i) principles of gene regulation and human genetics and understanding of differentiation processes during embryogenesis and in different stem cell systems; ii) current methods of stem cell research, inducible pluripotent stem cells (iPSCs); reprogramming; organoids; iii) haematopoietic stem cells, stem cell transplantation and immune reconstitution; iv) cell therapy concepts in the field of haematology-oncology and regenerative medicine; v) methods and risks of gene therapy and its legal basis.				
Learning outcomes / competence objectives					
	Students acquire an understanding of the complex relationships between the development of organs and organisms, tissue homeostasis and malignancy and are familiarised with current issues and the most important methods of stem cell research. Using the haematopoietic stem cell system as an example, the current range of methods and central areas of application of cell and gene therapy are presented.				
Participation requirements for the module or for individual courses in the module					
	Successfully completed MOI module				
Recommended prerequisites					
	Comprehensive knowledge of cell biology, basic knowledge of genetics and immunology				
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every winter semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			none		
Academic achievements			none		
Teaching / learning methods			Lecture		
Language of instruction / examination			English		
Module examination			Form / Duration		
Final module examination consisting of:			90-minute final exam based on lecture content		

Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Stem Cell Biology, Cell and Gene Therapy	V	2	3		x				
	Total		2	3						

ExT I	Excellence track I Cardio-Pulmonary Science	Compulsory elective module	8 CP (total) = 240 h		8 SWS
			Contact hours 8 SWS / 120 h	Self-study 120 h	
Contents					
	A research oriented learning module that runs over 6 weeks and links practical courses (5-8 practical courses (“Master classes”) - depending on the individual practical course duration) in individual research groups using advanced methods, with seminars on experimental design and a project planning. All methods are related to the cardiopulmonary system and cardiopulmonary diseases. The practical courses (group size ≤4 students) can be selected from a list of projects supplied by the CPI faculty in Frankfurt, Bad Nauheim and Giessen. The practical courses are explained in an initial seminar. The courses should be completed over a period of 4.5 weeks. There follows a 1.5-week seminar (research based learning (POL), 6-8 students/group), in which the project plan is drawn up to address a specific research question using the methods learned e.g. spatial transcriptomics, spatial proteomics, and that makes use of the techniques learnt and preliminary data generated. The project outlines are presented orally in the form of a poster presentation.				
Learning outcomes / competence objectives					
	Students will learn more advanced methods in a unique setting that fosters “research based learning”. The content will complement and advance on material already covered theoretically in the module. At the end students should be able to design and plan scientific experiments (time management), carry them out and adequately interpret the results obtained. Students also learn how to conduct scientific discussions, use scientific literature for their own experimental approaches and design a project proposal.				
Participation requirements for the module or for individual courses in the module					
	Successfully completed CR and MP modules				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every winter semester		
Duration of the module			1 semester		
Module coordinator / module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Practical course: regular and active participation Seminar: regular and active participation		
Academic achievements					
Teaching / learning methods			Practical course, seminar		
Language of instruction / examination			English		
Module examination			Form / Duration		

Final module examination consisting of:					
Cumulative module examination consisting of:					
Oral examination on the practical course (10-15 min) Poster presentation for the seminar (30-45 min incl. discussion)					
Formation of the module grade for cumulative module examinations:					
Oral examination: 60% of the module grade Poster presentation: 40% of the module grade					
		Mode of teaching / study	Semester hours per week	CP	Semester
					1 2 3 4 5 6
	Practical course (Master Class)	P	7,5	7	
	Seminar (POL)	S	0,5	1	
	Total		8	8	

ExT II	Excellence track II Drug Discovery	Compulsory elective module	8 CP (total) = 240 h		8 SWS
			Contact hours 8 SWS / 120 h	Self-study 12 h	
Contents					
	A research oriented learning module that runs over 6 weeks and links practical courses (5-8 practical courses (“Master classes”) - depending on the individual practical course duration) in individual research groups using advanced methods, with seminars on experimental design and a project planning. All of the methods are related to preclinical drug discovery – from screening and disease target identification, compound synthesis and validation, to evaluation in cell and animal models. The practical courses (group size ≤4 students) can be selected from a list of projects project. These are provided by professors affiliated with Goethe University who are active in faculties of corresponding consortia such as TheraNova, Proxidrugs and the Frankfurt Competence Center for Emerging Therapeutics. The practical courses are explained in an initial seminar. The courses should be completed over a period of 4.5 week period. There follows a 1.5 week seminar (research based learning (POL), 6-8 students/group), in which the project plan is drawn up to address a specific research question using the methods learned, e.g. phenotypic screening, proteomics, surface plasmon resonance, protein palmitoylation, multi-epitope-ligand-cartography (MELC), and that makes use of the techniques learnt and preliminary data generated. The project outlines are presented orally in the form of a poster presentation.				
Learning outcomes / competence objectives					
	Students will learn more advanced methods in a unique setting that fosters “research based learning”. The content will complement and advance on material already covered theoretically in the course. At the end students should be able to design and plan scientific experiments (time management), carry them out and adequately interpret the results obtained. Students also learn how to conduct scientific discussions, use scientific literature for their own experimental approaches and design a project proposal.				
Participation requirements for the module or for individual courses in the module					
	Successfully completed CR and MP modules				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every winter Semester		
Duration of the module			1 semester		
Module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Practical course: regular and active participation Seminar: regular and active participation		
Academic achievements					
Teaching / learning methods			Research internship, research seminar		
Language of instruction / examination			english		

Module examination				Form / Dauer / ggf. Inhalt						
Final module examination consisting of:										
Cumulative module examination consisting of:				Oral examination on the practical course (10-15 min) Poster presentation for the seminar (30-45 min incl. discussion)						
Formation of the module grade for cumulative module examinations:				Oral examination: 60% of the module grade Poster presentation: 40% of the module grade						
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Practical course (Master Class)	P	7,5	7			x			
	Seminar (POL)	S	0,5	1			x			
	Total		8	8						

RI B	Research Internship B	Compulsory module	9 CP (total) = 270 h		15 SWS
			Contact hours 15 SWS / 225 h	Self-study 45 h	
Contents					
	Full-day, six-week individual internship in a research-active working group in the field of molecular medicine. The criteria for participating research groups are defined and communicated transparently on OLAT by the examination board. This must be a different working group at a different institution than in research internship A; in the case of a stay abroad, research internships B and C can be combined into a research internship B/C lasting at least three months. Working on a narrowly defined scientific question under the guidance of research-active scientists; if possible, independent design and implementation of experimental approaches to address the question; involvement of the students in the research and discussions of the working group and participation in internal working group seminars. Presentation in the internal working group seminar on current scientific publications or the results achieved during the research internship; written summary of the internship content and the results achieved in a protocol in the style of scientific publications.				
Learning outcomes / competence objectives					
	Students are able to scientifically design and plan experiments (time management), carry them out and adequately interpret the results obtained. They acquire additional methods and/or deepen the handling of already known methods. Students learn how to conduct scientific discussions, use scientific literature for their own experimental approaches and become increasingly familiar with research practice. They will be able to summarise a small-scale research project in a scientific publication style.				
Participation requirements for the module or for individual courses in the module					
	Successfully completed module Research Internship A				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every semester		
Duration of the module			1 semester (6 weeks, full-time)		
Module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Practical course: regular and active participation Seminar: regular and active participation (usually presentation)		
Academic achievements			Protocol of the internship (12-30 pages excluding cover sheet, table of contents and bibliography).		
Teaching / learning methods			Internship, Seminar		
Language of instruction / examination			English		

Module examination				Form / duration / content if applicable						
Final module examination consisting of:				none						
Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Research internship	P	14	8			x			
	Research seminar	S	1	1			x			
	Total		15	9						

RI C	Research internship C	Compulsory module	9 CP (total) = 270 h		15 SWS
			Contact hours 15 SWS / 225 h	Self-study 45 h	
Contents					
	Full-day, six-week individual internship in a research-active working group in the field of molecular medicine. The criteria for participating research groups are defined and communicated transparently by the examination board. This must be a different working group at a different institution than in research internships A and B; in the case of a stay abroad, research internships B and C can be combined into a research internship B/C lasting at least three months. Working on a narrowly defined scientific question under the guidance of research-active scientists; independent conception and implementation of experimental approaches to address the question; involvement of students in research and meetings of the working group and participation in internal working group seminars. Presentation in the internal working group seminar on current scientific publications or the results achieved during the research internship; written summary of the internship content and the results achieved in a protocol in the style of scientific publications.				
Learning outcomes / competence objectives					
	Students can design and schedule experiments, carry them out and adequately interpret the results obtained. They acquire additional methods and/or optimise the use of existing methods. Students are able to discuss scientific issues and refer to scientific literature independently for their own research project and experimental planning. They are familiar with research practice and its detailed facets and know different approaches to scientific questions. They know how to summarise and communicate the results of a research project in writing in a scientific publication style.				
Participation requirements for the module or for individual courses in the module					
	Successfully completed module Research Internship A				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every semester		
Duration of the module			1 semester (6 weeks, full-time)		
Module coordinator			see course overview		
Semester-related certificates					
Proof of participation			Practical course: regular and active participation Seminar: regular and active participation (usually presentation)		
Academic achievements			Protocol of the internship (12-30 pages excluding cover sheet, table of contents and bibliography).		
Teaching / learning methods			Internship, Seminar		
Language of instruction / examination			English		
Module examination			Form / duration / content if applicable		

Final module examination consisting of:					none					
Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Research internship	P	14	8			x			
	Research seminar	S	1	1			x			
	Total		15	9						

CM	Completion Module	Compulsory module	31 CP (total) = 930 h		3 SWS
			Contact hours 3 SWS / 45 h	Self-study 885 h	
Contents					
	The final module includes the Master's thesis, which is an independent, full-day experimental investigation of a given scientific question in the field of molecular medicine and a written summary of the results obtained over a total period of six months. In this final module, project development precedes the actual Master's thesis; participation in a seminar takes place parallel to the Master's thesis. All three module components are completed within a working group that is active in research in the field of molecular medicine. The criteria for this are defined and communicated transparently on OLAT by the examination board. As part of the project development, the students work out a concept paper for the experimental addressing of the question to be dealt with by researching the relevant literature and studying the necessary methods in accordance with the supervisor's specifications. Together with the supervisor, the concept is concretised and goals as well as a schedule and milestones for the subsequent Master's thesis are derived (project outline). The results from the experimental work of the Master's thesis are summarised in writing in scientific publication style and discussed in the light of the current state of knowledge. The quality of the work is assessed by the the first examiner and a second assessor. The scientific questions and objectives of the Master's thesis are presented at the beginning and the results towards the end of the Master's thesis in the form of a presentation in an accompanying seminar within the working group.				
Learning outcomes / competence objectives					
	Students are able to develop a scientific project under supervision, taking into account time and technical constraints. Students apply the knowledge and practical, experimental and scientific skills acquired in the degree programme to specific, current scientific issues in molecular medicine. They are able to acquire and critically assess the current state of scientific knowledge on a specific issue and develop and apply their own ideas to answer a scientific question. They are able to critically reflect on their results, present them and explain and defend them in scientific discussions. They acquire the competence to summarise a research project in a scientific publication style.				
Participation requirements for the module or for individual courses in the module					
	completion module: Successful completion of all modules with the exception of M³ The project outline is a prerequisite for registering for the Master's thesis.				
Recommended prerequisites					
Assignment of the module (degree programme / department)			MSc Molecular Medicine / FB 16		
Applicability of the module for other degree programmes					
Frequency of the offer			every semester		
Duration of the module			2 semesters (3rd semester: Project Development, processing time: 2 weeks; 4th semester: Master's thesis, processing time: 6 months)		
Module coordinator			see course overview		

Semester-related certificates										
Proof of participation					Seminar: regular and active participation (usually 2 short presentations)					
Academic achievements					Project outline (max. 20 pages)					
Teaching / learning methods					Project development, seminar					
Language of instruction / examination					English					
Module examination					Form / duration / content if applicable					
Final module examination consisting of:					Thesis according to § 36 (Master's thesis, usually 60-100 pages without table of contents and bibliography; Duration: 6 months)					
Cumulative module examination consisting of:										
Formation of the module grade for cumulative module examinations:										
		Mode of teaching / study	Semester hours per week	CP	Semester					
					1	2	3	4	5	6
	Project Development	PD	2	1			x			
	Master Thesis	MT		29				x		
	Seminar	S	1	1				x		
	Total		3	31						