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Anhalt University of Applied Sciences

DEGREE PROGRAM AND EXAMINATION REGULATIONS

for obtaining the academic degree of

MASTER

for the degree program

MOLECULAR BIOTECHNOLOGY

dated 09.04.2025

(Part 2: Program-specific regulations)

The following degree program and examination regulations have been approved in accordance with § 77, clause 2, and § 13 of the Saxony-Anhalt Higher Education Act (*Hochschulgesetz Sachsen-Anhalt*), version dated 01.06.2021 (GVBl. LSA 367, 368) and in conjunction with the Degree Program and Examination Regulations for master's degree programs at Anhalt University of Applied Sciences (General Regulations) dated 16.11.2022 [*Datumswiedergabe im Format: MM.TT.JJJJ*] as amended.[1]

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1 To facilitate readability only the masculine form is used for denoting individuals, job titles and official office titles.

§ 1
Admission requirements and starting the program

(1) The General Degree Program and Examination Regulations for Master's degree programs at Anhalt University of Applied Sciences apply. Admission is open to students with a university degree in biotechnology, pharmaceutical engineering, molecular biology or related fields.
(2) Applicants must have proof that their English language proficiency is equivalent to TOEFL®iBT score of 95 or equivalent.
(3) Courses start on the first day of the winter semester / summer semester.
(4) applicants must provide proof of qualified practical experience after completing their first degree, usually not less than one year.

§ 2
Goals and structure of the program

(1) One credit point according to the European Credit Transfer System (ECTS) is equivalent to a full academic workload of 25 hours.

(2) Based on their fundamental knowledge of molecular biology and biotechnology, students enrolled in the continuing education program in **Molecular Biotechnology (MOB)** will acquire knowledge and skills in the field of cellular processes. This includes the analysis of such processes, the cultivation of cells and the planning and the execution of experiments for the (genetic) manipulation of cells for metabolite and protein production or as detection systems. The courses cover methods of cell culture technology, genetic engineering, genome analysis, molecular diagnostics and biotechnological production. The module courses offered in the continuing education program are highly focused on practical application. The individual modules are listed in Appendix 1.

In accordance with the program's academic objectives, graduates are likely to find employment in a variety of fields such as basic research in molecular biology, biotechnological production areas, the pharmaceutical industry, the food industry, research and development institutions, the environmental sector to biomedical areas including molecular diagnostics.
(3) For obtaining the Master's degree, a minimum of 90 credit points must be earned with compulsory and elective modules (cf. Appendix 1), with the Master's thesis and Master's thesis colloquium.

§ 3
Master's degree

Once the Master's degree examination has been passed, the Department of Applied Biosciences and Process Engineering awards the academic degree

Master of Science

(M.Sc.).

The Anhalt University of Applied Sciences will also issue a certificate bearing the date of the last examination.

§ 4

Normal program length

The normal program length, including the Master's degree examination, is three semesters. Both the program sequence and the module structures (cf. Appendices 1 and 2) have been designed so that the Master's degree examination can be completed in the third semester. Examinations may also be taken earlier than stipulated.

§ 5
Credit transfer

(1) The examinations committee may, based on a proposal submitted by the degree program advisor and, if applicable, in consultation with the person responsible for the module, approve the crediting of individual examination results in accordance with § 13 of the General Regulations. On the Master's examination certificate, the module in question is to be marked with a superscript "A" next to the module grade and a corresponding footnote reading "Examination result recognized by examinations committee or accepted non-academic competences".
(2) No marking according to clause 1 is required if the examination prerequisite has been credited and if the graded examination has been taken in this degree program.
(3) In cases of incomparable grading systems, the module is to be credited without a grade as 'passed'. The module is not included in the calculation of the overall grade of the Master's degree examination according to § 27 of the General Regulations.

§ 6
Types of examinations

The examinations (module completion and, if applicable, examination prerequisite) are listed in Appendix 1. The following types of examinations are used (in accordance with § 15 General Regulations)

Module completion:

K	Written examination (*Klausur*)	cf. General Regulations, § 15, clause 4
M	Oral examination (*mündliche Prüfung*)	cf. General Regulations, § 15, clause 5
PRO	Project	cf. General Regulations, § 15, clause 10
H	Term paper (*Hausarbeit*)	cf. General Regulations, § 15, clause 6
E/B	Design concept/paper (*Entwurf/Beleg*)	cf. General Regulations, § 15, clause 7
R	Research paper on an assigned topic (*Referat*)	cf. General Regulations, § 15, clause 8
Ex	Experiment description (*experiment. Arbeit*)	cf. General Regulations, § 15, clause 9
P	Presentation	cf. General Regulations, § 15, clause 11
C	Colloquium	cf. General Regulations, § 15, clause 15 and § 33
oP	Module completion without examination/grade (*Abschluss ohne Prüfung/Note*)	cf. General Regulations, § 2, clause 2

Examination prerequisite:

LNW	Ungraded Assessment (*Leistungsnachweis*)	Module description handbook stipulates type and scope of assessment
TN 80	Proof of attendance 80% (*Teilnahmenachweis 80 %*)	

§ 7

Registration for and admission to Master's thesis

(1) As a rule, the application for admission to the Master's thesis is to be submitted to the examinations committee by the end of the 2nd (= last but one) semester. Admission will be denied if, at the time of application, more than three modules of the total number of modules to be completed have not been successfully passed.
(2) The examination committee grants admission and confirms the topic of the Master's thesis according to § 29 of the General Regulations.

§ 8

Entry into force

(1) The statutes shall enter into force on the same day following their approval by the President of Anhalt University of Applied Sciences.
(2) These statutes apply to all students enrolled in the degree programs listed in Article I from the summer semester of 2023 onwards.
(3) Issued based on the decision of the Executive Board of 16 November 2022 and approval by the President of Anhalt University of Applied Sciences on 16 November 2022.
(4) Publication shall take place in the Official Gazette of Anhalt University of Applied Sciences No. 91/2022 and additionally on the Anhalt University of Applied Sciences Internet portal.

Appendix 1

Curriculum and examination schedule for the degree program Molecular Biotechnology

The curriculum specifies the number and allocation of the modules for each individual semester within the normal program length and the number of credits required. Parts of the Master's degree examination entail both compulsory and elective module examinations, the Master's thesis and the Master's thesis colloquium. Examination requirements are the prerequisites according to this appendix.

Semester	Hours per week per semester 15 weeks			Examination prerequisites	Type of examination	Length of examination	Credits
	V	Ü	P				
The teaching content is partly supported by multimedia or carried out in the form of online courses (see Section 10 Paragraph 9 in General Provisions)							
1st semester (Summer Semester)							
Compulsory modules							
Special Methods in Cell Culture and Tissue Engineering	2	0	2	LNW	K	90 min.	5
Molecular Genetics and Genetic Engineering	2	0	2	LNW	K	90 min.	5
Cellular Signal Transduction	0	3	1	LNW	M	30 min.	5
Project Work 1	0	0	4		E/B		5
Elective modules							
Elective Module 1	2	1	1				5
Elective Module 2	2	1	1				5
Sum. 1st Semester							30
2nd semester (Winter Semester)							
Compulsory modules							
Pharmaceutical Biotechnology	2	1	0		M	30 min.	5
Recombinant Protein Production	2	1	0		K	90 min.	5
Project Management	2	2	0		M	30 min.	5
Lecture Series "Trends in Biotechnology"	3	0	0	LNW	oP		5
Elective modules							
Elective Module 3	2	1	1				5
Elective Module 4	2	1	1				5
Sum. 2nd Semester							30
3rd semester							
Master's thesis				§ 30*	H		25
Master's thesis colloquium				§ 33*	C/P	45 min.	5
Sum. 3rd Semester							30
Degree program total							90
Elective modules (4 are to be chosen in total)							
"OMICS" Technologies	2	0	2	LNW	M	30 min.	5
Applied Thermodynamics	2	2	0	LNW	K	120 min	5
Enzyme development	2	1	0		K	90 min.	5
German as a Foreign Language	0	4	0	TN80	K	90 min.	5
Molecular Diagnostics	2	0	1	LNW	K	90 min.	5
Molecular Recognition and Pharmacodynamics	3	0	0		K	60 min.	5
Next Generation Sequencing, Databases and Bioinformatics	3	0	1	LNW	K	90 min.	5
Project Work 2	0	0	4		PRO		5
Quality Management	2	2	0	LNW	K	90 min	5
Technical and Scientific Communication Skills					oP		5
Technical statistics of quality assurance	1	2	0		E/B		5
Vaccines	2	1	0	LNW	M	30 min	5

*General provisions Study and examination regulations with a Master's degree

Module completion:	K	Written Examination	Examination prerequisite:	LNW	Ungraded Assessment
	M	Oral examination		TN 80	Proof of attendance 80%
	PRO	Project			
	H	Term paper			
	E/B	Design concept/paper			
	R	Research paper on an assigned topic			
	Ex	Experiment description			
	P	Presentation			
	C	Colloquium			
	oP	Module completion without examination/grade			

Course types:	V	Lecture (*Vorlesung*)
	Ü	Practical course (*Übung*)
	P	Lab/studio class (*Praktikum*)

Appendix 2

Standard course progression[2]

1st semester	(15) weeks - lectures, practical courses, lab/studio classes, excursions	(4) weeks internships, practical courses, projects, excursions - examinations	30 Credits
2nd semester	(15) weeks - lectures, practical courses, lab/studio classes, excursions	(4) weeks internships, practical courses, projects, excursions - examinations	30 Credits
3rd semester	20 weeks - Master's thesis and colloquium		30 Credits

Module examinations should ideally be scheduled during designated examination period and may also take place during term time.

Appendix 3

Module names Englisch-German

Module names - English	Modul names - German
CM 1 Special methods in cell culture and tissue engineering	*PM 1 Spezielle Methoden in Zellkultur und Tissue Engineering*
CM 2 Advanced genetics and genetic engineering	*PM 2 Genetik und Gentechnik für Fortgeschrittene*
CM 3 Cellular signal transduction	*PM 3 Zelluläre Signaltransduktion*
CM 4 Pharmaceutical biotechnology	*PM 4 Pharmabiotechnologie*
CM 5 Recombinant protein production	*PM 5 Rekombinante Proteinproduktion*
CM 6 Project Management	*PM 6 Projektmanagement*
CM 7 Project work 1	*PM 7 Projektarbeit 1*
CM 8 Project work 2	*PM 8 Projektarbeit 2*
EM 1 "OMICS" technologies	*WPM 1 "OMICS"-Technologien*
EM 2 Enzyme development	*WPM 2 Enzymentwicklung*
EM 3 Ethics in the life sciences	*WPM 3 Ethik in den Lebenswissenschaften*
EM 4 Molecular diagnostics	*WPM 4 Molekulare Diagnostik*
EM 5 Next Generation sequencing, databases and bioinformatics	*WPM 5 Next Generation Sequenzierung, Datenbanken und Bioinformatik*
EM 6 Vaccines	*WPM 6 Vakzine*

2 To be adapted according to the normal program length. Generally, the 15+3-weeks cycle applies, the exception being cooperative degree programs in cases of individual semesters affected by internships.

MOB01 Cellular Signal Transduction	**Compulsory Module**	
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	Prof. Dr. Kathrin Gnoth	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	0 h
	Practical Course	45 h
	Lab	15 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	PowerPoint presentations, lecture notes, catchword lists, problem sets	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	1 Ungraded Assessment	
Examination	Oral Examination, 30 Minutes	

Learning Objectives:
Imparting of basics in processes of cellular signal transmission/transduction which qualify the students to:

– Plan and perform experiments for elucidation of signal transduction pathways, in which a certain factor of interest is involved
– Establish and use systems for target validation in the context of pharmaceutical research
– Establish and use reporter- and screening systems, respectively, for detection of specific agents

Contents:

Practical Course

– Hormones and receptors
– Second messengers
– Phosphorylation / dephosphorylation as a regulatory principle
– Proteolysis and its inhibition as a regulatory principle
– Important cellular signal transduction pathways
– Transcription factors and their activation
– Proinflammatory signals
– Proliferative signals
– Apoptotic signals
– Defective signalling and cancerogenesis
– Integration of signalling pathways and "cross talk"
– Tools for identification of signalling pathways
– Generation of reporter systems suitable for the screening for specific agents

– Working on different questions covering the entire topic, derivation and drawing of signaling pathways

Lab

– Performance of cellular NO-Assay for detection of pro-inflammatory effects and apoptosis assay.

– Self-dependent preparation of one protocol each group of 5-6 students. Scientific exact description and critical discussion of the results is required. The protocol counts as a prerequirement and must be submitted at least 10 days before the examination.

Literature:

– **Gomperts, B. D.; Kramer, I. M.; Tatham, P. E. R.:** Signal Transduction, Academic Press, San Diego

– **Beckerman, M.:** Molecular and Cellular Signaling, Springer, Berlin

– **Marks, F.; Klingmüller, U.; Müller-Decker, K.:** Cellular Signal Processing, New York Oxford

– **Robert A. Weinberg, R. A.:** The Biology of Cancer, Garland Science, Heidelberg

– **Krauss, G.:** Biochemistry of Signal Transduction and Regulation, Wiley-VCH, Weinheim New York Chichester Brisbane Singapore Toronto

Prerequisites:
Basic knowledge in biology, cell biology, cell culture and gene technology

Further Informations:
http://themedicalbiochemistrypage.org/signal-transduction.html

www.cellsignal.com

MOB02 Molecular Genetics and Genetic Engineering		**Compulsory Module**
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	Prof. Dr. Kathrin Gnoth	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	0 h
	Lab	30 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	Power Point presentations, lecture notes	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Written Examination, 90 Minutes	

Learning Objectives:
– Understanding the molecular basis of genetic processes
– Understanding the molecular basis of genetic engineering techniques
– Acquire knowledge about the toolkit of genetic engineering
– Get an overview of gene technology methods used in research and practice
– Apply acquired knowledge and methodologies to new tasks
– self-dependent data analysis, evaluation and interpretation

Contents:
Lecture

– Molecular genetics
- Genome structure of bacteria, eukaryotes and viruses
- Molecular mechanisms of replication, recombination and gene expression
- Mutation and repair
- Virus infection and host defense strategies
- Transposons
- Epigenetics

– Genetic engineering
- Sanger Sequencing
- DNA, RNA, Protein electrophoresis
- Northern, Southern, Western blotting
- PCR/RT-PCR-based methods
- Cloning strategies
- Array technology
- RNA seq
- RNAi
- Genome editing

Lab
– Transformation of *E.coli* cells
– Isolation of plasmids and analysis by gel electrophoresis
– Restriction digestion of isolated plasmids
– Identification of recombinant clones by sequencing and basic local alignment search tool (BLAST-) based data evaluation
– CRISPR/Cas9

Literature: • **Alberts B.** *et al.*: Molecular Biology of the Cell, Garland Science • **Madigan M. T.** *et al.*: Brock Biology of Microorganisms, Pearson • **Krebs J. E.** *et al.*: Lewin's Genes, Jones and Bartlett Publishers • **Berg, J. M.** *et al.*: Stryer Biochemistry
Prerequisites: Basic knowledge in biology, genetics, biochemistry
Links To Further Informations: None

MOB03 Pharmaceutical Biotechnology		**Compulsory Module**
Programm	Molecular Biotechnology	
Person Responsible For Module	Dr. Daniel Ramsbeck	
Lecturer	Dr. Daniel Ramsbeck	
Semester	Winter	
Workload	110 h, Pertaining Only To On-Campus Classes 45 h	
Types Of Instruction	Lecture	30 h
	Practical Course	15 h
	Lab	0 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	PowerPoint presentations, lecture notes, catchword lists, problem sets	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Oral Examination, 30 Minutes	

Learning Objectives:
Imparting of basic knowledge in pharmaceutical biotechnology which qualify the students to:

– Be able to select an (almost) unmet medical need for future drug development
– Identify corresponding medical targets
– Establish appropriate bioassays and screen for drug candidates
– Produce and optimize the drug candidates
– Develop and perform methods for in vitro toxicity tests

Contents:
Lecture

– Medical needs
– Target identification and validation
– Construction of compound libraries
– Establishment of assays and screening for drug candidates
– Aspects and basic strategies of lead optimization
– Recombinant production of pharmaceutical proteins
– Safety aspects

Practical Course

Working on different questions covering the entire topic

Literature:
Dagmar Fischer and Jörg Breitenbach: Die Pharmaindustrie: Einblick - Durchblick - Perspektiven, Springer Spektrum

Different Review Articles

Prerequisites:
Basic knowledge in biology, cell biology, cell culture and genetic engineering

Further Informations:
None

MOB04 Project Management **Compulsory Module**		
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Stephan Schilling	
Lecturer	Prof. Dr. Stephan Schilling, Pierre Tangermann	
Semester	Winter	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	30 h
	Lab	0 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	PowerPoint presentations, lecture notes, internet resources	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Oral Examination, 30 Minutes	

Learning Objectives:
To convey all requirements for successful project organization and to qualify the student to:

– self-dependent organization of (scientific) projects
– analyze the specific project environment and stakeholders
– to conduct, monitor an finalize projects including different kinds of project reporting
– use relevant tools and methods for resource allocation and planning
– perceive and leverage project management as a strategy-forming element for value creation in forward-looking organizations

Contents:
Lecture and Practical Course

- Introduction to project management - project definition
- types of projects (emphasis on biotech)
- project portfolio, prioritization and valuation
- phases of projects
- quality aspects of projects
- legal aspects (e.g. patent management)
- publication processes
- project organization (e.g. matrix) and organizational units
- project plans (structure, resources, costs)
- evaluation (time, content)
- monitoring and reporting

Literature:

- A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 7th edition, PMI
- Project Management Essentials, 2nd edition, Kathryn N. Wells, Timothy J. Kloppenborg
- Patent Guides from several authority bodies available, The UK Patent Guide Is recommendable

Prerequisites:
Basic knowledge in life sciences

Further Informations:
https://www.hs-anhalt.de/moodle/

MOB05 Recombinant Protein Production		**Compulsory Module**
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	Prof. Dr. Kathrin Gnoth, Prof. Dr. Jana Rödig, Dr. Sabine Pech	
Semester	Winter	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	15 h
	Lab	0 h
	Time Spent In Independently Studying	80 h
Types Of Media Used	PowerPoint presentations, lecture notes, catchword lists, problem sets	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Written Examination, 90 Minutes	

Learning Objectives:
Imparting of comprehensive knowledge in recombinant protein production which qualify the students to:

– Be able to decide whether the recombinant production of a protein of interest does make sense
– Select the appropriate expression system for recombinant production of a certain protein
– Construct the required expression vector, plan and perform experiments for recombinant production of a protein of interest
– Optimize expression conditions, purify and analyse the recombinant protein

Contents:
Lecture
– Reasons for recombinant production of proteins (e.g. drugs, vaccines, antibody fragments, diagnostic enzymes, technical enzymes)
– Expression systems (e.g. bacteria, yeast, insect cells, algae, mammalian cells)
– Strategies for optimization of recombinant production (e.g. codon usage, promoters, gene dose effects)
– Fusion proteins / functional tags
– Purification of recombinant proteins
– Refolding of recombinant proteins
– Analysis of recombinant proteins (e.g. gel electrophoresis, HPLC, capillary zone electrophoresis, mass spectrometry)

Practical Course

Working on different questions covering the entire topic

Literature:
- **Cornel Mülhardt**: Molekularbiologie / Genomics, Spektrum Akademischer Verlag
- **Michael Wink**: Molekulare Biotechnologie: Konzepte, Methoden und Anwendungen, Wiley-VCH
- **Bernard R. Glick and Cheryl L. Patten**: Molecular Biotechnology: Principles and Applications of Recombinant DNA (ASM), Wiley
- **Nagesh K. Tripathi and Ambuj Shrivastava**: Recent Developments in Bioprocessing of Recombinant Proteins: Expression Hosts and Process Development, *Front. Bioeng. Biotechnol.* 7: 420, 2019
- **Primary publications, review articles, websites of companies**

Prerequisites:
Basic knowledge in biology, cell biology, cell culture and genetic engineering

Further Informations: None

MOB06 Special Methods In Cell Culture And Tissue Engineering
Compulsory Module

Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	Prof. Dr. Kathrin Gnoth	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	0 h
	Lab	30 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	PowerPoint presentations, lecture notes, catchword lists, problem sets	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	1 Ungraded Assessment	
Examination	Written Examination, 90 Minutes	

Learning Objectives:
Imparting of comprehensive knowledge in cell culture and tissue engineering which qualify the students to:

- equip a cell culture laboratory and to handle the required sterilization techniques
- take mammalian and other cells into culture, to passage, count and freeze them and to monitor them by use of microscopes
- to understand modern applications of cell culture such as FACS, CASY, transfection of cells, generation of hybridoma cells, cell culture in generation of transgenic animals and more
- to know the basics in generation of three-dimensional tissue cultures
- to understand the generation and use of organ-on-a-chip models
- to know how to isolate and use embryonic stem cells
- to handle high tech cell culture devices
- to communicate with experts in this field in an appropriate way

Contents:
Lecture

- Equipment of a cell culture laboratory
- Preparation of media
- Standard methods of cell culture
- Preparation of primary cell cultures, three-dimensional tissue and organ cultures
- Organ-on-a-chip models
- Isolation, induction and use of stem cells
- Cytotoxicity assays
- Modern methods and applications of cell culture (CASY, FACS, transfection of cells, hybridoma cells and more)

Lab

- Basics in cell culture (working sterile, change of medium, passaging of cells, counting of cells, vitality check, cloning of cells, freezing of cells)
- Use of flow cytometer for analysis of cells
- Generation and culturing of artificial skin

Literature:

- **Lindl, T.; Gstraunthaler, G.:** Zell- und Gewebekultur, Spektrum Akademischer Verlag, Heidelberg Berlin Oxford
- **Schmitz, S.:** Der Experimentator: Zellkultur, Spektrum Akademischer Verlag, Heidelberg Berlin Oxford

- **Minuth, W. W.; Strehl, R.; Schumacher, K.:** Von der Zellkultur zum Tissue Engineering, Pabst Science Publishers, Lengerich
- **Freshny, R.I.:** Culture of Animal Cells: A Manual of Basic Technique, Wiley & Sons

Prerequisites:
Basic knowlegde in biology and cell biology

Further Informations:
https://www.hs-anhalt.de/moodle/

MOB07 Enzyme Development **Elective Module**		
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Stephan Schilling	
Lecturer	Prof. Dr. S. Schilling, Prof. Dr. J. Rödig, Prof. Dr. C. Grewe	
Semester	Winter.	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	15 h
	Lab	0 h
	Time Spent In Independently Studying	80 h
Types Of Media Used	PowerPoint presentations, lecture notes, catchword lists, problem sets	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Written Examination, 90 Minutes	

Learning Objectives:
Imparting of basics in enzyme development which qualify the students to:

– Identify enzymes for specific applications
– Biochemically characterize enzymes
– Optimize enzymes concerning different aspects
– Produce, immobilize and use enzymes for specific applications

Contents:
Lecture
– Introduction to enzymes and their applications
– Enzyme characterization and kinetics
– Enzyme identification and optimization (directed evolution and rational design / modeling)
– Enzyme production from lab to large scale
– Use of enzymes including immobilized forms

Practical Course
– Working on different questions covering the entire topic

Literature:
– **Manfred T. Reetz**: Directed Evolution of Selective Enzymes, Wiley-VCH
– **Currin, A., Swainston, N., Day, P.J. and Kell, D.B.** (2015). Synthetic biology for the directed evolution of protein biocatalysts: navigating sequence space intelligently. *Chem. Soc. Rev.* 44, 1172-1239.
– **Lutz, S. (2010).** Beyond directed evolution - semi-rational protein engineering and design. *Curr. Opin. Biotechnol.* 21, 734-743.
– **Wang, M., Si, T. and Zhao, H. (2012).** Biocatalyst Development by Directed Evolution. Bioresour. Technol. 115C, 117-125.

Prerequisites:
Basic knowledge in biochemistry and genetic engineering

Further Informations:
None

MOB08 Ethics In Life Sciences

Elective Module

Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Jens Hartmann	
Lecturer	Prof. Dr. Jens Hartmann, Prof. Dr. Fabian Herz	
Semester	Winter.	
Workload	125 h, Pertaining Only To On-Campus Classes 45 h	
Types Of Instruction	Lecture	0 h
	Practical Course	45 h
	Lab	0 h
	Time Spent In Independently Studying	80 h
Types Of Media Used	Bill of instructions, literature research about data bases, own internet studies (films, websites), weekly newspapers	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	Term Paper	
Examination	-	

Learning Objectives:

The aim of the newly introduced compulsory elective module in **Ethics in Life Sciences** is to confront and sensitize students of all courses of study in the applied biosciences and process engineering with ethical principles and problems in their future engineering activities and to provide guidelines and rules as an orientation in ethical and moral issues. In addition to general principles of the engineer and philosophical terminology (progress, responsibility and sustainability), the focus is on the theory of follow-up ethics in the context of technical innovations in the life science area (e.g. energy transition, animal husbandry and food, automation). The growth society with constant profit maximization should be opposed to a professional code of engineers, which discusses terms such as safety / risk, sustainability, environmental protection and the courage to turn around growth in a series of decisions and bring them into the future society.

The students should use numerous case studies (contents) to inform themselves, discuss and make decisions or comment on them. The success of module goals is crucially on the activity of the students in their private studies with the help of own literature sources about literature research.

Contents:

Seminar

This is a project module in which five teams with 4 students each form. Each team independently develops a chosen topic from the catalog (see contents)

Main focus of research ethics in:

(1) Medical research / decision between life and death
(2) Animal experimentations / animal ethics first!
(3) Human experimentations / optimizing people?
(4) Stem cells and gene editing / scientists as creators?
(5) Artificial intelligence in life sciences / data acquisation, management, sharing and ownership
(6) Conflicts of interest and commitment
(7) Reaserch work in life sciences: Reproducibility of results
(8) Gene therapy and personalized medicine
(9) Antibody use as new therapeutical tools / benefit and serious complications
(10) Modern agriculture / role of gene technology
(11) Preimplantation diagnosis / right to life of disabled people
(12) Own election topic (biodata science+ biopower, food industry, pharma research, bioenergy)

Literature: See Moodle Course: Ethics in Life Sciences https://moodle.hs-anhalt.de/course/view.php?id=2291
Prerequisites: Basic knowledge in natural sciences and technologies
Further Informations: https://www.hs-anhalt.de/moodle/

MOB09 Molecular Diagnostics

Elective Module

Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	Prof. Dr. Kathrin Gnoth, Prof. Dietrich Mäde, Laura Orgus	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	0 h
	Lab	15 h
	Time Spent In Independently Studying	80 h
Types Of Media Used	PowerPoint presentations, lecture notes, catchword lists, problem sets	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	1 Ungraded Assessment	
Examination	Written Examination, 90 Minutes	

Learning Objectives:
Imparting basic techniques of modern laboratory diagnostics which qualify the students to

- Plan and perform experiments for the identification of disease-relevant genes and their products
- Develop and validate methods in the most important fields of molecular diagnostics at the nucleic acids (including forensic analysis) as well as the protein and other levels (e.g. blood glucose)
- Detect pathogenic microorganisms in samples
- Determine animals in samples
- Decide which devices are necessary and suitable for certain diagnostic analysis with particular focus on molecular diagnostics and to be able to contribute to research on technical refinement or even novel technologies in this field

Contents:

Lecture

- Identification of disease-relevant genes and their products: Basics of linkage analysis, differential screening at the nucleic acids (e.g. microchip array hybridization) and the peptide/protein level (2D-PAGE, mass spectrometry, ICAT)
- Methods and devices for diagnostics at the nucleic acids level (PCR, real-time-PCR, DNA sequence analysis, oligonucleotide ligation test etc.)
- Methods and devices for diagnostics at the peptide/protein level (enzyme-based assays, immunoassays such as ELISA, CEDIA, SELDI with antibody-coated chips and others)
- Special methods in infectiology (special PCR methods, transcription-mediated amplification / TMA, strand displacement amplification / SDA, branched chain amplification, hybrid capture and others)
- Other special applications of laboratory diagnostics (cancer diagnostics, prenatal diagnostics, forensics, food analysis, environment protection)

Lab

- Microsatellite analysis, fragment analysis by capillary zone electrophoresis
- Use of lateral flow devices for detecion of genetically engineered soybeans

Literature:

- **Frank Thiemann, Paul M. Cullen und Hanns-Georg Klein**: Leitfaden Molekulare Diagnostik - Grundlagen, Gesetze, Tipps und Tricks, Wiley-VCH
- **Lela Buckingham and Maribeth L. Flaws**: Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, Publisher F.A. Davis
- **George Patrinos and Wilhelm Ansorge**: Molecular Diagnostics, Publisher Elsevier LTD

– **Rodriguez-Lazaro, David**: Real-Time PCR in Food Science: Current Technology and Applications, Caister Academic Press
Prerequisites: Basic knowledge in molecular biology and gene technology
Further Informations: https://www.hs-anhalt.de/moodle/

MOB10 Next Generation Sequencing, Databases and Bioinformatics **Elective Module**		
Program	Molecular Biotechnology	
Person Responsible for Module	Msc. Ting Cui	
Lecturer	Msc. Ting Cui	
Semester	Summer	
Workload	125 h, Pertaining Only to On-Campus Classes 60 h	
Types Of Instruction	Lecture	45 h
	Practical Course	0 h
	Lab	15 h
	Time Spent in Independently Studying	65 h
Types Of Media Used	PowerPoint presentations, problem sets	
Credits	5 Credit Points	
Language	English	
Examination Prerequisite	1 Ungraded Assessment	
Examination	Written Examination, 90 Minutes	

Imparting knowledge of the various Next-Generation Sequencing (NGS) technologies, bioinformatics and their applications in basic and applied science as well as the basics of sequence data analyses to enable students to

– plan both wet-lab and dry-lab procedures for NGS based analyses
– perform basic sequence data analyses
– assess the validity of NGS based results and conclusions drawn thereof
– predict protein structure and dock with other molecules

Contents:
Lecture and Lab
– Differentiation between 1st, 2nd, and 3rd generation sequencing
– common features of next-generation sequencers
– Functioning of the different 2nd generation sequencing technologies in detail (Illumina, Ion Torrent, 454, SOLiD)
– Overview of 3rd generation sequencers
– Comparison of the platforms, their pros and cons
– Selected applications: whole-genome shotgun sequencing, transcriptomics (RNA-seq), metagenomics, amplicon sequencing
– Data generated by NGS, software for NGS data analyses tailored to the specific application
– Basics of Linux
– Tools for sequence analyses
– Prediction and analysis of protein structure
– Exercises at the computer

Literature:
Relevant references will be provided for each lesson

Prerequisites:
Basic knowledge in biochemistry, gene technology, and computer use

Further Informations:
https://www.hs-anhalt.de/moodle/

MOB11 "OMICS" Technologies **Elective Module**		
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Dirk Benndorf	
Lecturer	Deputy Prof. Dr. Dirk Benndorf	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	0 h
	Lab	30 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	black board, lecture notes, PowerPoint presentations, scientific publications	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	1 Ungraded Assessment	
Examination	Oral Examination, 30 Minutes	

Learning Objectives:
Imparting of basics in high-throughput analysis on the different omics levels (genomics, transcriptomics, metabolomics) and bioinformatic analysis of respective data:

- Plan and perform single or multi omics experiments
- Establish and apply omics technologies for exploration of cellular responses to environmental challenges
- Establish and apply omics technologies for exploration of microbial communities
- Evaluate the quality of omics data and transfer of findings to more targeted research

Contents:
Lecture

- Gas chromatography and liquid chromatography
- Mass spectrometry
- Experimental design and sample preparation
- (Meta-) proteomics
- Lipdomics
- Glycomics
- Metabolomics
- Data integration (including data from genomics and trancriptomics)

Lab

- Protein extraction (phenol extraction) and quantification (Amido Black assay)
- Protein electrophoresis (SDS-PAGE)
- Sample preparation for protein identification by mass spectrometry (reduction, alkylation and tryptic digestion)
- Measurement by mass spectrometry (nanoHPLC-MS/MS)
- Bioinformatic analysis of mass spectra for protein identification (database preparation, database search, pathway analysis)

Examination Prerequisite (Ungraded Assessment) Oral presentation / lab protocol

Literature:

- Lottspeich, F., Engels, W.J.: Bioanalytik. Springer, Berlin/Heidelberg, 2012
- Collection of review articles in English language provided via moodle.

Prerequisites:
Grundkenntnisse der Biologie und Zellbiologie

Further Informations:
https://www.hs-anhalt.de/moodle/

MOB12 Vaccines	**Elective Module**	
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Jana Rödig	
Lecturer	Prof. Dr. Jana Rödig	
Semester	winter	
Workload	125 h, Pertaining Only To On-Campus Classes 45 h	
Types Of Instruction	Lecture	30 h
	Practical Course	15 h
	Lab	0 h
	Time Spent In Independently Studying	80 h
Types Of Media Used	Lecture material such as manuscriptes, slides, white/black board, publications, references, world wide web	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	1 Ungraded Assessment	
Examination	Oral Examination, 30 Minutes	

Learning Objectives:

The students know the basics of virology. They acquire fundamental knowledge of immunology with a focus on vaccine-related B- and T-cell mediated immunity. The students are able to explain vaccine-mediated protection/ therapy and are able to deduce potential risks and/ or contraindications. The students know the definitions of terms such as API, small molecules, biologics, biopharmaceuticals, preventive and therapeutic vaccines and are able to distinguish them. They know the different vaccine approaches and are able to explain advantages and disadvantages as well as potential risks of the different technologies. The students know what components a final vaccine consists of and are able to explain the function in detail for selected examples. The students know the steps from vaccine and process (USP-, DSP-) development to vaccine approval. They are familiar with the basics of GMP and know general structures of commercially producing vaccine manufacturers. Beside the classical methods for vaccine production students know future vaccine concepts.

Content:

Lecture

- Vaccine history
- Basics of virology
- Basics of vaccine immunology
- Vaccine development, production and purification
- Vaccine formulation
- Selection of vaccine-relevant analytics
- GMP & vaccine approval
- Examples
- Trends in vaccine research and development

Seminar

Within the seminars working with and understanding of various scientific publications is trained. The students will expand their personal competences and skills in presenting and discussions scientific contents.
Trips and/or invited lecture will give insigths into public and/or commercial biopharmaceutical research and development and/or production.
The acceptance of seminar exercises represents a preparatory assessment (1 ungraded assessment) and has to be accepted until a minimum of 10 days before examination.

Literature:

- Immunologie, C. A. Janeway / P. Travers, M. Walport, M. Shlomchik; Spektrum, Akad. Verl., 2002
- Vaccines, S. A. Plotkin W. A. Orenstein, P. A. Offit, Elsevier, 2012]
- Allgemeine Mikrobiologie, H. G. Schlegel, Thieme, 1992
- Medizinische Mikrobiologie, F.H. Kayser, K. A. Bienz, J. Eckert, R.M. Zinkernagel, Thieme, 2001
- GMP – Qualifizierung und Validierung von Wirkstoffanlagen, R. Gengenbach, WILEY-VCH Verlag, 2008
- Pharmaceutical Biotechnology, G. Walsh, John Wiley & Sons Ltd., 2007
- Nonclinical Development of Novel Biologics, Biosimilars, Vaccines and Specialty Biologics, L. Plitnick, Academic Press, Elsevier, 2013]
- Ausgewählte, variierende Publikationen (Bekanntgabe im Rahmen der Übung und/oder Vorlesung

Prerequisites:
Bachelor-grade in a related field such as biology, biotechnology, medicine, pharmacy

Links To Further Informations:
https://www.hs-anhalt.de/moodle/

MOB15 Applied Thermodynamics		**Compulsory Module**
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Jörg Sauerhering	
Lecturer	Prof. Dr. Jörg Sauerhering	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	30 h
	Lab	
	Time Spent In Independently Studying	65 h
Types Of Media Used	Black board, Power Point presentations, lecture notes	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Written Examination, 120 Minutes	

Learning Objectives:
–Based on the basic statements of thermodynamics and the state behavior of systems, the students can analyze and optimize processes for heat transport and energy conversion.
-The sound fundamental knowledge enables a reliable assessment of the processes taking place in industrial applications with regard to efficient resource use.

Contents:
Lecture
-Laws of thermodynamics and their applications
-State behavior of elementary and complex systems, ideal and reals gases and fluids, multiphase systems
-Transient and non-transient heat transport by conduction, convection and radiation in plane and non-plane systems
-Application of the similarity theory
-Condition changes in open flow-through balance spaces. Application to pumps, compressors, turbines and others
-Processes for energy conversation in power plants, HVAC and refrigeration technology

Literature:
- **Andrews, Frank: Thermodynamics: principles and applications, Wiley**
- **Holman, J.P.**: Thermodynamics, McGraw-Hill

Prerequisites:
Basic knowledge in physics, math as well as

Links To Further Informations:
- https://www.thermopedia.com/
- Thermodynamic Lectures by Blake, Donald R. (UCI)
- Moodle

MOB16 Quality Management	**Elective Module**	
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Jean Titze	
Lecturer(s)	Prof. Dr. Elvira Mavric-Scholze, Prof. Dr. Jean Titze	
Semester	Winter	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	30 h
	Practical Course	30 h
	Lab	
	Time Spent In Independently Studying	65 h
Types Of Media Used	Black board, Power Point presentations, lecture notes	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Written Examination, 90 min.	

Learning Objectives/Skills:
• Know and be able to apply important basics of quality management,
• Raising awareness of special quality management requirements,
• Knowledge of the tasks and tools of quality management,
• Knowledge of the relevant certification systems,
• Knowledge of the DIN EN ISO 9000 ff series of standards,
• Knowledge of quality-relevant parameters of products and processes,
• Knowledge of quality determination and quality measurement procedures,
• Ability to select tools and methods from the area of quality management and use them in companies and their suppliers,
• Competence in assessing quality management concepts,
• Know and be able to apply important basics of statistical quality control, e.g. analyzing and drawing up test plans, applying process capability indices and designing elements of statistical process control, carrying out interlaboratory tests and
• Preparation for training to become a quality management specialist (QMS-TÜV) and Quality management representative (QMR-TÜV)

By conveying the teaching material in a combination of lectures and group work, interdisciplinary skills such as teamwork and group discussion are developed. The students are prepared for professional life through enough practical relevance of their studies, for example to help set up and maintain a process-oriented management system.

Under certain conditions, students have the opportunity to acquire the qualifications as
1. Quality management specialist (QMS-TÜV) and
2. Quality management representative (QMR-TÜV)
from the TÜV SÜD Academy as part of this module.

Contents:
1 Basic principles, history, terms and definitions
1.1 Basic principles of quality management and historical development
1.2 Basic principles management system
1.3 Role of the quality management representative (QMR}
2 Process management
2.1 Basic principles process management
2.2 Process management in organisation
3 Documentation
3.1 Basic principles documentation
3.2 Documentation structures
4 Continual improvement process (CIP)
4.1 Basic principles CIP
4.2 Continental improvement process - process, methods, tools

4.3 Nonconformity and complaint management
5 Standards
5.1 Overview of standarcls in quality management
5.2 Overview of ISO 9001:2015
5.3 Operational implementation of the standard ISO 9001:2015
6 Performance measurements and evaluations
6.1 Basic principles statistics
6.1 Basic principles of measurements and tests
6.3 Process reliability and quality control charts
6.4 Measuring equipment management
6.5 Customer satisfaction
6.6 Audit Basics
6.7 Certification and Accreditation
7 Methods and Tools
7.1 Basic principles methods and Tools
7.2 Selected QM methods
8 Quality management and law
8.1 Product liability and product safety
9 Supplier management
9.1 Supplier management
10 Strategie QMS
10.1 Risk management
10.2 Fundamentals of agile methods in quality management

Literature:

TÜV SÜD Akademie GmbH (ed.): Quality management specialist (QMS-TÜV), training materials.

TÜV SÜD Akademie GmbH (ed.): Quality management representative (QMS-TÜV), training materials.

PFEIFER, T., 2014: *Masing Handbuch Qualitätsmanagement*, 6. ed., Carl Hanser, München.

REINERT, U., BLASCHKE, B. and BROCKSTEIGER, U., 2013: *Technische Statistik in der Qualitätssicherung: Grundlagen für Produktions- und Verfahrenstechnik*, Springer, Berlin.

TITZE, J. and ILBERG, V., 2007: *Reduzierung des Produktionsrisikos – Statistischer Probenumfang für die Wareneingangskontrolle "Malz"*. – BrauIndustrie 92, no. 10, pp. 67-71.

GOLDRATT, E. M. and COX, J., 2013: *Das Ziel: Ein Roman über Prozessoptimierung*, 5. ed., Campus, Frankfurt am Main.

CLAUSEWITZ, C., 2008: *Vom Kriege: vollständige Ausgabe*, Nikol, Hamburg.

TZU, S. and TZU, S., 2018/2019: *Die Kunst des Krieges*, Nikol, Hamburg.

Since the module documents (lecture and internship scripts, collection of tasks, etc.) are constantly updated and changed by the lecturers, the students receive the latest version at the beginning of the first lecture. Therefore, you should bring a USB stick with you.

Prerequisites:
Basic knowledge in general business administration, marketing and mathematical statistics

Links To Further Informations:

- https://fzarchiv.sachon.de/index.php?restrict=default&words=Reduzierung%20des%20Produktionsrisikos&startyear=1998&endyear=2019&shpdf=Zeitschriftenarchiv/Getraenke-Fachzeitschriften/Brauindustrie/2007/10_07/BI_10-07_67-71_Reduzierung_des_Produktionsrisikos.pdf#all_thumb
- Moodle

MOB17 Molecular Recognition and Pharmacodynamics
Elective Module

Programm	Molecular Biotechnology	
Person Responsible For Module	Dr. Daniel Ramsbeck	
Lecturer	Dr. Daniel Ramsbeck	
Semester	Summer	
Workload	125 h, Pertaining Only To On-Campus Classes 45 h	
Types Of Instruction	Lecture	30 h
	Practical Course	0 h
	Lab	0 h
	Time Spent In Independently Studying	95 h
Types Of Media Used	Lecture material such as manuscriptes, slides, white/black board, publications, references	
Credits	5 Credit Points	
Language	Englisch	
Examination Prerequisite		
Examination	Written Examination, 60 Minutes	

Learning Objectives:

The students know basic concepts of pharmacology and they can explain how drugs (small molecules, peptides/proteins, oligonucleotides) work. They can describe different types of interactions and can explain the interaction of biomolecules at the molecular level. They are able to visualize and analyse receptor-ligand complexes and justify the binding modes of drugs to their targets. The students know the concepts of receptor theory and are able to explain the theoretical background of dose-response in drug binding. They know different receptors as important drug targets, can explain their function and interpret how drugs act on them to exert their effects.

Content:

Lecture

- Intra- and intermolecular interactions in biomolecular recognition
- Visualization of protein-ligand complexes and interpretation of binding modes (hands-on training ChimeraX) – lecture with practical content; homework: visualization project
- Law of mass action and dose-response
- receptor theory
- Receptors as drug targets
- Ion-channels as drug targets
- Biopharmaceuticals

Literature:

- Rang and Dale's Pharmacology, 9th edition, 2020, Elsevier
- Freissmuth, Offermanns, Böhm, Pharmakologie und Toxikologie, 3. Auflage, 2020, Springer
- Selected publications and references in the learning material (moodle)

Prerequisites:
Bachelor-grade in a related field such as biology, biotechnology, biochemistry, pharmacy

Links To Further Informations:
https://www.hs-anhalt.de/moodle/

Modul MOB Technical statistics of quality assurance		**Wahlpflichtmodul**
Studiengang	Master Molecular Biotechnology (MOB)	
Modulverantwortlicher	Prof. Dr. Jean Titze	
Dozent(en)	Prof. Dr. Jean Titze	
Semester	Sommersemester/ *summer semester*	
Aufwand	125 Stunden einschließlich 45 Lehrstunden	
Lehrformen	Vorlesung	15 h
	Übung	30 h
	Praktikum	0 h
	Selbststudium und Prüfungsvorbereitung	80 h
Medienformen	Vorlesungsmaterialien, Aufgabensammlung, Literaturverzeichnis/Internet	
Bewertung	5 Credits	
Sprache	Englisch	
Prüfungsvorleistung	Keine	
Prüfungsleistung	E/B	

Learning objectives/competencies:

The correct handling of measured values in industry requires knowledge of mathematical statistics in quality assurance. The following principle applies to all scientific measurements and work:

"*The correct statistics is the grammar of science!*"

Fundamentally, every measured quantity has a so-called true (measured) value. This true value is usually sought after. However, since the true value is often unknown, it can only be determined using an estimate. A measurement result should always be understood as representing only the best estimate of the (true) value associated with the measured quantity.

Students deepen their knowledge and understand how to correctly present and interpret measurement results.

Students understand and evaluate the possible applications of the standard normal distribution and assess its information appropriately and critically.

They can also calculate errors and error propagation.

Based on DIN 1319, students received instructions on critically evaluating measurement results.

The module builds on the content of the Quality Management module.

Content:

One of the central tasks of a technologist is to promote and ensure the quality of a company's products. Objective product quality is largely determined by compliance with certain stability criteria, as this is an expression of product stability and thus a key condition for quality. To assess objective product quality, students will learn selected topics of mathematical statistics, in particular:

- Basic understanding of standard deviation as a measure of error and standard error
- Knowledge of distributions, especially the standard normal distribution
- Error calculation and propagation
- Accuracy, repeatability, and comparability
- Outlier tests and tests for normal distribution
- Empirical law of large numbers
- Central limit theorem

All students will complete a written assignment as proof of achievement. The performance assessment is divided into the following three parts:

Part 1 Statistical Quality Control

1.1 Evaluation of a new raw material for technological purposes

1.2 Evaluation of an analytical method

Part 2 Evaluation of surveys

2.1 Employee survey

2.2 Consumer survey

2.3 Validation of survey results with experts

Literature:

1. Reinert, U., Blaschke, H. and Brockstieger, U.: *Technische Statistik in der Qualitätssicherung*, Springer.
2. Titze, J., Jörissen, K. and Titze, C., 2021: *EU-Rundungsleitlinien – Eine runde Sache!* – Deutsche Lebensmittel-Rundschau (DLR) 117, no. 8, pp. 390-397.
3. DIN 1319-3: Grundlagen der Meßtechnik - Teil 3: Auswertung von Messungen einer einzelnen Meßgröße, Meßunsicherheit
4. DIN 1319-4: Grundlagen der Meßtechnik - Teil 4: Auswertung von Messungen; Meßunsicherheit
5. Bastgen, N., Ginzel, M. and Titze, J., 2019: *Precision of a small brew house by determining the repeatability of different brews to guarantee the product stability of the beer*. – Beverages 5, no. 4, pp. 67 ff.
6. Titze, J., Faltermeier, A., Schnitzenbaumer, B., Gastl, M., Becker, T., Ilberg, V. and Arendt, E., 2013: *Theoretical Study on a Statistical Method for the Simple and Reliable Pre-Selection of Wheat Malt Types for Brewing Purposes based on Generally Accepted Quality Characteristics*. – Journal of the American Society of Brewing Chemists 71, no. 2, pp. 67-75.
7. Schnitzenbaumer, B., Arendt, E. and Titze, J., 2012: *Statistical comparison of a new rheological method for defining changes in mash viscosity during mashing with the established Rapid Visco Analyser*. – Journal of Cereal Science 57, pp. 39-46.
8. Titze, J., Ilberg, V., Jacob, F. and Parlar, H., 2005: *A comparison of the EBC 9.8 method with a common applied HPLC analysis for determining bitterness in beer*. – Monatsschrift für Brauwissenschaft 59, no. 11/12, pp. 18-24.

Voraussetzungen:

keine

Links zu weiteren Dokumenten:

MOB13 Project Work 1, 2 **Compulsory / Elective Module**		
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	All lecturers	
Semester	Summer and winter semester	
Workload	125 h, Pertaining Only To On-Campus Classes 60 h	
Types Of Instruction	Lecture	0 h
	Practical Course	0 h
	Lab	60 h
	Time Spent In Independently Studying	65 h
Types Of Media Used	Written elaboration, oral presentation	
Credits	5 Credit Points	
Language	English	
Examination Prerequisite	-	
Examination	Project	

Learning Objectives:

- Students have the ability to work on scientific problems from different fields of research in molecular biotechnology under supervision by a lecturer.
- They realize problems, are able to perform corresponding searches and to utilize the obtained results for their project work.
- Under supervision and in discussion within project groups are the students able to design, perform and evaluate experiments.
- They are able to express the obtained results in an appropriate scientific idiom, to present and defend it.
- Besides of the expansion of knowledge the students develop competencies in solving of problems, as well as skills in team work and communication. Abilities such as independent working and analytical thinking are further developed.

Contents:

Selected scientific problems form the working groups of the different professors.

Lab

- In the case of a practical work (preferred), performance of experimental studies in the laboratories of the different professors.

Literature:

- Depending on the topic specific primary and review articles.

Prerequisites:
Basic knowledge in molecular biotechnology.

Further Informations:

MOB14 Master Thesis (Including Colloquium) **Compulsory Module**		
Programm	Molecular Biotechnology	
Person Responsible For Module	Prof. Dr. Kathrin Gnoth	
Lecturer	All professors	
Semester	3.	
Workload	750 h	
Types Of Instruction	Lecture	
	Practical Course	
	Lab	
	Time Spent In Independently Studying	
Types Of Media Used	Writte thesis, oral presentation	
Credits	25 + 5 Credit Points	
Language	Englisch	
Examination Prerequisite	-	
Examination	Written Thesis And Oral Presentation And Defense (30 min)	

Learning Objectives:

- Students are capable of scientifically working on a specific problem in the field of molecular biotechnology in an independent way under supervision.
- Students check their learned knowledge and practical skills under technical, analytical and methodical aspects.
- Students acquire competencies in working on and solving challenging scientific problems within a team.
- Students are able to present their obtained results in written and oral form and to discuss and defend it.

Contents:

- Students are involved in operational processes of companies and research projects of scientific institutions.
- Students get the opportunity to utilize the knowledge and skills acquired during their study for the practical solving of a challenging scientific problem.

Lab

Performance of experimental studies in the laboratories of a company or scientific institution.

Literature:

- Specific primary publications and review articles mainly found by the students own searches.
- Manuals / protocols of methods / processes already established by the company / scientific institution.

Prerequisites:

Successful completion of the required modules and passing of the corresponding examinations.

Further Informations: