UNIVERSITÄT ZU LÜBECK

Module Guide for the Study Path

Master Molecular Life Science 2023

Version from 3. April 2025

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CS4440-KP04, CS4440 - Molecular Bioinformatics (MolBioInfo)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	4

Course of study, specific field and term:

- Master CLS 2023 (optional subject), computer science, 3rd semester
- Master Molecular Life Science 2023 (optional subject), mathematics / computer science, 1st semester
- Master CLS 2016 (optional subject), computer science, 3rd semester
- Master MES 2011 (advanced curriculum), biophysics and biomedical optics, 2nd semester
- Master CLS 2010 (optional subject), computer science, 1st or 3rd semester
- Master Computer Science 2012 (compulsory), specialization field bioinformatics, 1st semester

Classes and lectures:

- Molecular Bioinformatics (lecture, 2 SWS)
- Molecular Bioinformatics (exercise, 1 SWS)

Workload:

- 55 Hours private studies
- 45 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:

- Methods for fast genome comparison
- Analysis of data describing gene expression profiles and sequence variation
- Advanced usage of biological databases (for sequences, motifs, structures, gene regulation and interactions)

Qualification-goals/Competencies:

- The students can apply indexing based software to Next Generation sequence data.
- They can use and design databases for molecularbiological research.
- They are able to detect statistically significant changes in Microarray data.

Grading through:

- written exam

Requires:

- Introduction to Bioinformatics (CS1400-KP04, CS1400)

Responsible for this module:

- Prof. Dr. rer. nat. Thomas Martinetz

Teacher:

- Institute for Neuro- and Bioinformatics

- Prof. Dr. Bernhard Haubold
- Prof. Dr. rer. nat. Thomas Martinetz
- MitarbeiterInnen des Instituts
- Prof. Lars Bertram

Literature:

- M. S. Waterman: Introduction to Computational Biology - London: Chapman and Hall 1995
- B. Haubold, T. Wiehe: Introduction to Computational Biology - Birkhäuser 2007
- R. Durbin, S. Eddy, A. Krogh, G. Mitchison: Biological sequence analysis. Probabilistic models - Cambridge, MA: Cambridge University Press
- J. Setubal, J. Meidanis: Introduction to computational molecular - Pacific Grove: PWS Publishing Company
- D. M. Mount: Bioinformatics - Sequence and Genome - New York: Cold Spring Harbor Press

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- None

Prerequisites for admission to the written examination:
- Successful completion of exercises as specified at the beginning of the semester

Module exam(s):
- CS4440-L1: Molecular Bioinformatics, written exam, 90 min, 100 % of module grade

EW4170-KP04 - Systems Biology (SystBio04)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	4

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), life sciences, 1st semester

Classes and lectures:

- Introduction to classic and translational system biology (lecture, 2 SWS)
- Introduction to classic and translational system biology (exercise, 2 SWS)

Workload:

- 60 Hours in-classroom work
- 60 Hours private studies

Contents of teaching:

- Introduction to the genome and proteome of cellular systems
- Networks: cellular, genetic, gene-regulatory networks, interactomes
- Analysis of dynamical systems: fixed points, bifurcations and feedback
- Bioinformatic analysis of Omics data
- Introduction to public databases: e.g. STRING, Gene Expression Omnibus, TCGA, KEGG, Reactome, MSigDB
- Exercises: computer lab for analysis of dynamical systems and cellular pathways in R
- Exercises: Practical exercises on the analysis of dynamical systems and cellular signaling pathways
- Exercises on the solution of differential equations

Qualification-goals/Competencies:

- The students can explain the principles of signal transduction in the cell
- The students can relate to the genome, transcriptome, interactome and proteome
- They can analyse and characterize dynamical systems
- They know common methods to analyse high-throughput data
- Lab work will enable the students to continue studying this subject on their own

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. Hauke Busch

Teacher:

- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Prof. Dr. Hauke Busch
- Dr. Axel Künstner
- MitarbeiterInnen des Instituts

Literature:

- Marian Walhout, Marc Vidal, Job Dekker: Handbook of Systems Biology: Concepts and Insights - (Englisch) Gebundene Ausgabe 15. November 2012
- Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald;: Systems Biology: A Textbook - Englisch) Taschenbuch 20. April 2016
- Yoram Vodovotz and Gary: An Translational Systems Biology, Concepts and Practice for the Future of Biomedical Research

Language:

- offered only in English

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- successful participation in the exercises

Module exam:
- EW4170-L1: Systembiology, written exam, 90 min, 100 % module grade

LS4010 A - Module part LS4010 A: Cell Biology (ViroZB)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	3

Course of study, specific field and term:

- Master Molecular Life Science 2023 (compulsory), cell biology, 1st semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 1st semester
- Master MLS 2016 (Module part of a compulsory module), cell biology, 1st semester
- Master MLS 2009 (Module part of a compulsory module), cell biology, 1st semester

Classes and lectures:

- Cell Biology (lecture, 2 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Secretion in pro- and eukaryotes
- Structure, function biogenesis and stasis of membraneouse compartments of eukaryotes
- Cellular fusion, cytokinesis and organellar inheritence
- RNA-metabolism

Qualification-goals/Competencies:

- Ability, to understand and reproduce detailled knowledge in cell biology in the areas listed under contents
- Ability to link the newly communicated detailed cell biology knowledge with the already acquired knowledge and to apply it in the context of other modules
- Ability, to recognize the connection between the cell biology of hosts and the molecular strategies of viral and other microbiological parasites

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Institute for Biology
- Prof. Dr. rer. nat. Enno Hartmann

Literature:

- Lodish: Molecular Cell Biology
- Alberts: Molecular Biology of the Cell

Language:

- English, except in case of only German-speaking participants

Notes:

Exam see LS4010
Is part of LS4010 and also used in LS4031-KP12

LS4010 B - Module part LS4010 B: Molecular Virology (ViroMV)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	3

Course of study, specific field and term:

- Master Molecular Life Science 2023 (compulsory), cell biology, 1st semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 1st semester
- Master MLS 2016 (Module part of a compulsory module), cell biology, 1st semester
- Master MLS 2009 (Module part of a compulsory module), cell biology, 1st semester

Classes and lectures:

- Molecular Virology (lecture, 2 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Viral and cellular receptors for virus-cell interaction as well as their inhibition by inhibitors
- Detailed molecular mechanisms of genome replication from selected virus families (focussed on RNA viruses)
- Host factors and their function in viral genome replication on the basis of selected examples
- Structural biology of viruses and its application for anti-viral therapy
- Basics of viral pathogenesis
- Viral strategies against the innate immune system

Qualification-goals/Competencies:

- Detailed knowledge on the interaction between viruses and their host cells
- Details on virus structure and replication mechanisms as well as on derived anti-viral strategies
- Pathogenic processes and virus-host interactions in virus infections

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Institute of Virology and Cell Biology
- Prof. Dr. rer. nat. Norbert Tautz
- Dr. rer. nat. Olaf Isken

Literature:

- S.J. Flint et al.: Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses - American Society Microbiology, February 2009, 3rd Ed., ISBN: 978-1-55581-443-4
- S.Modrow, D. Falke, U. Truyen, H. Schätzl: Molekulare Virologie - Spektrum, Heidelberg, 3. Aufl. 2010, ISBN 978-3-8274-1833-3
- : Grundlagen- und Übersichtsartikel

Language:

- English, except in case of only German-speaking participants

Notes:

The lectures are from January to February during 4 SWH: 2 from LS4010B and 2 from LS4040.
Is part of LS4010

LS4010-KP06, LS4010 - Basics of Cell- and Molecular Biology for Virology (Viro)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	6

Course of study, specific field and term:

- Master Molecular Life Science 2023 (compulsory), cell biology, 1st semester
- Master MLS 2018 (compulsory), cell biology, 1st semester
- Master MLS 2016 (compulsory), cell biology, 1st semester
- Master MLS 2009 (compulsory), cell biology, 1st semester

Classes and lectures:

- Part of the module A: Cell Biology (lecture, 2 SWS)
- Part of the module B: Molecular Virology (lecture, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- See part of the modules A and B

Qualification-goals/Competencies:

- See part of the modules A and B

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Enno Hartmann

Teacher:

- Institute of Virology and Cell Biology
- Institute for Biology

- Prof. Dr. rer. nat. Enno Hartmann
- Prof. Dr. rer. nat. Norbert Tautz
- Dr. rer. nat. Olaf Isken

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- Bachelor degree in Molecular Life Sciences or in related fields.

Prerequisites for admission to the written examination:
- nothing

Module exam:
- LS4010-L1: Basic of Cell and Molecular Biology for Virology, written exam, 90 min, 100 % module grade (Content of LS4010A and LS4010B)

LS4026-KP06 - Bioanalytics A (BioanalyA)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	6

Course of study, specific field and term:

- Master Infection Biology 2023 (optional subject), life sciences, 1st semester
- Master Biophysics 2023 (compulsory), biophysics, 1st semester
- Master Molecular Life Science 2023 (compulsory), life sciences, 1st semester

Classes and lectures:

- LS4021-V: Crystallography (lecture, 2 SWS)
- LS4027-V: Optical Methods (lecture, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Lecture Crystallography:Crystal growth, precipitant and phase diagram, crystal morphology, symmetry and space groups, crystallogenesis
- X-rays, X-ray sources, X-ray diffraction, Bragg's law, reciprocal lattice and Ewald-sphere construction
- X-ray diffraction by electrons, Fourier analysis and synthesis
- Protein structure determination by X-ray diffraction, crystallographic phase problem, Patterson map, molecular replacement (MR), multiple isomorphous replacement (MIR), multi-wavelength anomalous diffraction (MAD)
- Crystallography and the drug discovery process: studying protein-ligand interactions
- Practical exercises employing an X-ray generator (collection of a diffraction image) and the computer (MR; calculation and interpretation of electron density maps)
- Site visit at the Synchrotron DESY (Hamburg)
- Lecture Optical Methods:Basic principles of optics
- Light sources and detectors
- Classical light microscopy
- Photophysics, fluorescence microscopy
- Confocal microscopy
- Nonlinear microscopy
- Fluorescent dyes; GFP and genetically encoded fluorescent markers; live cell/intravital imaging: important experimental parameters
- Protein-protein interactions in living cells: FRET, FLIM; biosensors
- Photoactivatable/switchable fluorescent proteins; fluorescent timers
- Optogenetics: Cell manipulation by light
- Super-resolution 3D fluorescence microscopy: STED, PALM, STORM
- Optical tweezers as instrument for nanomanipulation
- Visualization and quantitative evaluation; data format and data storage media
- In vivo imaging in tissues and living animals
- Bioluminescence and optoacoustic imaging
- Flow cytometry & fluorescence activated cell sorting
- High-content screening; optical sensor technology
- Technologies under developmen

Qualification-goals/Competencies:

- Lecture Crystallography:They have a general scientific competence in macromolecular X-ray diffraction analysis
- They have the methodological competence to grow protein crystals by hanging or sitting drops
- They have the methodological competence to correctly interpret (salt or protein) the diffraction image of a crystal using the Ewald Sphere construction
- They have the methodological competence to tackle the phase problem either by MR, MIR or MAD
- They can calculate and interprete electron density maps
- They have the methodological competence, to apply structure- or fragment-based techniques for lead compound identification
- They have the communication competency to convey the principles of X-ray diffraction theory
- Lecture Optical Methods:Students acquire professional competence in basic principles and concepts of optics.
- Students know the basics of light and fluorescence microscopy.
- They know and understand the most important methods for marking and microscopic visualization of proteins and sub-cellular structures.
- Students know the possible applications of live cell microscopy, intravital imaging, and quantitative fluorescence techniques in biological questions.

- They know basic techniques of 3-dimensional optical imaging of tissues and animals.
- Student are familiar with current research topics in the field of optical methods in the life sciences and are able to evaluate them in terms of their application maturity and potential.
- Student are familiar with current research topics in the field of optical methods in the life sciences and are able to evaluate them in terms of their application maturity and potential.
- Students can classify optical methods according to their complexity and outline possible applications.

Grading through:

- written exam

Responsible for this module:

- Dr. math. et dis. nat. Jeroen Mesters

Teacher:

- Institute of Biomedical Optics
- Institute of Biochemistry

- Dr. math. et dis. nat. Jeroen Mesters
- Prof. Dr. rer. nat. Gereon Hüttmann
- Prof. Dr. rer. nat. Sebastian Karpf
- Dr. rer. nat. Norbert Linz
- Dr. rer. nat. Fred Reinholz

Literature:

- Jan Drenth: Principles of Protein X-ray Crystallography - Science+Business Media, LLC, New York
- J. B. Pawley, ed.: Handbook of Biological Confocal Microscopy, Springer
- V. V. Tučin: Handbook of optical biomedical diagnostics, SPIE Press
- L. V. Wang, and H.-i. Wu: Biomedical optics principles and imaging, Wiley

Language:

- offered only in English

Notes:

Is part of Module, too:
- LS4030-KP12 -> Prof. Hübner
- LS4021-KP06 -> Prof. Hübner

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- nothing.

Module exam:
- LS4026-L1: Bioanalytics A, written exam, 120 min, 100 % module grade (Content of both lectures Crystallographie and Optical Methods)

4 exercises in Crystallographie, 2 hours each, are offered in addition to the lecture. Dates are given at the start of the semester.

LS4027-KP06 - Bioanalytics B (BioanalyB)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	6

Course of study, specific field and term:

- Master Infection Biology 2023 (optional subject), life sciences, 1st semester
- Master Biophysics 2023 (compulsory), biophysics, 1st semester
- Master Molecular Life Science 2023 (optional subject), structure biology, 1st semester

Classes and lectures:

- Single Molecule Methods (lecture, 2 SWS)
- NMR-Spectroscopy (lecture, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Lecture Singel Molecule Methods:Physical basics of fluorescence
- Photo physics
- Microscopy techniques
- Protein labeling
- Fluorescence resonance energy transfer
- Single molecule enzymology
- Single molecule protein folding
- Physical basics of optical tweezers
- Protein folding with optical tweezers
- NMR-Spectroscopy:
- Assignment of NMR spectra
- Description of the NOESY experiment using the vector modelChemical Exchange and Transfer-NOEs
- Multidimensional NMR spectroscopy
- Assignment strategy for peptides
- Introduction into the product operator formalism (POF)
- Description of the COSY and of the HSQC experiment using POF
- NMR experiments for the assignment of proteins
- NMR structural analysis of proteins
- Experiments to probe the motions of protein

Qualification-goals/Competencies:

- Lecture Singel Molecule Methods:
- Understanding of the physical basics of single molecule methods
- Understanding of the benefits of single molecule methods
- Understanding of the limits of single molecule methods
- Lecture NMR-Spectroscopy:
- Students are able to assign and analyze complex NMR spectra
- Understanding of NMR experiments based on the product operator formalism
- Students are able to analyze structure and dynamics of proteins through NMR experiments

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Ulrich Günther

Teacher:

- Institute of Chemistry and Metabolomics
- Institute of Physics

- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Ulrich Günther
- Dr. Alvaro Mallagaray

Literature:

- Lakowicz, Joseph R: Principles of Fluorescence Spectroscopy - ISBN 978-0-387-46312-4
- Markus Sauer, Johan Hofkens, Jörg Enderlein: Handbook of Fluorescence Spectroscopy and Imaging: From Ensemble to Single Molecules - ISBN: 978-3-527-31669-4
- James Keeler: Understanding NMR Spectroscopy
- Horst Friebolin: Ein- und zweidimensionale NMR-Spektroskopie. Eine Einführung
- Malcolm H. Levitt: Spin Dynamics - Basics of Nuclear Magnetic Resonance
- D. Neuhaus & M. P. Williamson: The Nuclear Overhauser Effect in Structural and Conformational Analysis

Language:

- offered only in English

Notes:

Is module part of:
- LS4021-KP06 (former LS4020-IB) -> Prof. Hübner
- LS4020-KP06 (former LS4020-MLS) and LS4020-KP12

This module part is identical to LS4020 C-MIW without seminar.

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- snothing

Module exam:
- LS4027-L1: Bioanalytics B, written exam, 90 min, 100 % module grade(included content of LS4022-V Single Molecule Methods und LS4024-V NMR-Spectroscopy)

LS4030-KP06 - Molecular Pathomechanisms and Strategies for Therapy (Pathom)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	6

Course of study, specific field and term:

- Master Molecular Life Science 2023 (compulsory), life sciences, 1st semester
- Master MLS 2018 (compulsory), cell biology, 1st semester
- Master MLS 2016 (compulsory), cell biology, 1st semester
- Master MLS 2009 (compulsory), life sciences, 1st semester

Classes and lectures:

- Molecular Pathomechanisms and Strategies for Therapy (lecture, 4 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Mechanisms of tumor initiation and tumor progression
- Oncogenes und tumor suppressor genes
- Correlation of DNA damage and tumorigenesis
- Tumor-inducing pathogens
- Metastasis and angiogenesis
- pathways, regulation and pathological relevant deregulation of apoptosis
- microRNAs: a new player in cancer development
- Tumor diagnostic
- Therapeutic concepts

Qualification-goals/Competencies:

- The attendants of the course are able to describe the various general mechanisms of tumor initiation and tumor progression and discuss the terms and definitions in the overall context of tumor biology as well as apply them to given examples
- The students are qualified to explain correlations between tumor biology and pathogenic mechanisms in apoptosis, RNA interference and tumor-inducing viruses and bacteria.
- Furthermore, they can assess which concepts for tumor diagnosis and therapy are reasonably applied in the clinic and can evaluate to what extent alternative therapeutic concepts can be used in the correlation to their current limitations.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Timo Gemoll, MSc

Teacher:

- University of Luebeck
- Prof. Dr. rer. nat. Timo Gemoll, MSc
- N.N.

Literature:

- V. DeVita, S. Rosenberg and T. Lawrence: DeVita, Hellman, and Rosenberg s Cancer Principles & Practice of Oncology, - Lippincott Williams & Wilki; Auflage 5 oder höher; ISBN: 978-0397515745
- G. Löffler et al.: Biochemie und Pathobiochemie - Berlin, 11/2006, ISBN 978-3540326809
- C. Wagener & O. Müller: Molekulare Onkologie: Entstehung, Progression, klinische Aspekte - Stuttgart, 10/2009, ISBN-13: 978-3131035134
- R. A. Weinberg: The Biology of Cancer - Garland Publishing Inc, 7/2006, ISBN-13: 978-0815340782
- : Current research and review articles

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- BSc in Molecular Life Science or related fields

Prerequisites for admission to the written examination:
- nothing

Module exam:
- LS4030-L1: Moleculare Pathomechanisms and Therapeutic Strategies, written exam, 90 min, 100 % module grade

LS4040-KP04 - General Virology and Biosafety (AllgeViro)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	4

Course of study, specific field and term:

- Master Molecular Life Science 2023 (compulsory), life sciences, 1st semester
- Master MLS 2018 (compulsory), life sciences, 1st semester
- Master MLS 2016 (compulsory), interdisciplinary competence, 1st semester
- Master MLS 2009 (compulsory), life sciences, 1st semester

Classes and lectures:

- General virology and biosafety (lecture, 2 SWS)
- General virology and biosafety (practical course as compact course, 1 SWS)

Workload:

- 60 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Lecture: History of virology
- Virus taxonomy and structure
- Virus morphology in overview
- Viral life cycles (entry, assembly, budding)
- Replication mechanisms
- Viral evolution
- Basic techniques in virology and methods of virus diagnostics
- Blood-borne viruses and safety of blood products
- Biosafety classification of viruses according to Gentechnikrecht and Biostoffverordnung and the roles of GSP of the University of Lübeck and of the DFG-guidelines.
- Exercises with regard to the topics of the lecture

Qualification-goals/Competencies:

- They can categorize viruses systematically
- They can explain and compare viral life cycles and replication strategies
- They can explain and exercise basic virological techniques in research and virus diagnostics
- They can list basic practices and protocols for the virological safety of blood products
- They can apply basics knowledge according to Gentechnikrecht and Biostoffverordnung and are able to work in the lab with regard to the roles of GSP of the University of Lübeck and of the DFG-guidelines.
- They can use scientific termini of molecular virology in English
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Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Norbert Tautz

Teacher:

- Institute of Biochemistry
- Institute of Virology and Cell Biology

- Prof. Dr. rer. nat. Norbert Tautz
- Dr. math. et dis. nat. Jeroen Mesters
- Dr. rer. nat. Olaf Isken

Literature:

- S.J. Flint et al.: Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses - American Society Microbiology, February 2009, 3rd Ed., ISBN: 978-1-55581-443-4
- S.Modrow, D. Falke, U. Truyen, H. Schätzl: Molekulare Virologie - Spektrum, Heidelberg, 3. Aufl. 2010, ISBN 978-3-8274-1833-3

Language:

- English, except in case of only German-speaking participants

Notes:

Admission requirements for taking the module:
- BSc in Molecular Life Science, Biophysics or related fields.

Admission requirements for participation in module examination(s):
- nothing

Module Exam(s):
- LS14040-L1: Basic Virology and Biosafety, written exam, 90 min, 100 % of the module grade

The lectures are from Oktober to Dezember during 4 hours: two hours of LS4040 and two hours of LS4010 B.
The first written exam takes place after X-mas holiday season and the modul is finished.

From January to February the two hours of this modul (LS4040) are used for the modul LS4010 B Molecular Virology, which is taught 4 hours a week during this second half of the semester.

The practical course takes place in the semester break as a one week bloc.

Only those who have passed the exam can take part in the practical course.

Master Biophysics: without the practical course.

(Share of Virology in V is 66,6%)
(Share of Biochemistry in V is 33,3%)

(Share of Virology in P is 100%)

Lecture also used in LS4031-KP12.

MA3400-KP04, MA3400 - Biomathematics (Biomathe)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	4

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), mathematics / computer science, 1st semester
- Bachelor MES 2020 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), mathematics, 5th or 6th semester
- Bachelor Medical Informatics 2014 (optional subject), medical computer science, 5th or 6th semester
- Bachelor MES 2014 (optional subject), mathematics / natural sciences, 3rd or 5th semester
- Bachelor Computer Science 2014 (compulsory), specialization field bioinformatics, 5th semester
- Master MES 2011 (optional subject), mathematics, 1st semester
- Bachelor Medical Informatics 2011 (optional subject), bioinformatics, 4th to 6th semester
- Master Computer Science 2012 (optional subject), specialization field medical informatics, 3rd semester
- Bachelor MES 2011 (optional subject), mathematics, 5th semester
- Bachelor Computer Science 2012 (compulsory), specialization field bioinformatics, 5th semester

Classes and lectures:

- Biomathematics (lecture, 2 SWS)
- Biomathematics (exercise, 1 SWS)

Workload:

- 55 Hours private studies and exercises
- 45 Hours in-classroom work
- 20 Hours exam preparation

Contents of teaching:

- Examples and elementary solution methods for ordinary differential equations
- Existence and uniqueness theorems
- Dependence of solutions on initial conditions
- Linear systems (in particular with constant coefficients)
- Higher-Order linear differential equations
- Qualitative theory of nonlinear systems
- In accordance to the rules of GSP of UzL

Qualification-goals/Competencies:

- Students are able to explain basic notions from the theory of ordinarydifferential equations.
- Based on examples, students are able to explain
- Based on theorems, students are able to give conditions under which
- Students are able to find explicit solutions of simple differential equations.
- Students are able to explain how solutions of differential equations can beanalysed qualitatively.
- Students are able to present important models of the natural sciences which canbe analysed by differential equations.

Grading through:

- written exam

Requires:

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000-KP08, MA1000)
- Analysis 2 (MA2500-KP04, MA2500)
- Analysis 1 (MA2000-KP08, MA2000)

Responsible for this module:

- PD Dr. rer. nat. Christian Bey

Teacher:

- Institute for Mathematics
- PD Dr. rer. nat. Christian Bey

Literature:

- G. Birkhoff, G.-C. Rota: Ordinary Differential Equations

- H. Heuser: Gewöhnliche Differentialgleichungen - Teubner Verlag 2009 (6. Auflage)
- M.W. Hirsch, S. Smale: Differential Equations, Dynamical Systems, and Linear Algebra
- J. D. Murray: Mathematical Biology - Springer
- J. Scheurle: Gewöhnliche Differentialgleichungen
- R. Schuster: Biomathematik - Vieweg + Teubner Studienbücher 2009
- W. Walter: Gewöhnliche Differentialgleichungen

Language:

- offered only in German

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- Successful completion of homework assignments during the semester

Module exam:
- MA3400-L1: Biomathematik, written exam, 90 min, 100 % module grade

MZ5111-KP06 - Immunology (Immuno)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	6

Course of study, specific field and term:

- Master Infection Biology 2023 (compulsory), Immunology, 1st semester
- Master Nutritional Medicine 2023 (Module part of a compulsory module), life sciences, 1st semester
- Master Molecular Life Science 2023 (optional subject), Immunology, 1st semester
- Master MLS 2018 (optional subject), Immunology, 1st semester
- Master Nutritional Medicine 2019 (Module part of a compulsory module), life sciences, 1st semester
- Master MLS 2016 (optional subject), cell biology, 1st semester

Classes and lectures:

- Immunology (lecture, 2 SWS)
- Immunology (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Lecture: Introduction to immunology
- Cells of the innate immune system
- Innate immune system: pathogen recognition
- Complement and inflammation
- Introduction into the adaptive immune system
- Antigen-presentation and T cell activation
- Immunological memory
- Immune system and infektion I: bacteria, worms, fungi
- Immune system and infektion II: Viruses
- Signal transduktion in immune cells
- Organs and tissues of the immune system, homing
- Immunpathogenesis I: allergy and asthma
- Immunpathogenesis II: autoimmune diseases
- Immunprivileged Organs
- Hematopoiesis and hematopoietic stem cells
- Experimental and clinically applied biologicals
- Seminar: PCR
-
- ELISA/ELISPOT
- Flow cytometry I: FACS-Analysis
- Flow cytometry II: MACS, FACS-Sort
- Flow cytometry III: Practical course at the ISEF (MACS, Analysis, Sort)
- Conventional and confocal microscopy
- Methods in signal transduction
- Migration: transwell assay; adhesion test etc.
- 2-Photon microscopy
- Animal models in life science
- Genetically modified mice I: conventional transgenics and KO mice
- Genetically modified mice II: conditional KO und Knock In Mice

Qualification-goals/Competencies:

- Students are able to:
- Name cells of the immune system and allocate their functions
- Name organs that belong to the immune system and allocate their functions
- Name mechanisms, cells and molecules of the innate and adaptive immune system and allocate their functions during bacterial, viral and fungal infections
- Name and allocate functions of molecules important for B cell -T cell co-cooperation
- Name and allocate the functions of molecules and antigen-presenting cells important for T cell activation and differentiation
- Name molecules of the complement system and allocate their functions for immune protection and immune diseases
- Name structure and function of the distinct antibody classes
- Name and allocate functions of molecules important for homing and migration of immune cells

- Name and allocate functions of molecules important for the initiation and resolution of inflammation
- Name the functions of immunological memory
- Name molecules and mechanisms involved in the development of B cell and T cell memory
- Describe the principal sequence of an immune reaction during infection and after vaccination
- Name genetic, molecular and cellular disturbances of the immune system relevant for immune deficiency, autoimmune and allergic diseases
- Describe the basic mechanisms of signal transduction in immune cells
- Name mechanisms and molecules involved in hematopoiesis
- Name and explain immunological methods
- Present and discuss scientific data

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Christian Karsten

Teacher:

- Institute for Systemic Inflammation Research (ISEF)

- Prof. Dr. rer. nat. Rudolf Manz
- Prof. Dr. med. Jörg Köhl
- Prof. Dr. rer. nat. Christian Karsten
- Prof. Dr. Admar Verschoor
- PD Dr. rer. nat. Yves Laumonnier

Literature:

- Janeway, Travers, Walport, Shlomchik: Janeway's Immunobiology - Routledge Chapman Hall
- : original and review articles

Language:

- offered only in English

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the seminar MLS/NM (for MLS- and NM-students) or IB (for IB-students)

Module exam:
- LS4035-L1: Immunology, written exam, 90 min, 66,67 % module grade
- LS4035-L2: succesful participation in the Seminar, 33,33 % module grade

MZ5111 Immunology is an elective course in the graduate programs (GRK1727, IRTG1911 etc.) and equal to MZ5135-KP06.

MZ5116-KP06 - Molecular Neurosciences (MolNeuro)

Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	6

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), neuroscience, 1st semester

Classes and lectures:

- Neuroscience 1 (lecture, 2 SWS)
- Neuroscience 1 (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Micro- and macroscopic anatomy of the CNS
- Electrical activity of neurons
- Neuronal channel and transporters
- Synaptic transmission
- Neurotransmitters and their receptors
- Intracellular signal transduction in neurons
- Plasticity and memory formation
- Circadian rhythms and sleep
- The visual system
- Nervous system development

Qualification-goals/Competencies:

- The students can explain the basics of neurobiological function.
- The students can explain the structure and development of the CNS.
- They can explain neuronal activation and signal transmission.
- They know examples for the neuronal basis of behavior and plasticity and can explain them.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Henrik Oster

Teacher:

- Department of Neurosurgery
- Institut of Physiology
- Institute of Experimental and Clinical Pharmacology and Toxicology
- Institute of Neurobiology

- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. med. Cor de Wit
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. med. Markus Schwaninger
- PD Dr. rer. nat. Christina Zechel

Literature:

- Nicholls: From Neuron to Brain: A Cellular and Molecular Approach to the Function of the Nervous System - ISBN-10: 0878936092, 679 Seiten, Palgrave Macmillan; 5th edition (2012
- Purves: Neuroscience - ISBN-10: 0878936955, 858 Seiten, Palgrave Macmillan; 5th edition. (2011)
- Brady: Basic Neurochemistry: Principles of Molecular, Cellular, and Medical Neurobiology - ISBN-10: 0123749476, 1096 Seiten, Academic Press; 8th Edition (2011)
- : Research and review articles

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the seminar

Module exam:
- MZ5115-L1: Moleculare Neurosciences, written exam, 90 min, 100 % module grade

MZ5117-KP06 - Frontiers in Metabolic Medicine Research (FronMet)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	each winter semester	6	10

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), life sciences, 1st semester
- Master MLS 2018 (optional subject), cell biology, 1st semester
- Master MLS 2016 (optional subject), cell biology, 1st semester

Classes and lectures:

- Frontiers in Metabolic Medicine Research (lecture, 2 SWS)
- Frontiers in Metabolic Medicine Research (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Central adipose regulation
- Thyroid hormones
- Central adipokine action
- Cancer metabolism
- Chronometabolism
- Nutrient barriers

Qualification-goals/Competencies:

- Students know some current themes in metabolic physiology and medicine
- Students know experimental approaches to studying metabolic processes
- Students understand the molecular basics of metabolic diseases and can devise strategies of experimental design in this field

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Henrik Oster

Teacher:

- Institute of Neurobiology

- Prof. Dr. med. Sebastian Meyhöfer
- Prof. Dr. Jens Mittag
- Dr. rer. nat. Carla Schulz
- Prof. Dr. rer. nat. Henrik Oster
- Leonardo de Assis, PhD
- Dr. rer. nat. Violetta Pilorz

Literature:

- Keith N. Frayn: Metabolic Regulation: A Human Perspective - Wiley-Blackwell, ISBN:978-1-4051-8359-8
- : Research and review papers

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the seminar

Module exam:
- MZ5117-L1: Frontiers in Metabolic Medicine Research, written exam, 90 min, 100 % module grade

PS4610-KP06 - Ethics in Sciences / Scientific Writing (EthScWr)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	6

Course of study, specific field and term:

- Master MLS 2016 (compulsory), interdisciplinary competence, 2nd or 4th semester
- Master Molecular Life Science 2023 (compulsory), interdisciplinary competence, 2nd or 4th semester
- Master MLS 2018 (compulsory), interdisciplinary competence, 2nd or 4th semester
- Master MLS 2009 (compulsory), interdisciplinary competence, 4th semester
- Master Infection Biology 2012 (compulsory), Interdisciplinary modules, 2nd or 4th semester

Classes and lectures:

- PS4620-S Ethics in the Life Sciences (seminar, 2 SWS)
- PS4610-S: Scientific Writing (seminar and project work, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Societal and ethical implications of research in biomedical sciences and technologies
- Basics of philosophy and sociology of science.
- Good scientific practice
- Basics of bioethics: duties of investigators, obligations to colleagues.
- Ethics of human subjects research and animal experiments, environmental ethics. Governance of technology, risk assessement
- Neuroethics
- Ethics of AI and robotics
- Fundamentals of ethics: basic terms, concepts, aspects of metaethics.
- Basic issues of research ethics and cases from recent debates
- Publication of scientific studies, including structuring and writing of a scientific article, scientific journals and their procedures
- Design of scientific studies from an ethical and statistical viewpoint, ethical approval for animal and human studies
- Peer review process, including critical analysis of publications and studies, post publication peer review
- Scientific misconduct, the legal framework of research, good scientific practice, retractions
- Different forms of scientific writing, including poster and power point presentations or grant applications

Qualification-goals/Competencies:

- You will be able to explain the methodology of the natural sciences in terms of their philosophy of science and theories of science
- You can recognize ethical dimensions of practice and deciding
- You can understand the rules of Good Scientific Practice (GSP) of the University of Lübeck and of the DFG-guidelines and the relevant laws in Germany and abroad.
- You can participate in current discussions in bioethics and research ethics
- You can reflect on ethical dimensions of biomedical sciences
- You can write a structured ethics paper about a self-chosen topic
- The students will be able to critically assess the design of scientific studies, including the ethical, statistical and legal framework
- They can critically assess published work of other authors and discuss the scientific content.
- They can assemble data for a scientific publication and draft the written framework for such a manuscript.

Grading through:

- Essay, talk and written exam

Responsible for this module:

- Prof. Dr. phil. Christoph Rehmann-Sutter

Teacher:

- Institute for Experimental Endocrinology
- Institute for History of Medicine and Science Studies

- Prof. Dr. phil. Christoph Rehmann-Sutter
- Prof. Dr. phil Christina Schües
- Prof. Dr. med. Cornelius Borck
- Dr. phil. Frank Wörler
- Prof. Dr. rer. nat. Jens Mittag

Literature:

- Urban Wiesing (Hg.): Ethik in der Medizin. Ein Studienbuch. - Stuttgart: Reclam 5. Aufl. 2020
- Ben Mepham: Bioethics. An Introduction for the Biosciences - Oxford: Oxford University Press 2008, 2nd ed
- Jennifer A. Parks, Victoria S. Wike: Bioethics in a Changing World - Upper Saddle River, N.J.: Prentice Hall, 2010

Language:

- offered only in English

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- PS4620-L1: nothing
- PS4610-L1: nothing

Module exam:
- PS4620-L1 Ethics in Science, sucessful participation in the seminar, ungraded
- PS4610-L1 Scientific Writing, term paper must be passed, ungraded

LS4101 A - Module part: Molecular Oncology (AMolOnk)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,67

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), cell biology, 2nd semester
- Master Nutritional Medicine 2023 (module part), advanced curriculum, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master Nutritional Medicine 2019 (Module part of a compulsory module), advanced curriculum, 2nd semester
- Master MLS 2016 (module part), cell biology, 2nd semester

Classes and lectures:

- Molecular Oncology (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Oncology from the view of the clinician (neuro-epithelial tumors)
- concepts in initiation (mutation, epigenetics, viruses, immune system), progression and therapy of tumors (melanoma, glioma, tumors of the hematopoietic system).
- molecular and biochemical processes (oncogenes, tumor suppressor genes, metabolic disturbances, link between metabolism and epigenetics) in tumors.

Qualification-goals/Competencies:

- knowledge of the general concepts in oncology
- understanding the processes in tumor initiation, tumor progression, immune evasion and relapse
- Understanding the significance of metabolic processes for tumor initiation and therapy
- Understanding the molecular and cellular features of tumors (selected examples such as glioma, melanoma, leukemia and lymphoma)

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Department of Neurosurgery
- PD Dr. rer. nat. Christina Zechel

Literature:

- : Original publications and Reviews
- Schlegel et al.: Neuroonkologie - Thieme
- Wagener & Müller: Molekulare Onkologie - Thieme

Language:

- offered only in English

Notes:

MLS: part of the module MZ4101-KP08/LS4101-KP09
Nutritional Medicine: part of the module EW4200-KP08

LS4101 B - Module part: Molecular Endocrinology (BMolEndo)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,67

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), cell biology, 2nd semester
- Master Nutritional Medicine 2023 (module part), advanced curriculum, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master Nutritional Medicine 2019 (Module part of a compulsory module), advanced curriculum, 2nd semester
- Master MLS 2016 (module part), cell biology, 2nd semester

Classes and lectures:

- Molecular Endocrinology (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Hormone-secreting glands and tissues
- The prime hormonal axes
- Principples of hormone structure and function
- Hormone receptors and signal transduction
- Hormonal regulation of homeostasis
- Endocrine disruption
- Endocrine diseases and treatment options (e.g. diabetes mellitus, hypo- and hyperthyroidism, hyper- and hypofunction of the adrenal cortex, disorders of the reproductive axis, cancer)

Qualification-goals/Competencies:

- Understanding how hormone production is regulated according to selected examples (pancreas, thyroid, adrenal, adipocytes etc.)
- Understanding the mechanisms of hormonal action
- Know the underlying mechanisms for the treatment of endocrine dysfunctions

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Institute of Neurobiology

- Prof. Dr. rer. nat. Henrik Oster
- PD Dr. Misa Hirose
- Dr. rer. nat. Violetta Pilorz
- Dr. rer. nat. Isabel Heyde

Literature:

- : Williams Textbook of Endocrinology - Elsevier Ltd, Oxford; Auflage: 14th Edition. (19. Dezember 2019)

Language:

- offered only in English

Notes:

MLS: part of module LS4101-KP04, LS4101-KP09, MZ4101-KP08
Nutritional Medicine: part of module EW4200-KP08.

(Share of Institute of Neurobiology in V is 100%)

LS4101 C - Module part: Molecular Biology of the Cardiovascular System (CMolkard)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,67

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), cell biology, 2nd semester
- Master Nutritional Medicine 2023 (module part), advanced curriculum, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master Nutritional Medicine 2019 (Module part of a compulsory module), advanced curriculum, 2nd semester
- Master MLS 2016 (module part), cell biology, 2nd semester

Classes and lectures:

- Molecular Biology of the Cardiovascular System (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Introduction to the anatomy, physiology and pathophysiology of the heart
- Cardiovascular diseases and nutrition
- Cardiovascular diseases and genetics
- Bioinformatic strategies in cardiovascular research
- Molecular changes and genetics in atherosclerosis
- Cell-based, organ and animal models in cardiovascular medicine
- Personalized medicine in cardiology
- Diagnostics, biomarkers and therapeutic approaches for cardiovascular diseases

Qualification-goals/Competencies:

- Acquisition of basic knowledge in the field of cardiovascular medicine
- Understanding of pathophysiological and molecular mechanisms in the development of cardiovascular diseases
- Insights into personalized medicine and therapeutic approaches in cardiovascular medicine

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Medical Clinic II
- Institute of Cardiogenetics

- Prof. Dr. rer. nat. Tanja Zeller
- Dr. hum. biol. Zouhair Aherrahrou
- Prof. Dr. med. Joachim Weil
- Ph.D. Redouane Aherrahrou
- Dr. rer. nat. Amer Ghalawinji
- Dr. rer. nat. Stephanie Tennstedt
- Prof. Dr. rer. nat. Jorge Duque Escobar
- Dr. rer. nat. Olga Schweigert
- Dr. med. Teng Tong
- Dr. med. Elias Rawish
- Dr. med. Tobias Graf
- Dr. rer. nat. Tobias Reinberger

Literature:

- Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine: ISBN 1416041060 / 9781416041061 · 2304 Pages · 1500 Illustrations, Saunders · 8th edition published November 2007
- Baars, H.F., Doevendans, P.A.F.M., Houweling, A., van Tintelen, J.P.: Clinical Cardiogenetics - ISBN 978-3-319-44203-7 (2016)

Language:

- offered only in English

Notes:

MLS: part of module MZ4101-KP08 / LA4101-KP09.
Nutritional Medicine: part of module EW4200-KP08.

LS4101 D - Part of the module D: Tissue regeneration (DGewebre)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,66

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), cell biology, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master MLS 2016 (module part), Clinical Immunology, 2nd semester

Classes and lectures:

- Tissue regeneration (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Tissue development during evolution
- Ontogenesis, homeostasis, regeneration
- Stem cells and their niches
- Regeneration in evertebrates and vertebrates
- Special forms of natural regeneration
- Comparison of natural and artificial regeneration in humans: Skin
- Comparison of natural and artificial regeneration in humans: Fingertips
- Comparison of natural and artificial regeneration in humans: Heart and liver
- Comparison of natural and artificial regeneration in humans: Nervous system

Qualification-goals/Competencies:

- Students have an understanding of the ontogenetic and phylogenetic mechanisms of tissue development and regeneration
- Students have an understanding of the function of stem cells in the homeostasis and regeneration of tissues
- Students have an understanding of the physiological mechanisms of regeneration
- Students have an understanding of the molecular and physiological mechanisms of the:
- - Wound healing
- - Fingertip regeneration
- - Heart regeneration
- - Liver regeneration
- - neuronal regeneration
- Students have knowledge of various strategies for artificial regeneration of the tissues in question

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Institute of Medical and Marine Biotechnology
- Prof. Dr. rer. nat. Charli Kruse
- Dr. rer. nat. Daniel Hans Rapoport
- Dr. rer. nat. Philipp Ciba

Literature:

- : Recommendations at the beginning of each lecture

Language:

- German: slides, English: Notes

Notes:

Part of the module MZ4101-KP08 / LS4101-KP09

LS4101 E - Part of the module E: Techniques in Neurobiology (EMolNeur)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,66

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), neuroscience, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), neuroscience, 2nd semester
- Master MLS 2016 (module part), neuroscience, 2nd semester

Classes and lectures:

- Techniques in Neurobiology (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Introduction into neuroanatomy
- Modern methods of structural, functional and metabolic neuroimaging
- Electrophysiology in diagnostics of neurological diseases and understanding basic neurobiologic mechanisms (EEG, EMG, TMS)
- Linkage analyses, genetic association, next generation sequencing, molecular neurobiology, iPS cells, applied stem cell biology, Drosophila melanogaster as disease model
- Selecting neurogenetic diseases: dystonia-parkinsonism syndromes, repeat disorders

Qualification-goals/Competencies:

- Acquiring basic skills in neuroanatomy, neuroimaging, electrophysiology and neurogenetics
- Understanding pathophysiology in the context of selected examples of neurogenetic diseases

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

-
- Prof. Dr. med. Christine Klein
- Prof. Dr. Philip Seibler

Literature:

- Beal, Lang, Ludolph: Neurodegenerative Diseases. Neurobiology, Pathogenesis and Therapeutic - Cambridge University Press, 2005
- : u.a. Lehrbücher

Language:

- offered only in English

Notes:

Part of the module MZ4101-KP08 / LS4101-KP09

LS4101 F - Part F of the module: Clinical Immunology 2 (FClinIm2)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,66

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), Immunology, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), Immunology, 2nd semester
- Master MLS 2009 (Module part of a compulsory module), cell biology, 2nd semester
- Master MLS 2016 (Module part of a compulsory module), Clinical Immunology, 2nd semester

Classes and lectures:

- Clinical Immunology II (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- The students get basic knowledge of various branches and aspects of clinical immunology
- The students get an insight into the interdisciplinary clinical-immunological aspects of dermatological and allergological diseases
- The students get to know immunopathogenesis, diagnosis and treatment of selected diseases (contact dermatitis, Hymenoptera allergy, food allergy, psoriasis, atopic dermatitis, lichen planus), in context of the involved immune system (especially immunodeficiencies, allergic diseases and chronic inflammation)

Qualification-goals/Competencies:

- Students are able to explain the immune response of the innate and adaptive immune system in the context of diagnostic and therapeutic issues
- The students can describe the current knowledge for the development of different types of allergies, Lichen planus or Psoriasis and can explain the basic mechanisms causing these diseases
- They can provide examples of genetic defects leading to primary immunodeficiencies and allergy

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. med. vet. Jennifer Hundt
- Prof. Dr. rer. nat. Charli Kruse

Teacher:

- Institute of Nutrition Medicine
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Department of Dermatology, Allergology and Venerology

- Dr. Torsten Schröder
- Priv.-Doz. Dr. med. Andreas Recke
- Prof. Dr. med. Ralf Ludwig
- Priv.-Doz. Dr. rer. physiol. Katja Bieber
- Prof. Dr. med. vet. Jennifer Hundt

Literature:

- Kenneth M. Murphy, Paul Travers, Mark Walport: Janeway Immunologie
- Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand: Clinical Immunology: Principles and Practice, 4th Edition

Language:

- English, except in case of only German-speaking participants

Notes:

SGO18 or older: Part of the module MZ4101-KP08 / LS4101-KP04
SGO23: Part of the module LS4101-KP09 and part of MZ4130-KP09

LS4101 G - Module part G: Neuroendocrinology (GNeuroend)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	2,67

Course of study, specific field and term:

- Master Molecular Life Science 2023 (module part), neuroscience, 2nd semester
- Master Nutritional Medicine 2023 (Module part of a compulsory module), advanced curriculum, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master Nutritional Medicine 2019 (Module part of a compulsory module), advanced curriculum, 2nd semester
- Master MLS 2016 (module part), neuroscience, 2nd semester

Classes and lectures:

- LS4107-V: Neuroendocrinology (lecture, 2 SWS)

Workload:

- 50 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- introduction into neuroendocrinology
- hypothalamo-pituitary-system
- adrenal glands/glucocorticoids
- animal experimental methodology
- thyroid hormones centralnervous aspects
- corticotropin releasing factor and other neuropeptides in the CNS
- adipokines interactions of peripheral signals with the CNS
- endocrine rhythms
- energy homeostasis

Qualification-goals/Competencies:

- students will acquire basic knowledge of neuroendocrinology
- they understand the interaction of selected central nervous and peripheral (neuro)endocrine systems (energy homeostasis, adrenals/glucocorticoids) and can transfer this knowledge to practical applications
- they recall and understand experimental methods and are able to apply them in experiments
- they can analyse and interpret research results and publications

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Institute for Experimental Endocrinology
- Institute of Neurobiology
- Institute for Biology

- Dr. rer. nat. Carla Schulz
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. rer. nat. Jens Mittag

Literature:

- David O. Norris and James A. Carr.: Vertebrate Endocrinology - Academic Press; 5 edition
- : additional literature will be supplied in the course of the seminar

Language:

- German, except in case of only English-speaking participants

Notes:

MLS: part of the module LS4101-KP08 / 4101-KP09.
Nutritional Medicine: part of the module EW4200-KP08.

LS4101-KP09 - Molecular Biomedicine (MolBiom09)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	9

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), cell biology, 2nd semester

Classes and lectures:

- See LS4101 A to G (lecture, 2 SWS)

Workload:

- 150 Hours private studies
- 90 Hours in-classroom work

Contents of teaching:

- See part of the modules LS4101 A to G

Qualification-goals/Competencies:

- See part of the modules LS4101 A to G

Grading through:

- written exam

Requires:

- Bachelor Thesis (LS3990-KP12, LS3990)

Responsible for this module:

- Prof. Dr. rer. nat. Charli Kruse

Teacher:

- Institute of Medical and Marine Biotechnology
- Institute for Experimental Endocrinology
- Institute for Biology
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Medical Clinic I
- Institute of Neurobiology
- Department of Pathology
- Department of Neurology
- Medical Clinic II
- Department of Neurosurgery
- Institute of Virology and Cell Biology

- Prof. Dr. Philip Seibler
- Prof. Dr. med. Christine Klein
- Priv.-Doz. Dr. rer. physiol. Katja Bieber
- Dr. rer. nat. Carla Schulz
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. rer. nat. Jens Mittag
- Prof. Dr. rer. nat. Charli Kruse

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- nothing

Module exam:
- LS4101-L1: Molecular Biomedicine, 3 written exam, 90 min, each 33.33 % module grad

Prerequisite for the certificate is the attendance of 3 courses of LS 4101A-G. The choice of the courses is free. The attendance of further presentations is optional. A registration for optional courses is not mandatory.

Four weeks after the start of the semester, the selection of the courses is obligatory (Registration via moodle). These courses are then subject of the written test. A written
registration is required for the written test. The determination of the date (1st or 2nd written test) is mandatory (Registration via moodle).

From WS 2023, LS4101 F will be omitted here and will be included in module MZ4130.
(Consists of LS4101 A, LS4101 B, LS4101 C, LS4101 D, LS4101 E, LS4101 G) (Choice 3 of all)

LS4110 A - Part of the module LS4110A: Pharmacology and Toxicology (WiFoPharma)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	3

Course of study, specific field and term:

- Master Molecular Life Science 2023 (Module part of a compulsory module), life sciences, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master MLS 2016 (Module part of a compulsory module), cell biology, 2nd semester
- Master MLS 2009 (Module part of a compulsory module), structure biology, 2nd semester

Classes and lectures:

- Pharmacology and Toxicology (lecture, 2 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Serendipity in the age of rational drug design: a case study
- Pharmacodynamic
- Pharmacokinetics
- Oral Antidiabetics
- Pharmacology of the Renin-Angiotensin-Aldosterone-System
- Cerebrovascular Pharmacology
- Reverse Pharmacology
- Pharmacology of the Blood-Brain-Barrier
- Pharmacology of Thyroid Homones
- Anxiolytics, Hypnotics and Sedatives
- Antiepileptic Drugs
- Gene Therapy of neurological diseases
- Pain physiology and analgetic therapies

Qualification-goals/Competencies:

- Effects of therapeutic drugs on the organism (Pharmacodynamics)
- Time course of therapeutic drug concentrations in the organism (Pharmacokinetics)
- Mechanisms of action of various substance classes
- Experimental methods in pharmacology

Grading through:

- written exam

Responsible for this module:

- Siehe Hauptmodul

Teacher:

- Institute of Experimental and Clinical Pharmacology and Toxicology
-

- Prof. Dr. rer. nat. Olaf Jöhren
- Prof. Dr. rer. medic. Lisa Marshall
- Prof. Dr. rer. nat. Walter Raasch
- Dr. rer. nat. Dipl.-Psych. Sonja Binder
- Prof. Dr. med. Markus Schwaninger
- Dr. rer. nat. Jan Wenzel
- Prof. Dr. rer. nat. Enrico Leipold
- Dr. rer. hum. biol. Helge Müller-Fielitz

Literature:

- Brunton L, Knollmann B: Goodman & Gilman's The Pharmacologic Basis of Therapeutics - McGraw-Hill Education; 14. Edition (1. November 2022) - ISBN-10: 1264258070
- Lüllmann H, Mohr K, Hein L, Ziegler A, Bieger D: Color Atlas of Pharmacology - Thieme; 5. Edition (15. November 2017) - ISBN-10:

9783132410657

Language:

- English, except in case of only German-speaking participants

Notes:

Part of the module LS4110

LS4110 B - Part of the module LS4110B: Drug Design (WiFoDrug)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	3

Course of study, specific field and term:

- Master Molecular Life Science 2023 (Module part of a compulsory module), structure biology, 2nd semester
- Master MLS 2018 (Module part of a compulsory module), cell biology, 2nd semester
- Master MLS 2016 (Module part of a compulsory module), cell biology, 2nd semester
- Master MLS 2009 (Module part of a compulsory module), structure biology, 2nd semester

Classes and lectures:

- Drug Design (lecture, 2 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work

Contents of teaching:

- Drug Discovery - An Overview
- Target identification and validation
- X-ray Crystallography in Drug Design
- Structure-based drug design - Principles and Methods
- Examples of structure-based Drug Design
- NMR experiments in Drug Design
- Chemical Synthesis of Drugs - Combinatorial Approaches

Qualification-goals/Competencies:

- The students know basic strategies of Drug Design and are able to explain them.
- They know the way from the target discovery to the drug and the techniques of rational Drug Design.
- They know NMR and X-ray Crystallography as important tools for target monitoring and optimization and are able to explain them.
- The students know the relationship between chemical structure and effect and the techniques for theoretical prognosis and experimental tests, particular X-ray crystallography and NMR-experiments.
- The students understand concepts of synthesis and are able to assess their application in Drug Design.
- The students know the borders of X-ray crystallography and NMR-experiments.

Grading through:

- written exam

Responsible for this module:

- Dr. Alvaro Mallagaray

Teacher:

- Institute of Biochemistry
- Institute of Chemistry and Metabolomics

- Dr. Alvaro Mallagaray
- Prof. Dr. Lars Redecke

Literature:

- G. Klebe: Wirkstoffdesign - Spektrum-Verlag Heidelberg, 2009. ISBN 978-3-8274-2046-6
- C.G. Wermuth, D. Aldous, P. Raboisson, D. Roynan: The Practice of Medicinal Chemistry, - 4th Ed., Academic Press, 2015
- : Grundlagen- und Übersichtsartikel für beide Veranstaltungen

Language:

- English, except in case of only German-speaking participants

Notes:

Part of the module LS4110-KP06
lectures also used in LS4031-KP12.

LS4110-KP06 - Drug Research (WiFo)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	6

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), life sciences, 2nd semester
- Master MLS 2018 (compulsory), cell biology, 2nd semester
- Master MLS 2016 (compulsory), cell biology, 2nd semester
- Master MLS 2009 (compulsory), life sciences, 2nd semester

Classes and lectures:

- Part of the module A: Pharmacology and Toxicology (lecture, 2 SWS)
- Part of the module B: Rational Drug Design (lecture, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- See part of the modules A and B

Qualification-goals/Competencies:

- See part of the modules A and B

Grading through:

- written exam

Responsible for this module:

- Dr. Alvaro Mallagaray

Teacher:

- Institute of Biochemistry
- Institute of Molecular Medicine
- Institute of Experimental and Clinical Pharmacology and Toxicology
- Institute of Chemistry and Metabolomics

- Prof. Dr. Lars Redecke
- Prof. Dr. rer. nat. Olaf Jöhren
- Dr. rer. nat. Jan Wenzel
- Prof. Dr. med. Markus Schwaninger
- Prof. Dr. rer. nat. Enrico Leipold
- Prof. Dr. rer. nat. Walter Raasch
- Dr. rer. nat. Dipl.-Psych. Sonja Binder
- Prof. Dr. rer. medic. Lisa Marshall
- Dr. rer. hum. biol. Helge Müller-Fielitz
- Dr. Alvaro Mallagaray

Literature:

- see LS4110 A and -B:

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- nothing

Module exam:
- LS4110-L1: Drug Research, written exam, 90 min, 100 % module grade (included the content of the 2 lectures LS4110 A, LS4110 B)

LS4131-KP04 - Basics of Membrane Biophysics (Membiop04)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	4

Course of study, specific field and term:

- Master Biophysics 2023 (Module part of a compulsory module), life sciences, 2nd semester
- Master Molecular Life Science 2023 (optional subject), structure biology, 2nd semester
- Master MLS 2018 (optional subject), structure biology, 2nd semester
- Master MLS 2016 (optional subject), structure biology, 2nd semester

Classes and lectures:

- Basics of Membrane Biophysics (lecture, 2 SWS)
- Basics of Membrane Biophysics (exercise, 1 SWS)

Workload:

- 75 Hours private studies
- 45 Hours in-classroom work

Contents of teaching:

- Importance and function of cell membranes: structure, physical function and dynamic models
- Basics of the membrane components
- Thermodynamic self-assembling of lipids and reconstitution techniques
- Transmembrane and intrinsic membrane potentials
- Mechanical properties of lipid membranes
- Physical basics of membrane transport mechanisms
- Investigations using lipid monolayer
- Electrical and optical experiments using planar lipid bilayers
- Examples for interaction mechanisms between peptides/ proteins and planar membranes
- Spectroscopic methods on membranes and membrane proteins
- Light and force microscopy on membranes and membrane proteins
-

Qualification-goals/Competencies:

- Constituents and composition of biological membranes
- Physical role and function of membrane lipids and proteins
- Mechanical and electrical properties of membranes
- Various methods to investigate reconstituted and natural membranes

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Thomas Gutsmann

Teacher:

- Research Center Borstel, Leibniz Lung Center

- Prof. Dr. rer. nat. Thomas Gutsmann
- Prof. Dr. rer. nat. Andra Schromm
- Dr. Christian Nehls

Literature:

- Adam, P. Läuger, G. Stark: Physikalische Chemie und Biophysik - Springer-Verlag, 4. Auflage 2003
- W. Hanke, R. Hanke: Methoden der Membranphysiologie - Spektrum Akademischer Verlag, Auflage 1997
- Ole G. Mouritsen: Life - As a Matter of Fat - Springer 2005, ISBN 987-3-540-23248-3
- Thomas Heimburg: Thermal Biophysics of Membranes - Whiley-VCH 2007, ISBN 978-3-527-40471-1
- Lukas K. Buehler: Cell Membranes - Garland Science 2016, ISBN 978-0-8153-4196-3

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the exercises

Module exam:
- LS4131-L1: Membrane-Biophysics, written exam, 90 min, 100 % module grade

LS4135-KP04 - Protein biophysics (ProtBiop04)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	4

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), structure biology, 2nd semester
- Master MLS 2018 (optional subject), structure biology, 2nd semester
- Master MLS 2016 (optional subject), structure biology, 2nd semester
- Master Biophysics 2023 (Module part of a compulsory module), life sciences, 2nd semester

Classes and lectures:

- Physics of Proteins (lecture, 2 SWS)
- Physics of Proteins (exercise, 1 SWS)

Workload:

- 75 Hours private studies
- 45 Hours in-classroom work

Contents of teaching:

- Protein structure
- Energy landscapes
- Thermodynamics of protein folding
- Kinetics of protein folding
- Thermodynamics of enzymatic reactions
- Kinetics of enzymatic reactions

Qualification-goals/Competencies:

- Understanding of physical principles of:
- protein folding
- protein dynamics
- protein interactions

Grading through:

- written exam

Requires:

- Introduction into Biophysics (LS2200-KP04, LS2200)

Responsible for this module:

- Prof. Dr. rer. nat. Christian Hübner

Teacher:

- Institute of Physics

- Prof. Dr. rer. nat. Christian Hübner
- PD Dr. rer. nat. Hauke Paulsen

Literature:

- Hans Frauenfelder, Shirley Chan und Winnie Chan: Physics of Proteins: An Introduction to Molecular Biophysics (Biological and Medical Physics, Biomedical Engineering) - von Springer, Berlin (Gebundene Ausgabe - 30. Dezember 2010)
- Alan Fersht: Structure & Mechanism in Protein Science: Guide to Enzyme Catalysis and Protein Folding - W H Freeman & Co (Gebundene Ausgabe - 15. Februar 1999)
- Meyer B. Jackson: Molecular and Cellular Biophysics - ISBN: 978-0-521-62470-1

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the exercises.

Module exam:
- LS4135-L1: Protein-Biophysics, written exam, 90 min, 100 % module grade

LS4137-KP09 - Bioanalytics C (BioanalC)

Duration:	Turnus of offer:	Credit points:
1 Semester	every summer semester	9

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), life sciences, 2nd semester

Classes and lectures:

- LS4137-V: Cryo-electron microscopy (lecture, 1 SWS)
- LS4137-S: Cryo-electron microscopy (seminar, 0,5 SWS)
- LS4138-V: Metabolomics (lecture, 2 SWS)
- LS4138-S: Metabolomics (seminar, 1 SWS)
- LS4139-V: Mass Spectrometry-based Proteomics and Structural Biology (lecture, 1 SWS)
- LS4139-S: Mass Spectrometry-based Proteomics and Structural Biology (seminar, 0,5 SWS)

Workload:

- 165 Hours private studies
- 105 Hours in-classroom work

Contents of teaching:

- +++Contents of teaching cryo-EM:+++
- Common procedures in the cryo-electron microscopy and application to biological systems
- Anatomy of the cryo-electron microscope
- Theoretical background: Fourier transforms and image formation
- Sample preparation
- Common procedures in the cryo-electron microscopy
- Single Particle Analysis (SPA) Background and practical
- +++Contents of teaching Metabolomics:+++
- What is Metabolomics, how is it related to metabolism?
- Underlying analytical techniques: Mass spectrometry and NMR.
- Use of isotope labeling for metabolic flux analysis.
- Statistical methods used for Metabolomics.
- Computational flux-balance modelling.
- Case studies from current literature (pharmakometabolomics, role of metabolomics in drug research).
- +++Contents of Practicals Metabolomics:+++
- Metabolomics: Introduction to practical approaches
- Using Matlab for data analysis
- Understanding statistics using practical approaches
- Computer-based data analysis in Matlab
- Simple coding for metabolomics
- +++Contents of teaching Basics of Membrane Biophysics:+++ - see LS4131

Qualification-goals/Competencies:

- The students understand the methods using in metabolomics research
- They understand basic metabolic mechanisms and their importance for drug research
- They understand the statistical methods used in metabolic analyses
- They have developed a basic understanding of methods used to model metabolic networks
- Students have a basic theoretical understanding of cryo-EM and can weigh up the method against other structural biology methods
- The students know which basic experimental steps are required to determine a protein structure.
- Students have gained initial experience in the processing of cryo-EM data
- Qualification-goals/Competencies Basics of Membrane Biophysics see LS4131

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Ulrich Günther

Teacher:

- Institute of Chemistry and Metabolomics

- Institute of Biochemistry

- Prof. Dr. Thomas Krey
- Prof. Dr. rer. nat. Ulrich Günther
- PD Dr. rer. nat. Guido Hansen

Literature:

- new papers:

Language:

- English, except in case of only German-speaking participants

Notes:

Students who choose the module Bioanalytics C must take the module LS4135 Protein Biophysics in the elective area Biophysics

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the exercises

Module exam:
- LS4137-L1: Bioanalytics C, written exam, 90 min, 100 % module grade

ME5050-KP05 - Biophysics of Ionizing Radiation and Radiation Safety (StrahlenSk)

Duration:	Turnus of offer:	Credit points:
1 Semester	each semester	5

Course of study, specific field and term:

- Bachelor Biophysics 2024 (compulsory), life sciences, 5th semester
- Master Molecular Life Science 2023 (optional subject), interdisciplinary competence, 2nd semester
- Master MLS 2018 (optional subject), interdisciplinary competence, 2nd semester
- Bachelor Biophysics 2016 (compulsory), life sciences, 5th semester
- Master MLS 2016 (optional subject), interdisciplinary competence, 1st or 2nd semester

Classes and lectures:

- Biophysics of Ionizing Radiation and Radiation Safety (lecture, 2 SWS)
- Biophysics of Ionizing Radiation and Radiation Safety (practical course, 2 SWS)

Workload:

- 60 Hours private studies
- 60 Hours in-classroom work
- 30 Hours exam preparation

Contents of teaching:

- Physics of ionizing radiation
- Basic principles of dosimetry
- Introduction to methods of radiation measurement
- Radiation biology: principles of radiation damage, deterministic and stochastic effects, health risks caused by ionizing radiation
- Radiation chemistry, handling of open and enclosed radioactive materials
- Safety requirements in radionuclide laboratories
- Application of radionuclides in research and medicine
- German and international laws and regulations dealing with radiation safety
-
-

Qualification-goals/Competencies:

- The students will have acquired in depth knowledge of the legal regulations concerning the work with radioactive materials and are able to implement these regulations in all relevant situations: Purchase, transport, storage, experimental use, disposal and decontamination
- They are able to safely handle open and enclosed radioactive compounds
- They are able to work in radiation protection areas in compliance with legal regulations
- They are able to measure radioactivity, calculate radiation doses and evaluate the results with respect to legal thresholds and biological impact
- They are able design experiments using radioactive materials, identify and meet the necessary safety precautions and establish a suitable workplace
- The students will acquire the requisite qualification (Fachkunde) according to German law (RöV and StrlSchV). This will qualify them (upon fulfillment of other regulatory requirements) to perform as a radiation safety officer according to German law.

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. rer. nat. Christian Schmidt

Teacher:

- Institute of Medical Engineering
- Institute of Biochemistry
- Institute for Biology
- Institute of Physics
- Isotopes laboratory

- Prof. Dr. rer. nat. Christian Schmidt
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Magdalena Rafecas

- Dr. math. et dis. nat. Jeroen Mesters
- Prof. Dr. Lars Redecke

Literature:

- Skript of the practical course:
- German rules for radiation saftey:
- Bundesamt für Strahlenschutz (BfS) (2007): Die Empfehlungen der Internationalen Strahlenschutzkommission (ICRP) von 2007 - ICRP-Veröffentlichung 103 (BfS-SCHR-47/09)
- G. Major.: Strahlenschutz - Im Buch: W. Schlegel, C.P. Karger, O. Jäkel (Hrsg.), Medizinische Physik. Springer-Verlag, 2018.
- H. Krieger: Grundlagen der Strahlungsphysik und des Strahlenschutzes - Springer, 2017
- H. Krieger: Strahlungsmessung und Dosimetrie - Springer, 2013
- Veröffentlichungen der Strahlenschutzkommission - Band 43: Berechnungsgrundlage für die Ermittlung von Körper-Äquivalentdosen bei äußerer Strahlenexposition - 2017

Language:

- offered only in German

Notes:

Admission requirements for taking the module:
- Participation in the radiation protection instruction

Admission requirements for participation in module examination(s):
- Successful participation in 90 % of the radiation protection internship

Module examination(s):
- ME5050-L1: Biophysics of ionizing radiation and radiation protection, written exam, 120 min, 100% of the module grade (ungraded for MLS)

Each winter semester preferential for students of Biophysics and MIW, every summer semester preferential for MLS students.

Only by passing the German examination is it possible to obtain the certificate of professional competence!
Prerequisite for the award of the certificate of proficiency: Attendance during the entire course (In justified exceptional cases, a maximum absence of 10% of the lecture time is permitted) and at least 70% of the points in the written examination.
If less than 70% but more than 50% of the points are achieved, a written or oral re-examination will be offered promptly at the discretion of the module coordinator. If the re-examination is passed, the certificate of specialist knowledge will be awarded. In this case, only the result of the first examination is decisive for the grade on the certificate of achievement.
The Guideline on the technical knowledge required in radiation protection (technical knowledge guideline according to the Radiation Protection Ordinance) in the currently valid version is decisive for the implementation of the course and the issuing of the certificates of technical knowledge.

ME5055-KP05 - Animal Models and Animal Safety (TiermTsch)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	each summer semester	5	15

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), interdisciplinary competence, 2nd semester
- Master MLS 2018 (optional subject), interdisciplinary competence, 2nd semester
- Master MLS 2016 (optional subject), interdisciplinary competence, 1st or 2nd semester

Classes and lectures:

- Animal Models and Animal Protection (lecture, 2 SWS)
- Practical course Animal Models and Animal Protection (practical course, 2 SWS)
- Seminar Animal Protection (seminar, 1 SWS)

Workload:

- 60 Hours private studies
- 30 Hours in-classroom work
- 30 Hours Practical course
- 10 Hours group work

Contents of teaching:

- Basics of the biology of the most important experimental animal species in terms of anatomy, physiology, breeding, genetics and genetic modification.
- Animal behavior and housing requirements and methods, including environmental enrichment (general and species-specific).
- Animal husbandry and handling of laboratory animals
- Health monitoring in lab animal facilities, microbiological status of laboratory animals
- Ethics regarding the human-animal relationship, intrinsic value of life, and arguments for and against the use of animals for scientific purposes
- Requirements of the principle of the indispensability of animal experiments in accordance with the Animal Welfare Act
- Research and evaluation of scientific literature including those on alternatives to animal experiments
- 3R principle, good scientific practice in the context of animal research, ARRIVE & PREPARE guidelines
- Biometric statistics
- recognizing pain, suffering and distress in species most commonly used for animal experiments. Humane endpoints versus scientific endpoints
- analgesia and anesthesia, euthanasia of laboratory animals in accordance with Animal welfare laws and regulations
- legislation on the animal husbandry, care and killing of animals that are intended to be used in animal experiments, or whose tissues or organs are intended to be used for scientific purposes, as well as mondatory legal requirements for conducting animal experiments
- Practical part: planning of animal experiment procedures and projects
- Practical part: species-specific handling and experimentation methods, relevant experimentation techniques and interventions

Qualification-goals/Competencies:

- The course content meets the requirements of the legally prescribed qualifications for conducting animal experiments
- The successful graduates have acquired the knowledge and skills required by the Animal Welfare Act (TierSchG) and Animal Welfare Experimental Animal Ordinance (TierSchVersV) and professional implementation and documentation in the sense of good scientific practice of animal experiments.
- The graduates are able to reflect on the meaning, purpose and necessity of animal experiments
- Successful and regular participation in the lecture and block internship is confirmed by an examination and the award of a certificate. It is a prerequisite for the issuance of a special permit to carry out animal experiments in accordance with § 9 of the German Animal Welfare Act

Grading through:

- written exam

Responsible for this module:

- Dr. med. vet. Ph.D. Barthel Schmelting

Teacher:

-

- Dr. med. vet. Ph.D. Barthel Schmelting
- Dr. rer. nat. Michael Niehaus
- Dr. med. vet. Katherina Ramisch

Literature:

- Animal Welfare Act (TierSchG) and Animal Welfare Experimental Animal Ordinance (TierSchVersV):

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- A valid Tetanus vaccination for the practical course

Prerequisites for admission to the written examination:
- succesful participation in lectures, seminar and practical course

Module exam:
- ME5055-L1:Animal Models and Animal Protection,
written exam, 90 min, 0 % module grade, has to be passed, none-graded modul

The lecture takes place in the summer semester, followed by the internship in September. We advise against participating in the internship if you suffer from a rodent allergy.

MZ4121-KP06 - Biology of Infections (Infek)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	6

Course of study, specific field and term:

- Master Nutritional Medicine 2023 (optional subject), Infection Biology, 2nd semester
- Master Molecular Life Science 2023 (optional subject), Infection Biology, 2nd semester
- Master MLS 2018 (optional subject), Infection Biology, 2nd semester
- Master MLS 2016 (optional subject), cell biology, 2nd semester

Classes and lectures:

- Specific Topics of Infection Biology (lecture, 2 SWS)
- Specific Topics of Infection Biology (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Infectious diseases, viral, prokaryotic and eukaryotic infectious agents, parasites, zoonotic diseases
- Molecular mechanisms of antimicrobial chemotherapy, mechanisms of resistance against antiviral and antibacterial drugs
- Intracellular pathogens, molecular mechanisms of intracellular survival, Mycobacteria
- Antimicrobial immune mechanisms, compartments and regulation of antimicrobial defence, allergy
- Immune therapy and vaccination, mechanisms of the induction of specific T-cell and B-cell mediated protective immunity, adjuvants, DNA vaccines
- Experimental techniques in the infection biology, in vitro and ex vivo methods, experimental animal models of infectious diseases, gene knock-out mice, gene manipulated infectious agents
- Immune deficiencies, immunosuppressive chemotherapy and its consequences, retroviruses, HIV-AIDS
- Epidemiology of infectious diseases, zoonoses

Qualification-goals/Competencies:

- Detailed knowledge of infectious agents, infectious diseases and their pathomechanisms
- Detailed understanding of antimicrobial defence mechanisms at the cellular and molecular level. Understanding the mechanisms of vaccination and immune deficiencies.
- Knowledge of in vivo and in vitro techniques of infection biology.
-

Grading through:

- oral presentation
- written exam

Responsible for this module:

- Prof. Dr. med. Jan Rupp

Teacher:

- Department of Infectiology
- Research Center Borstel, Leibniz Lung Center
- Institute of Virology and Cell Biology
- Institute of Medical Microbiology

- Prof. Dr. med. Jan Rupp
- Dr. rer. nat. Tobias Dallenga
- Dr. rer. nat. Christoph Hölscher
- PD Dr. rer. nat. Norbert Reiling
- Dr. rer. nat. Bianca Schneider
- Prof. Dr. med. Tanja Lange
- Prof. Dr. rer. nat. Stefan Niemann
- Prof. Dr. rer. nat. Markus Hoffmann, Dr. med.
- Dr. rer. nat. Matthias Hauptmann
- Prof. Dr. rer. nat. Matthias Merker
- Samyr Kenno, PhD
- Prof. Dr. rer. nat. Stefan Taube

Literature:

- Basics and new papers:

Language:

- offered only in English

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the seminar

Module exam:
- MZ4121-L1: Infection Biology, written exam, 60 min, 75% module grade
- MZ4121-L2: Infection Biology seminar, Seminar lecture, 25% module grade

MZ4126-KP06 - Clinical Neurobiology (ClinNeuro)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	6

Course of study, specific field and term:

- Master Nutritional Medicine 2023 (optional subject), neuroscience, 2nd semester
- Master Molecular Life Science 2023 (optional subject), neuroscience, 2nd semester

Classes and lectures:

- Neuroscience 2 (lecture, 2 SWS)
- Neuroscience 2 (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- Alzheimer's disease
- Infections of the CNS
- Neural stem cells and neurodegenerative disease
- Neural stem cells and tumor stem cells in brain tumors
- Neurobiology of cerebral ischemia
- Brain channelopathies: epilepsy and ataxia
- Neurogenetic disorders
- Neuroimmunology of multiplesclerosis
- Neurometabolic disorders
- Neuropathies
- Molecular basis of Parkinson disease and other movement disorders
- Schizophrenia

Qualification-goals/Competencies:

- Introduction to neuronal stem cells
- Introduction to various neuropathological diseases
- Understanding molecular mechanisms of neuropathological diseases

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. med. Markus Schwaninger

Teacher:

- Department of Neurosurgery
- Department of Neurology
- Institute of Experimental and Clinical Pharmacology and Toxicology

- Prof. Dr. med. Markus Schwaninger
- Prof. Dr. rer. nat. Katja Lohmann
- PD Dr. Sc. Ana Westenberger
- Prof. Dr. rer. nat. Olaf Jöhren
- Prof. Dr. rer. nat. Enrico Leipold
- PD Dr. med. Harald Krenzlin
- Dr. Deepak Ailani

Literature:

- Purves D, Augustine G, Fitzpatrick D, Hall W, LaMantia A: Neuroscience - Oxford University Press; 6. Edition (25. September 2018) - ISBN-10: 160535841X
- : Original publications and Reviews

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- Regular and successful participation in the seminar

Module exam:
- MZ4125-L1: Clinical Neurobiology, written exam, 90 min, 100 % module grade

MZ4128-KP06 - Clinical Immunology - Autoimmunity (ClinImmAut)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	6

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), Immunology, 2nd semester

Classes and lectures:

- Special topics of clinical immunology (lecture, 2 SWS)
- Special topics of clinical immunology (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- The students get advanced knowledge of various branches and aspects of clinical immunology
- The students get an insight into the interdisciplinary clinical-immunological aspects of dermatological, gastroenterological, hematological and rheumatologic disorders
- The students get to know immunopathogenesis, diagnosis and treatment of selected diseases, (pemphigus, pemphigoid, connective tissue diseases, ANCA-associated vasculitis, inflammatory bowel disease, multiple sclerosis), in context of the involved immune system (especially immunodeficiencies, autoimmune diseases and chronic inflammation)
- Gender differences of the immune system
- Epigenetic changes in the context of clinical immunology

Qualification-goals/Competencies:

- Students are able to explain the immune response of the innate and adaptive immune system in the context of diagnostic and therapeutic issues
- Students are able to explain common features of primary immunodeficiencies affecting humoral immune response or T cell function
- The students can describe the current knowledge for the development of autoimmune diseases like multiple sclerosis, rheumatoid arthritis, systemic lupus erythematosus and bullous autoimmune skin diseases.
- They can provide examples of genetic defects and epigenetic modification leading to primary immunodeficiencies and autoimmunity
- They know gender differences of the immune system
- The students can critically evaluate scientific content of recent scientific publications in the field of clinical immunology
- The students can give didactically good presentations

Grading through:

- written exam

Responsible for this module:

- Prof. Dr. med. Dr. rer. nat. Enno Schmidt

Teacher:

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- Clinic for Rheumatology and Clinical Immunology
- Medical Clinic I
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)

- Prof. Dr. med. Dr. rer. nat. Enno Schmidt
- Dr. rer. nat. Susanne Lemcke
- Dr. Stephanie Goletz
- Dr. Ingolf Karl
- Prof. Diamant Thaci
- Prof. Dr. med. Gabriela Riemekasten
- Prof. Peter Lamprecht
- Prof. Dr. med. vet. Jennifer Hundt

Literature:

- Kenneth M. Murphy, Paul Travers, Mark Walport: Janeway Immunologie
- Hans-Hartmut Peter / Werner J. Pichler / Ulf Müller-Ladner: Immunologie - ISBN: 978-3-437-23256-5
- Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand: Clinical Immunology: Principles and Practice, 4th Edition

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the seminar

Module exam:
- MZ4127-L1: Clinical Immunology 1, written exam, 90 min, 100 % module grade

Similar to MZ4127

MZ4130-KP09 - Clinical Immunology: Model Systems (ClinImmMod)

Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	9

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), Immunology, 2nd semester

Classes and lectures:

- MZ4131-V Clinical Immunology II (lecture, 2 SWS)
- MZ4130-V: Animal Models in Complex Diseases (lecture, 2 SWS)
- MZ4130-S: Animal Models in Complex Diseases (seminar, 2 SWS)

Workload:

- 180 Hours private studies
- 90 Hours in-classroom work

Contents of teaching:

- Clinical Immunology 2:The students get basic knowledge of various branches and aspects of clinical immunology
- The students get an insight into the interdisciplinary clinical-immunological aspects of dermatological and allergological diseases
- The students get to know immunopathogenesis, diagnosis and treatment of selected diseases (contact dermatitis, Hymenoptera allergy, food allergy, psoriasis, atopic dermatitis, lichen planus), in context of the involved immune system (especially immunodeficiencies, allergic diseases and chronic inflammation)
- Animal Models:The students get basic knowledge of various animals used in animal models
- The students get insights into the advantages and disadvantages of the different animal models used in clinical immunology and clinical research trials
- The students get to know different animal models in dermatology, rheumatology, neurology, cardiology, psychiatry and oncology

Qualification-goals/Competencies:

- Lecture Clinical Immunology 2:Students are able to explain the immune response of the innate and adaptive immune system in the context of diagnostic and therapeutic issues
- The students can describe the current knowledge for the development of different types of allergies, Lichen planus or Psoriasis and can explain the basic mechanisms causing these diseases
- The students can provide examples of genetic defects leading to primary immunodeficiencies and allergy
- The Students are able to choose the correct animal species and the suitable animal models
- The students can describe the current knowledge of the development of different types of animal models and the animal species used
- The students can provide examples of animal models: nematode, fly, zebrafish, frog, mouse, rat, rabbit, dog and primate rhesus macaque

Grading through:

- written exam, oral exam and/or presentation as announced by the examiner
- Marked presentation

Responsible for this module:

- Prof. Dr. med. vet. Jennifer Hundt

Teacher:

- Clinic for Rheumatology and Clinical Immunology
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Priv.-Doz. Dr. med. Andreas Recke
- Priv.-Doz. Dr. rer. physiol. Katja Bieber
- Prof. Dr. med. vet. Jennifer Hundt
- Dr. med. Sören Dräger

Literature:

- Kenneth M. Murphy, Paul Travers, Mark Walport: Janeway Immunologie
- Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand: Clinical Immunology: Principles and Practice, 4th Edition
- SAGE: Journal for Laboratory Animals

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- nothing

Prerequisites for admission to the written examination:
- succesful participation in the seminar

Module exam:
- MZ4130-L1: Clinical Immunology: Model Systems, graded exam 100 % of module grade (Written exam consists of 50% each of contents from MZ4131-V and MZ4130-V)

LS5111-KP16 - Internship in MLS (BP16)

Duration:	Turnus of offer:	Credit points:
1 Semester	each semester	16

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), advanced curriculum MLS, 3rd semester
- Master MLS 2018 (compulsory), advanced curriculum, 3rd semester
- Master MLS 2016 (compulsory), advanced curriculum, 3rd semester

Classes and lectures:

- Practical Course /Internsip (practical course, 24 SWS)

Workload:

- 360 Hours in-classroom work
- 120 Hours private studies

Contents of teaching:

- Two practical courses have to be passed on real research projects. Everybody has to lern 2 different skills of the following list in each practical course. One term must have 3 month (12 weeks) labwork, the other 8 to 12 weeks labwork.
- Structural biology:
- S 1: Structure analytics of macromolecules
- S 2: Proteinexpression- and cleaning
- S 3: Membranbiophysics
- S 4: RNA-Technologies
- S 5: Computer aided methods
- Cell biology:
- Z 1: Tissue culture/ Cell culture
- Z 2: Cellphysiology and Cellbiochemistry
- Z 3: Classical and moleculare Genetics
- Z 4: Infection and Immunology
- Z 5: Microscopic Techniques
- Z 6: Neuroscience

Qualification-goals/Competencies:

- Ability to applicate knowledge of the first ans second semester of the master course in practice
- Absorbing knowledge in documentation and presentation of scientific data (poster presentation and talk)
- Ability to work in a team
- Getting lab experiences by working on real research projects
- Basic skills to design and perform their own experiments with regardto the rules of GSP of the University of Lübeck and of the DFG-guidelines.

Grading through:

- Oral talk and posterpresentation
- grading by the reviewer

Requires:

- Molecular Pathomechanisms and Strategies for Therapy (LS4030-KP06)
- Basics of Cell- and Molecular Biology for Virology (LS4010-KP06, LS4010)

Responsible for this module:

- Prof. Dr. rer. nat. Enno Hartmann

Teacher:

- Institutes and hospitals of the University of Lübeck
- Dozentinnen/Dozenten der UzL

Literature:

- : - Lehrbücher, Methodenanleitungen, Grundlagen- und Übersichtsartikel

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- 44 ECTS from the first and second semester of the master program MLS including LS4010-L1 and LS4030-L1.

Prerequisites for admission to the written examination:
- succesful participation in the practical course

Module exam:
- LS5111-L1: Internship 1, poster presentation, with 2 examiners, each 30 min, each 25% of final grade.
- LS5111-L2: Internship 2, oral presentation with 2 examiners, 20 min, 50% of final grade.

The practical course can run at the University of Lübeck, at other Universities in Germany or foreign countries, at research center or at companies.

The Minimum of one of the three practical parts (PC 1, 2 or Master Thesis) must pass at the University of Lübeck.

LS5200-KP06 - Consolidation in MLS (VTMLSKP06)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	each winter semester	6	10

Course of study, specific field and term:

- Master Molecular Life Science 2023 (optional subject), advanced curriculum, 3rd semester
- Master MLS 2018 (compulsory), advanced curriculum MLS, 3rd semester
- Master MLS 2016 (compulsory), advanced curriculum, 3rd semester

Classes and lectures:

- See the list of 20 different courses on the website (seminar, 2 SWS)
- See the list of 20 different courses on the website (seminar, 2 SWS)

Workload:

- 120 Hours private studies
- 60 Hours in-classroom work

Contents of teaching:

- 20 different courses with topics of molecular cellbiology, structure biology, neurosciences or clinical immunology. Everybody has to choose two of it. See special plan of the courses located on the MLS website.

Qualification-goals/Competencies:

- Extended knowledge in two special topics of molecular cellbiology, structure biology, neurosciences or clinical immunology
- Detailed knowledge of actual research projects
- Working with specialist literature
- Ability, to understand and reproduce the specific knowledge of the topics
- Improving special practical skills

Grading through:

- as announced by examiner

Requires:

- Molecular Pathomechanisms and Strategies for Therapy (LS4030-KP06)
- Basics of Cell- and Molecular Biology for Virology (LS4010-KP06, LS4010)

Responsible for this module:

- Prof. Dr. rer. nat. Enno Hartmann

Teacher:

- Universitätsklinikum S-H
- Research Center Borstel, Leibniz Lung Center
- All institutes of the University of Lübeck
- Alle Dozentinnen/Dozenten der UzL

Literature:

- see special course:

Language:

- English, except in case of only German-speaking participants

Notes:

Prerequisites for the module:
- LS4010-L1, LS4030-L1

Prerequisites for admission to the examination:
- successful participation in the 2 Consolidation courses

Module exam:
- LS5200-L1: Consolidation Courses, 2 Consolidation courses have to be passed, 0 % modul grade, ungraded modul

The seminars must run at the University of Lübeck. The list is located on the website of the Master Program MLS.

LS5990-KP30 - Master Thesis in MLS (MScArbeit)

Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	each semester	30	1

Course of study, specific field and term:

- Master Molecular Life Science 2023 (compulsory), advanced curriculum MLS, 4th semester
- Master MLS 2018 (compulsory), advanced curriculum, 4th semester
- Master MLS 2016 (compulsory), advanced curriculum, 4th semester
- Master MLS 2009 (compulsory), advanced curriculum, 4th semester

Classes and lectures:

- Practical work (autonomous practical studies , 39 SWS)
- Authoring of the Master Thesis (self-study, 5 SWS)
- Colloquium (presentation (incl. preparation), 1 SWS)

Workload:

- 900 Hours research for and write up of a thesis

Contents of teaching:

- Scientific project in the field of molecular life sciences

Qualification-goals/Competencies:

- Ability to solve a preformulated more complex scientific problem in a defined period of time and to present and defende the experimental results within the rules of the UzL for GSP and the DFG-guidelines.
- Basic skills to design and perform their own experiments

Grading through:

- written exam, oral presentation, and defence of the experiment´s results

Requires:

- Basics of Cell- and Molecular Biology for Virology (LS4010-KP06, LS4010)
- Molecular Pathomechanisms and Strategies for Therapy (LS4030-KP06)

Responsible for this module:

- Studiengangsleitung MLS

Teacher:

- Institutes and hospitals of the University of Lübeck
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges

Literature:

- : - will be announced by the lecturer

Language:

- English

Notes:

Prerequisites for the module:
- Student are at least in the third semester.
- The modules LS4010-L1 and LS4030-L1 are fully completed
- The other modules of the first two semesters must have been completed in full, except for one.
- One of the training sessions of the internship module is fully completed and the second one is experimentally completed.

Prerequisites for admission to the written examination:
- succesful work on the subject

Module exam:
- LS5990-L1: Master Thesis in MLS, written thesis, 66,66 % module grade
- LS5990-L2: Colloquium about the thesis in MLS, oral defend (english), 60 min (20 min oral presentation), 33,33 % module grade (the arithmetic mean of the two examinators)

If the Master thesis is done externally (outside our university) the student has to choose a licensed lecturer (see PO) of our university as a second instructor who will be First Examiner in the examination.

Language for written thesis: English, on request also German if the examiners and the student are German native speakers and there are special reasons