
UNIVERSITÄT ZU LÜBECK

Module Guide for the Study Path

# Bachelor MLS

Version from 1. April 2019

## 1st and 2nd semester



## 1st semester



## 2nd semester



## 3rd and 4th semester



## 3rd semester



## 4th semester

## 5th semester



## 6th semester



## arbitrary semester

# ME1025 - Exercises Physics 1 and Physics 2 (UePhy1u2)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 2 Semester | each semester | 4 |

**Course of study, specific field and term:**

- Bachelor MLS (optional suject), physics, 1st and 2nd semester

**Classes and lectures:**

- Exercises Physics I (exercise, 2 SWS)
- Exercises Physics 2 (exercise, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- equivalent to content of the exercises of the modules ME1010 and ME1020

**Qualification-goals/Competencies:**

- You can name the basic laws of physics
- You can measure according to physics rules
- You can explain physical laws based on observations
- You can formally analyze physical problems
- You can judge which concept is best suited to solve a certain problem
- You can design novel physical experiments on your own

**Grading through:**

- participation in discussions

**Responsible for this module:**

- Prof. Dr. rer. nat. Thorsten Buzug

**Teacher:**

- Institute of Biomedical Optics
- Institute of Physics
- Institute of Medical Engineering

- Prof. Dr. rer. nat. Thorsten Buzug
- Prof. Dr. rer. nat. Christian Hübner
- PD Dr. rer. nat. Hauke Paulsen
- Prof. Dr. rer. nat. Alfred Vogel

**Literature:**

- Douglas C. Giancoli: Physik

**Language:**

- offered only in German

**Notes:**

When this module is selected, the exercises of Physics 1 and Physics 2 must be visited. (Ungraded B certificate)

## LS1000-MLS - Biology 1 (Bio1)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each winter semester | 8 |

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 1st semester

**Classes and lectures:**

- Basic Biology (lecture, 4 SWS)
- Basic Biology (practical course, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:
- Introduction
- Structure and functions of the prokaryotic cell
- Structure of the eukaryotic cells
- Selected topics of multicellular organisation
- Storage, duplication and realization of the hereditary information
- Cell cycle
- Fertilization and development
- Formal and molecular genetics, evolution
- Practical course:
- Individual testHandling of light microscopes
- Structure of prokaryotic cells
- Structure of cells from metazoan
- Human chromosomes
- Cell cycle and mitosis
- Genetics
- Bacteria

**Qualification-goals/Competencies:**

- Improvement of basic knowledge for life-science education
- Ability to understand, reproduce and use in the further studies basics of all areas listed in
- Understanding of Genetics and operate with the basic skills in the following semesters
- Basal practical skills in light microscopy

**Grading through:**

- continuous, successful participation in practical course, >80%
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Enno Hartmann

**Teacher:**

- Institute for Biology

- Prof. Dr. rer. nat. Enno Hartmann
- Prof. Dr. rer nat. Rainer Duden
- PD Dr. rer. nat. Kai-Uwe Kalies
- PD Dr. rer. nat. Bärbel Kunze

**Literature:**

- : Cambell Biology

**Language:**

- offered only in German

## LS1100-MLS - Basic Chemistry (AC)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each winter semester | 10 |

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 1st semester

**Classes and lectures:**

- Basic Chemistry (lecture, 3 SWS)
- Basic Chemistry (exercise, 1 SWS)
- Basic Chemistry (practical course, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:
- Organisation of matter and the periodic table of the elements
- Chemical bonds, molecules and Ions
- Chemical formula and stoichiometry
- The threedimensional structure of molecules: From the VSEPR model to molecular orbitals
- Special properties of water
- Chemical Equilibrium
- Acids and Bases
- Redox reactions and electrochemistry
- Complexes and metal-ligand bonds
- Interactions between mater and radiation - methods of Spectroscopy
- Thermodynamics
- Chemical Kinetics
- Exercises:
- Students explain problems on the blackboard of all themes of the lecture
- Practical course:
- the students work in groups of two. Themes:
- Basics and techniques
- Salt and their aqueous solutions
- Acids, Bases and Buffer
- Redox Reactions
- Catalyses, Metal complexes and Chemical Equilibria
- Lab test

**Qualification-goals/Competencies:**

- The students have the knowledge in basics of general and inorganic chemistry
- They understand basic general and inorganic chemical concepts and can adopt them on reactions
- They are able to do simple chemical anaysis with basic laboratory techniques by applying safety at work in chemical Laboratories (GHS)
- They are able to use tools for professional documentation, interpretation and presentation of data (lab journal, protocol, colloquium) of simple chemical analysis
- By practicing teamwork in small groups during the practical course and writing a collective protocols they got capacity of teamwork
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**Grading through:**

- written exam

**Is requisite for:**

- Organic Chemistry (LS1600-MLS)

**Responsible for this module:**

- PD Dr. phil. nat. Thomas Weimar

**Teacher:**

- Institute of Chemistry and Metabolomics

- PD Dr. phil. nat. Thomas Weimar
- Dr. rer. nat. Rosemarie Pulz

**Literature:**

- Brown et.al:: Chemie studieren Kompakt - Pearson Studium
- Binnewies et al.: Allgemeine und Anorganische Chemie - Spektrum - Verlag

**Language:**

- offered only in German

**Notes:**

Prerequisite for examination is the successful participation in the practical course with certified protocols and oral presentation; written examination

## MA2000-MLS - Analysis 1 (Ana1)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each winter semester | 9 |

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 1st semester

**Classes and lectures:**

- Analysis 1 (lecture, 4 SWS)
- Analysis 1 (exercise, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures and exercises: Basics (sets, numbers, maps, inequalities, binomial expression, complex numbers)
- Sequences and series (convergence, boundedness, monotonicity, Euler number, ratio and root tests for convergence, absolute and conditional convergence, alternating series test)
- Continuity and differentiability of functions of one real variable (limits, monotonicity, convexity, derivatives, mean value theorem, L'Hospital's rule, Taylor polynomials, relative extrema, differential equation for population growth)
- Multivariable calculus (differentiation)

**Qualification-goals/Competencies:**

- Correct use of numbers, terms and functions
- Understanding of mathematical algorithms
- Fundamentals of the application of math in natural sciences

**Grading through:**

- Exercises
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Jürgen Prestin

**Teacher:**

- Institute for Mathematics

- Prof. Dr. rer. nat. Jürgen Prestin
- PD Dr. rer. nat. Hanns-Martin Teichert

**Literature:**

- K. Meyberg, P. Vachenauer: Höhere Mathematik 1
- H.G. Zachmann: Mathematik für Chemiker
- K. Fritzsche: Grundkurs Analysis 1
- H. Heuser: Lehrbuch der Analysis 1
- L. Papula: Mathematik für Ingenieure und Naturwissenschaftler

**Language:**

- offered only in German

**Notes:**

Only students who have passed the exercises and e-tests are admitted to the final written examination

## ME1010-KP06, ME1010-MLS - Physics 1 (Phy1KP06)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 1st semester
- Bachelor MLS (compulsory), life sciences, 1st semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 1st semester

**Classes and lectures:**

- Physics 1 (lecture, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Physical values, units, accuracy, measurement errors
- Mathematical methods and notations
- Kinematics of point mass, Newton s Axioms, contact forces, modulus, virtual forces, Newton s equation of motion, differential equations
- Work and energy, power and efficiency, momentum, inertia, physical pendulum, momentum of rotation
- Conservation laws and symmetries
- Gravitation, oscillation, waves, acoustics, Doppler effect
- Resting and flowing gases and liquids, effects of surfaces and interfaces
- Temperature, thermometer, therm. expansion, state equations, kinetic gas theory
- Van-der-Waals state equation, heat capacity, heat conduction, 1st law of thermodynamics, volume work, p-V diagram
- Adiabatic processes, 2nd law of thermodynamics, thermal engines and Carnot cycle, efficiency, heat pump
- Entropy, disorder and probability, 3rd law of thermodynamics

**Qualification-goals/Competencies:**

- You can name the basic laws of physics
- You can measure according to physics rules
- You can explain physical laws based on observations
- You can formally analyze physical problems
- You can judge which concept is best suited to solve a certain problem
- You can design novel physical experiments on your own

**Grading through:**

- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Christian Hübner

**Teacher:**

- Institute of Biomedical Optics
- Institute of Medical Engineering
- Institute of Physics

- Prof. Dr. rer. nat. Robert Huber
- Prof. Dr. rer. nat. Christian Hübner
- PD Dr. rer. nat. Hauke Paulsen
- Prof. Dr. rer. nat. Thorsten Buzug

**Literature:**

- Douglas C. Giancoli: Physik

**Language:**

- offered only in German

## LS1500-KP06, LS1500 - Biology 2 (Bio2)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 2nd semester
- Bachelor MLS (compulsory), life sciences, 2nd semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 2nd semester

**Classes and lectures:**

- Genetics (lecture, 2 SWS)
- Histology (lecture, 1 SWS)
- Histology (practical course, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Part A Gnetics: a) Bacterial Genetics (Dr. U. Mamat)The bacterial cell
- Cell division and replication of the bacterial chromosome - part 2
- Gene organization and gene expression - part 2
- Bacterial pathogenicity factors
- Mutations in bacteria
- Accessory genetic elements and gene transfer mechanisms - part 1
- Accessory genetic elements and gene transfer mechanisms - part 2
- b) Human Genetics (Dr. F. Kaiser)Methods in molecular genetics
- Mutations and mechanisms in autosomal recessively inherited disorders
- Mutations and mechanisms in X-chromosomal inherited disorders
- Mutations and mechanisms in autosomal dominant inherited disorders
- Mutations and mechanisms in mitochondrial and tumor genetics
- Multifactorial inheritance, association studies, risk calculation
- Overwiew: Cytogenetics
- Part B Histology:Lecture: Preparation of tissue specimen
- General microscopy
- Epithelium, glands
- Connective tissues
- Cartilage and bone
- Muscle
- Neural tissue
- Skin
- Blood, vascular system and bone marrow
- Lymphatic organs
- Introduction in immunology
- Practical course Microscopy, Histology: Microscopy of cell structure and cell size as taught in the histology lectures. Critical investigation under the microscope. Drawing of the corresponded tissues (from the histology lectures)

**Qualification-goals/Competencies:**

- Part A Genetics:Understanding of the heredity
- Mutations and verific
- Bacterial genetics
- Part B Histology section:
- They can identify different histological stainings
- They can explain the structure of tissues containing site-specific cells and extracellular matrix molecules
- They can determine the 4 basic tissues and explain their functions
- They can explain the process of bone formation and remodeling
- They can identify unmature and mature blood cells
- They can describe the structure of lymphatic organs
- Basic skills to design and perform their own experiments

**Grading through:**

- continuous, successful participation in practical course, >80%

- written exam

**Responsible for this module:**

- PD Dr. rer. nat. Kathrin Kalies

**Teacher:**

- Institute of Human Genetics
- LIED | Lübecker Institut für experimentelle Dermatologie (Lübeck Institute of Experimental Dermatology)
- Institute of Anatomy

- PD Dr. rer. nat. Kathrin Kalies
- Dr. rer. nat. Susanne Lemcke
- Prof. Dr. Frank Kaiser

**Literature:**

- Lüllmann-Rauch: Histologie - Thieme Verlag, Stuttgart

**Language:**

- offered only in German

## LS1600-MLS - Organic Chemistry (OC)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each summer semester | 10 |

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 2nd semester

**Classes and lectures:**

- Organic Chemistry for MLS (lecture, 3 SWS)
- Organic Chemistry for MLS (exercise, 1 SWS)
- Organic Chemistry for MLS (practical course, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:
- Introduction
- Alkanes, Cycloalkanes
- Alkene and Alkynes
- Aromatic Compounds
- Stereoisomery
- Substitution and elimination reactions
- Alcohols, Phenols and Thiols
- Ether and Epoxides
- Aldehydes and ketones
- Carboxylic acids and derivates
- Amines and derivates
- NMR-Spectroscopy and structure analysis
- Heterocycles
- Lipids
- Carbohydrates
- Amino Acids and Peptides
- Nucleotides and nucleic acids
- Exercises:
- Exercises converning topics from the lectures and the practical course
- Practical course:
- 3 D-structure of organic compounds; Mechanismen in chemical reactions
- Synthesis and analysis
- Reaction of biological relevant molecules I
- Reaction of biological relevant molecules II
- Quantitative analytical destinations of proteins with spectroscopical methods
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**Qualification-goals/Competencies:**

- Understanding the basics and the principles of organic chemistry
- Advanced training of laboratory techniques and safty (GHS). First steps into spectroscopy techniques (NMR, UV/VIS)
- Handling complex problems: synthesis, purification and analysis of compounds
- Acquiring tools for professional documentation and presentation of experimental data (lab journal, protocols, oral presentation with qualified feedback, colloquium)

**Grading through:**

- written exam

**Requires:**

- Basic Chemistry (LS1100-MLS)

**Responsible for this module:**

- PD Dr. phil. nat. Thomas Weimar

**Teacher:**

- Institute of Chemistry and Metabolomics

- PD Dr. phil. nat. Thomas Weimar
- Dr. rer. nat. Rosemarie Pulz
- Dr. phil. nat. Hannelore Peters

**Literature:**

- Buice, P.Y.: Organische Chemie - Pearson Studium
- Hart, H., L.E. Craine, D.J. Hart: Organische Chemie - Wiley-VCH
- Buddrus, J.: Organische Chemie - De Gruyter Verlag

**Language:**

- offered only in German

**Notes:**

Prerequisite for examination is the successful participation in the practical course with certified protocols, presentation and colloquiums is requirment for written examination

## MA2500-KP05, MA2500-MLS - Analysis 2 (Ana2KP05)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), mathematics / computer science, 2nd semester
- Bachelor MLS (compulsory), mathematics / computer science, 2nd semester
- Bachelor MLS starting 2018 (compulsory), mathematics / computer science, 2nd semester

**Classes and lectures:**

- Analysis 2 (lecture, 2 SWS)
- Analysis 2 (exercise, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures and exercises:integral calculus for functions of one real variable (indefinite integrals, antiderivatives, substitution, partial fractions, definite integrals, fundamental theorem of calculus)
- Sequences and series of functions
- Fourier series

**Qualification-goals/Competencies:**

- Correct use of the basic mathematical skills and methods of analysis
- Fundamentals for the application of math in natural sciences

**Grading through:**

- Exercises
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Jürgen Prestin

**Teacher:**

- Institute for Mathematics
- Prof. Dr. rer. nat. Jürgen Prestin
- Dr. Peter Dencker

**Literature:**

- K. Meyberg, P. Vachenauer: Höhere Mathematik 2
- H.G. Zachmann: Mathematik für Chemiker
- K. Fritzsche: Grundkurs Analysis 1 + 2
- H. Heuser: Lehrbuch der Analysis 2
- L. Papula: Mathematik für Ingenieure und Naturwissenschaftler

**Language:**

- offered only in German

**Notes:**

Only students who have passed the exercises and e-tests are admitted to the final written examination

## ME1020-MLS - Physics 2 (Phy2)

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

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 2nd semester

**Classes and lectures:**

- Physics 2 (lecture, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Electric charge, Coulomb force, electric field, electric potential, capacity
- Stationary electric current, resistor, Kirchhoff s laws
- Magnetic field, magnetic dipole, electric current and magnetic field
- Electromagnetic induction, resonant circuit
- Nonstationary electric and magnetic fields, displacement current, Maxwell s equations
- Refraction, reflexion
- Geometrical optics, image generation, lenses, aberrations, optical instruments
- Interference, diffraction, resolution power
- Polarization, birefringence, Brewster s angle
- Relativity theory
- Bohr s atomic model, spectral lines, quantum mechanical atomic model
- Molecules and solid bodies

**Qualification-goals/Competencies:**

- You can name the basic laws of physics
- You can measure according to physics rules
- You can explain physical laws based on observations
- You can formally analyze physical problems
- You can judge which concept is best suited to solve a certain problem
- You can design novel physical experiments on your own

**Grading through:**

- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Alfred Vogel
- Prof. Dr. rer. nat. Thorsten Buzug
- Prof. Dr. rer. nat. Christian Hübner

**Teacher:**

- Institute of Biomedical Optics
- Institute of Medical Engineering
- Institute of Physics

- Prof. Dr. rer. nat. Alfred Vogel
- Prof. Dr. rer. nat. Christian Hübner
- PD Dr. rer. nat. Hauke Paulsen
- Prof. Dr. rer. nat. Thorsten Buzug

**Literature:**

- Douglas C. Giancoli: Physik

**Language:**

- offered only in German

## LS2200-KP04, LS2200 - Introduction into Biophysics (EinBiophy)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 3rd and 4th semester
- Bachelor CLS starting 2016 (optional subject), life sciences, 5th semester
- Bachelor Nutritional Medicine (compulsory), biophysics, 3rd semester
- Bachelor Biophysics (compulsory), biophysics, 3rd semester
- Bachelor MES since 2014 (optional subject), mathematics / natural sciences, 3rd or 5th semester
- Bachelor MLS (compulsory), life sciences, 3rd and 4th semester
- Bachelor CLS (optional subject), life sciences, 5th semester
- Bachelor MES before 2014 (compulsory), Medical Engineering Science, 5th semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 3rd and 4th semester

**Classes and lectures:**

- Biophysics (lecture, 2 SWS)
- Biophysics (practical course, 1 SWS)

**Workload:**

- 50 Hours private studies
- 45 Hours in-classroom work
- 15 Hours written report
- 10 Hours exam preparation

**Contents of teaching:**

- Biological macro molecules, structure, forces
- Proteins, structure, properties
- Biomembranes, structure, properties
- Mechanical properties of cells
- Thermo dynamics of biological processes

**Qualification-goals/Competencies:**

- You can assign forces in biological systems
- You become familiar with the basic aspects of living matter
- You gain the expertise to simplify complex living systems
- You can choose and apply appropriate experimental methods for the study of living matter

**Grading through:**

- Written or oral exam as announced by the examiner

**Responsible for this module:**

- Prof. Dr. rer. nat. Christian Hübner

**Teacher:**

- Institute of Physics

- Prof. Dr. rer. nat. Christian Hübner
- Dr. Young-Hwa Song

**Literature:**

- Volker Schünemann: Biophysik: Eine Einführung
- Werner Mäntele: Biophysik

**Language:**

- offered only in German

**Notes:**

The lecture occurs every winter semester. The practical course occurs every summer semester.

## LS2000-MLS - Biochemistry 1 (Biochem1)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each winter semester | 10 |

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 3rd semester

**Classes and lectures:**

- Biochemistry I (lecture, 4 SWS)
- Biochemistry I (practical course, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures: Characteristics of biosystems
- Biomolecules
- Proteins: structure and dynamics
- Enzymes: structure, function, regulation
- Metabolism of carbohydrates: Properties of carbohydrates, Functions of carbohydrates, Metabolic pathways
- Citric acid cycle
- Oxidative phosphorylation
- Lipid metabolism- I
- Lipid metabolism- II
- Amino acid oxidation and the urea cycle
- Practical course groups of 2: Biological buffer systems
- Photometric methods / hemoglobin
- Protein separation I:
- Enzymatic Catalysis
- Characterization of carbohydrates

**Qualification-goals/Competencies:**

- Understanding structures and functions of biochemical important biomolecules
- Understanding biochemical interrelations and their importance for cellular metabolism
- Estimation of the biotechnological potential of biomolecules
- Studying of biochemical separation and analysis procedures
- Practicing
- Quantitave evaluation, protocolling and discussion of outcomes of biochemical experiments
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**Grading through:**

- continuous, successful participation in practical course, >80%
- protocols
- written exam

**Requires:**

- Organic Chemistry (LS1600-MLS)

**Responsible for this module:**

- Prof. Dr. rer. nat. Rolf Hilgenfeld

**Teacher:**

- Department of Neurosurgery
- Institute of Biochemistry

- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Prof. Dr. rer. nat. Stefan Anemüller
- Dr. Lars Redecke
- Dr. math. et dis. nat. Jeroen Mesters
- PD Dr. rer. nat. Christina Zechel

**Literature:**

- Voet/Voet: Biochemistry - 4th edition, 2011, Wiley
- Lehninger: Principles of Biochemistry - 6th edition, 2013, Freeman
- Stryer: Biochemistry - 7th edition, 2012, Freeman
- Lodish et al.: Molecular Cell Biology - 7th edition, 2013, Freeman
- Alberts et al.: Molecular Biology of the Cell - 5th edition, 2008, Garland Science

**Language:**

- offered only in English

**Notes:**

Successful participation in the practical course: Prerequisite for examination: each student needs a minimum of 2 certificates during the practical course and marked protocols.

## LS2600-KP06, LS2601 - Biological Chemistry (BiolChem06)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 3rd semester
- Master CLS starting 2016 (compulsory), MML with specialization in Life Science, 1st semester
- Bachelor MLS (compulsory), life sciences, 3rd semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 1st semester

**Classes and lectures:**

- Biological Chemistry (lecture, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Lecture topics:
- What is Biological Chemistry?
- The nature of chemical bonds
- Chemical reactions to modify proteins
- Synthesis of peptides
- Chemical analytics - MS and NMR
- Metabolic labeling
- Chemical reactions to follow the fate of molecules in cells and whole organisms

**Qualification-goals/Competencies:**

- The nature of chemical bonds - an in depth treatment based on quantum mechanical principles
- How to use synthetic organic chemistry to solve biological questions
- In-depth treatment of reaction mechanisms of chemical reactions important in biological systems
- Analytical techniques to identify and characterize compounds

**Grading through:**

- exercises during lecture
- written exam

**Responsible for this module:**

- Prof. Dr.  rer. nat. Thomas Peters

**Teacher:**

- Institute of Chemistry and Metabolomics
- Prof. Dr.  rer. nat. Thomas Peters

**Literature:**

- Paula Y. Bruice: Organic Chemistry - Pearson Verlag

**Language:**

- offered only in German

## ME2053-KP04, ME2053 - Physics Lab Course (PhysPrakt)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2018 (compulsory), life sciences, 3rd semester
- Bachelor Biophysics (compulsory), physics, 3rd semester
- Bachelor MES since 2014 (compulsory), physics, 3rd semester
- Bachelor MLS (compulsory), life sciences, 3rd semester
- Bachelor MES before 2014 (compulsory), physics, 3rd semester

**Classes and lectures:**

- Physics Lab Course (practical course, 3 SWS)

**Workload:**

- 55 Hours written report
- 45 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**

- Experiment 1: fluid dynamics
- Experiment 2: heat
- Experiment 3: non stationary current
- Experiment 4: stationary current
- Experiment 5: spectrometer
- Experiment 6: diffusion
- Experiment 7: wave optics
- Experiment 8: geometrical optics
- Experiment 9: radio activity
- Experiment 10: sound and ultrasound

**Qualification-goals/Competencies:**

- Hands-on access to physical relations
- Graphical representation of experimental data
- Excellence in interpreting data
- Excellence in documating data and teamwork
- Basic knowledge in safety measures in the lab

**Grading through:**

- certificates and protocols

**Requires:**

- Physics 2 (ME1020-KP08, ME1020)
- Physics 1 (ME1010-KP08, ME1010)
- Physics 2 (ME1020-MLS)
- Physics 1 (ME1010-KP06, ME1010-MLS)

**Responsible for this module:**

- Prof. Dr. rer. nat. Christian Hübner

**Teacher:**

- Institute of Biomedical Optics
- Institute of Medical Engineering
- Institute of Physics

- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Thorsten Buzug
- PD Dr. rer. nat. Hauke Paulsen
- Prof. Dr. rer. nat. Alfred Vogel
- MitarbeiterInnen des Instituts

**Literature:**

- Giancoli: Physik

**Language:**

- offered only in German

## LS2300-KP08, LS2301 - Biophysical Chemistry (BPCKP08)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each summer semester | 8 |

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 4th semester
- Master CLS starting 2016 (compulsory), MML with specialization in Life Science, 2nd semester
- Bachelor Biophysics (compulsory), biophysics, 4th semester
- Master CLS (optional subject), computational life science / life sciences, 2nd semester
- Bachelor MLS (compulsory), life sciences, 4th semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 4th semester

**Classes and lectures:**

- Biophysical Chemistry (lecture, 3 SWS)
- Biophysical Chemistry (exercise, 1 SWS)
- Biophysical Chemistry (practical course, 3 SWS)

**Workload:**

- 160 Hours private studies
- 80 Hours in-classroom work

**Contents of teaching:**

- Lecture topics:
- What is Biophysical Chemistry?
- Basics of NMR spectroscopy
- Basics of mass spectrometry
- Theoretical calculation of molecules - Quantum mechanics or molecular mechanics?
- Basics of chemical thermodynamics
- Thermodynamics of ligand binding
- Basics of chemical kinetics
- Basics of enzyme kinetics
- Practical:
- NMR, Molecular Modeling, experiments with a focus on thermodynamics and kinetics

**Qualification-goals/Competencies:**

- Acquire basic knowledge on spectroscopic techniques to analyze (bio)molecules. Focus is on NMR and mass spectrometry techniques
- Insight into properties (e.g. structure, dynamics, spectroscopic properties) of molecules employing theoretical models. Acquisition of basic knowledge to compute molecules
- Application of laws of thermodynamics to describe chemical reactions and biological processes with a focus on binding and recognition reactions in biological systems
- Acquire basic knowledge to analyze time courses of chemical reactions and biological processes
- Acquisition of skills to work independently and self-determined in the laboratory

**Grading through:**

- written exam

**Requires:**

- Biological Chemistry (LS2600-KP06, LS2601)
- General Chemistry (LS1100-KP04)
- Organic Chemistry (LS1600-KP10, LS1600-MLS)

**Responsible for this module:**

- Prof. Dr. rer. nat. Thomas Peters

**Teacher:**

- Institute of Chemistry and Metabolomics

- Prof. Dr. rer. nat. Thomas Peters
- PD Dr. phil. nat. Thomas Weimar

**Literature:**

- Peter Atkins and Julio de Paula: Physical Chemistry for the Life Sciences - Oxford, University Press, Freeman and Company, 2006, ISBN

0-1992-8095-9
- Thomas Engel und Philip Reid: Physikalische Chemie - Pearson Studium, 2006, ISBN 13: 978-3-8273-7200-0
- van Holde, Johnson & HoPrentice Hall: Principles of Physical Biochemistry - New Jersey, 1998, 2006, ISBN 0-13-720459-0
- Atkins: Physical Chemistry - Oxford University Press, Oxford Mel-bourne Tokyo, 1998, ISBN 0-19-850101-3 Paperback, Deutsche Ausgabe (dritte Auflage) bei Wiley VCH, 2002: ISBN 3-527-30236-0 Wiley-VCH, Weinheim
- Fersht, W. H.: Structure and Mechanism in Protein Science - New York, 1999, ISBN 0-7167-3268-8
- Cantor & Schimmel: Biophysical Chemistry, Parts I-III - Freeman and Company, New York, 1980, ISBN 0-71671188-5 Paperback
- H. Friebolin: Ein- und zweidimensionale NMR-Spektroskopie - Wiley-VCH

**Language:**

- offered only in German

**Notes:**

Prerequisite for examination is the successful participation in the excercises and oral presentation.
The practical course takes place in September as compact course. Prerequisite LS1600 and LS2600.

## LS2510-MLS - Biochemistry 2 (Biochem2)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each summer semester | 10 |

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 4th semester

**Classes and lectures:**

- Biochemistry 2 (lecture, 4 SWS)
- Biochemistry 2 (practical course, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:Structure and function of DNA and RNA
- Amino acid metabolism
- Signal transduction and ho
- Biochemical methods
- Practical course groups of 2:Cell respiration and biological oxidation
- Protein biosynthesis
- Polymerase chain reaction (PCR) and DNA
- Immunological methods

**Qualification-goals/Competencies:**

- Understanding structures and functions of biochemical important biomolecules
- Understanding biochemical interrelations and their importance for cellular metabolism
- Estimation of the biotechnological potential of biomolecules
- Studying of biochemical separation and analysis procedures
- Practicing
- Quantitave evaluation, protocolling and discussion of outcomes of biochemical experiments
-

**Grading through:**

- certificates and protocols
- continuous, successful participation in practical course, >80%
- written exam

**Requires:**

- Organic Chemistry (LS1600-MLS)

**Responsible for this module:**

- Prof. Dr. rer. nat. Rolf Hilgenfeld

**Teacher:**

- Institute of Biochemistry

- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Prof. Dr. rer. nat. Stefan Anemüller

**Literature:**

- Voet/Voet: Principles of Biochemistry - 4th edition, 2011, Wiley
- Lehninger: Principles of Biochemistry - 6th edition, 2013, Freeman
- Stryer: Biochemistry - 7th edition, 2012, Freeman
- Lodish et al.: Molecular Cell Biology - 7th edition, 2013, Freeman
- Alberts et al.: Molecular Biology of the Cell - 5th edition, 2008, Garland Science

**Language:**

- offered only in English

**Notes:**

Prerequisite for the lab course: certificate in Organic Chemistry, knowledge in Biochemistry 1.
Successful participation in the practical course: each student needs a minimum of 2 certificates during the practical course and marked protocols.

## LS2700-MLS - Cell biology (ZellBio)

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

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 4th semester

**Classes and lectures:**

- Cell biology (lecture, 3 SWS)
- Cell biology (practical course, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:
- Special structure of cells
- Cell cycle and apoptosis
- Introduction into developmental biology
- Practical course (groups of 2):
- Basics in cell culture techniques
- Staining of cellular structures
- Cell fractionation and functional analysis of organelles
- Behaviour of cells during stress
- Protein pattern of apoptotic cells
- Differentiation of cells

**Qualification-goals/Competencies:**

- Principle of the basic function of the eukaryotic cells
- Detailed knowledge in all areas of cell biology covered by the lecture (see
- Handling of basic cell biology techniques
- Improving the ability to document results correctly and to work in a team
-

**Grading through:**

- continuous, successful participation in practical course, >80%
- written exam

**Requires:**

- Biology 1 (LS1000-MLS)

**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
- PD Dr. rer. nat. Kai-Uwe Kalies
- Prof. Dr. rer. nat. Charlie Kruse
- Prof. Dr. rer. nat. Jürgen Rohwedel
- Dr. rer. nat. Heyke Diddens-Tschoeke

**Literature:**

- Lodish: Molecular Cell Biology
- Pollard: Cell Biology
- Wolpert: Principles of Development
- Alberts: Molecular Biology of the Cell

**Language:**

- offered only in German

**Notes:**

Knowledge in Biology 1 and 2 and Biochemistry 1 is a prerequisite for this course. Entrance requirement for the practical course: Certificate of the course Biology 1 and Biochemistry 1

## LS2800 - Optional Subject (OS) of Molecular Life Science (WPBSc)

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

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 4th semester

**Classes and lectures:**

- Exactly one of part of the modules LS2800A to G (lecture with exercises or seminar, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- See part of the module LS2800...

**Qualification-goals/Competencies:**

- See part of the module LS2800...

**Grading through:**

- as announced by examiner

**Responsible for this module:**

- Prof. Dr. rer. nat. Enno Hartmann

**Teacher:**

- All institutes of the University of Lübeck
- Alle Dozentinnen/Dozenten der UzL

**Language:**

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

## LS2800 A - OS MLS: Part of the module A: Selected methods of nucleic acid biology (WPBScNucls)

| Duration: | Turnus of offer: | Credit points: | Max. group size: |
|---|---|---|---|
| 1 Semester | each summer semester | 4 | 9 |

**Course of study, specific field and term:**

- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Selected methods of nucleic acid biology (lecture with exercises or seminar, 3 SWS)

**Workload:**

- 80 Hours private studies
- 40 Hours in-classroom work

**Contents of teaching:**

- Annealing of complementary RNA: a kinetic analysis
- Synthesis of Nucleid acids
- Steady state and pre-steady state kinetic analyses of protein/nucleic acid interactions

**Qualification-goals/Competencies:**

- Studying basic of the molecular biology of nucleic acids and interacting proteins
- Transfer of theoretical models to experimental studies

**Grading through:**

- evaluated protocol
- continuous, successful participation in practical course, >80%
- participation in discussions

**Responsible for this module:**

- Dr. rer. nat. Rosel Kretschmer-Kazemi Far

**Teacher:**

- Institute of Molecular Medicine

- Dr. rer. nat. Rosel Kretschmer-Kazemi Far
- Prof. Dr. rer. nat. Georg Sczakiel
- Prof. Dr. rer. nat. Tobias Restle
- Dr.rer.nat Sonja Petkovic

**Literature:**

- : - Arbeitsvorschriften, Originalliteratur

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800

## LS2800 C - OS MLS: Part of the module C: Model organisms in molecular biology research (WPBScBio)

| Duration: | Turnus of offer: | Credit points: | Max. group size: |
|---|---|---|---|
| 1 Semester | each summer semester | 4 | 16 |

**Course of study, specific field and term:**

- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Model organisms in molecular biology research (lecture with exercises or seminar, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Microorganisms Saccharomyces cerevisae
- Green plants Arabidopsis thaliana
- Invertebrates I Caenorhabditis elegans
- Invertebrates II Drosophila melanogaster
- Vertebrates Mus musculus
- Phylogeny of model organisms

**Qualification-goals/Competencies:**

- basic understanding of the biology of the organisms presented
- basic understanding of the advantages and disadvantages of the different model organisms for biological research
- basic practical abilities in handling these organisms

**Grading through:**

- continuous, successful participation in course

**Requires:**

- Biology 1 (LS1000-MLS)

**Responsible for this module:**

- Siehe Hauptmodul

**Teacher:**

- Institute for Biology

- Prof. Dr. rer. nat. Enno Hartmann
- Prof. Dr. rer nat. Rainer Duden
- Prof. Dr. rer. nat. Christian Schmidt
- Prof. Dr. rer. nat. Walther Traut

**Literature:**

- : - zur Einführung: Campbell Allgemeine Biologie die entsprechenden Kapitel

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800

## LS2800 D - OS MLS: Part of the module D: Experimentel Physiology (WPBScPhysi)

| Duration: | Turnus of offer: | Credit points: | Max. group size: |
|---|---|---|---|
| 1 Semester | each summer semester | 4 | 12 |

**Course of study, specific field and term:**

- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Experimentel Physiology (lecture with exercises or seminar, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Experiments on isolated organs and physiological studies in humans:
- Practical course for the isolation of organs from frog, mouse and rat
- Study of isolated nerves and skeletal muscle to characterize organ physiology
- Determination of blood groups, hemolysis, and coagulation in human blood
- Study of isolated gut, blood vessels, and uterus to characterize the function of smooth muscle
- Practical course on sensory physiology exemplified on the eye
- Study on the circulatory regulation in humans

**Qualification-goals/Competencies:**

- Acquiring knowledge on experimental procedures in physiology and pharmacology

**Grading through:**

- continuous, successful participation in practical course, >80%
- presentation and experiments

**Responsible for this module:**

- Siehe Hauptmodul

**Teacher:**

- Institut of Physiology
- Prof. Dr. med. Cor de Wit

**Literature:**

- : - Lehrbücher der Physiologie

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800

## LS2800 E - OS MLS: Part of the module E: Experimental Biological Chemistry (WPBScBiolC)

| Duration: | Turnus of offer: | Credit points: | Max. group size: |
|---|---|---|---|
| 1 Semester | each summer semester | 4 | 6 |

**Course of study, specific field and term:**

- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Practical course Biological Chemistry (lecture with exercises or seminar, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Recombinant protein synthesis often requires affinity chromatography. This step involves immobilization of a ligand that specifically binds to the protein to be purified. As an example a ligand for human blood group B galactosyltransferase will be synthesized and immobilized.

**Qualification-goals/Competencies:**

- Simple organic synthesis
- Independent planning of a simple synthesis
- Purification and characterization of synthesis products employing MS and NMR

**Grading through:**

- evaluated protocol
- presentation

**Requires:**

- Biological Chemistry (LS2600-KP06, LS2601)
- Organic Chemistry (LS1600-MLS)

**Responsible for this module:**

- Siehe Hauptmodul

**Teacher:**

- Institute of Chemistry and Metabolomics
- Prof. Dr. rer. nat. Thomas Peters
- Dr. Alvaro Mallagaray de Benito

**Literature:**

- : Scientific publications

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800
Scheduling and timing of experiments is up to the students. Therefore, a maximum of six students will be allowed per course.

## LS2800 F - OS MLS: Part of the module F: Basics of Economics (WPBScWl)

| Duration: | Turnus of offer: | Credit points: | Max. group size: |
|---|---|---|---|
| 1 Semester | each summer semester | 4 | 20 |

**Course of study, specific field and term:**

- Master Robotics and Autonomous Systems (module part), interdisciplinary competence, 1st or 2nd semester
- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Business and Economics (lecture with exercises or seminar, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Basics of market economy
- Three actual problems of economy (like globalisation...)
- Structure, organisation and production model of a company
- Product and price policy
- Human Ressource Management: men as a central part

**Qualification-goals/Competencies:**

- Introduction to basic concept of economics
- Knowing of structure and devision of work in a company
- Understanding of economic interrelation and compliance

**Grading through:**

- continuous, successful participation in course

**Responsible for this module:**

- Prof. Dr. rer. nat. Enno Hartmann

**Teacher:**

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- Dipl.- Ökonom Jürgen Spiekermann

**Literature:**

- Hutzschenreuter, T.: Allgemeine Betriebswirtschaftslehre - Wiesbaden, 2007
- Olfert, K., Rahn, H.-J.: Einführung in die Betriebswirtschaftslehre - Ludwigshafen, 2005, 8. Auflage
- Wöhe, G.: Einführung in die Allgemeine Betriebswirtschaftslehre - München, 2010, 24. Auflage
- : - daneben: Wirtschaftswoche, The Economist, Die Zeit, Frankfurter Allgemeine Zeitung, Der Spiegel, ...

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800

## LS2800 G - OS MLS: Part of the module G: Philosophy of Science (WPBScWTh)

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

**Course of study, specific field and term:**

- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Philosophy of Science (lecture with exercises or seminar, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Science, technology and medicine permeate modern societies to increasing degrees. But what distinguishes science from other forms of knowledge, and how does its application impact our way of life? This module will introduce you to the foundations of philosophy of science through a lecture and a compact seminar in which we will discuss recent developments in the biosciences. You will learn to apply conceptual analysis and arguments in order to elucidate and evaluate such developments with regard to their philosophical, ethical, historical and social concequences. For this purpose, the compact seminar will turn to a theme that is currently hotly debated under the catchword Big Data . This is actually not a recent theme in the biosciences. Many biological disciplines including botany, biogeography or ecology -- but also medical disciplines like pathology or epidemiology have always been data-driven rather than hypothesis-driven. While these disciplines were pushed into the background by molecular biology in the twentieth century, they experienced a renaissance in the last two decades associated with the rise of new research programmes such as biodiversity research, evidence based medicine or precision medicine. In the seminar we will discuss on the basis of historical sources, select scientific papers and documents from popular media how the life sciences collect, process and communicate data, which roles classifications, algorithms and models play in these processes, and which new ethical problems data-intensive research faces.
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**Qualification-goals/Competencies:**

- Students are able to recall and contextualise important dates, persons, and ideas in the history of concepts of life.
- They can formulate, explain and discuss important philosophical aspects of biology, especially synthetic biology.
- They can evaluate and critisize ethical standpoints in public debates of contemporary biology.

**Grading through:**

- continuous, successful participation in course
- oral presentation and essay

**Responsible for this module:**

- Dr. phil. Staffan Müller-Wille

**Teacher:**

- Institute for the History of Medicine and Science Studies
- Dr. phil. Staffan Müller-Wille
- Prof. Dr. med. Cornelius Borck
- Prof. Dr. rer. nat. Burghard Weiss

**Literature:**


- : Special Section Synthetic Biology - Science 333(2011): 1235-1256
- J. Boldt, O. Müller, G. Maio: Synthetische Biologie - Bern 2009
- M. A. Bedau / E. C. Parke: The Ethics of Protocells. Moral and Social Implications of Creating Life in the Laboratory - Cambridge, Mass: MIT Press 2009
- K. Köchy: Biophilosophie zur Einführung - Hamburg 2008
- A. Brenner: Leben. Grundwissen Philosophie - Stuttgart: Reclam 2009
- Martin G. Weiß (Hg.): Bios und Zoe. Die menschliche Natur im Zeitalter ihrer technischen Reproduzierbarkeit - Frankfurt a.M.: Suhrkamp 2009
- J. Schummer: Das Gotteshandwerk. Die künstliche Herstellung von Leben im Labor - Frankfurt/M. 2009.

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800
Basics understanding of molecular Biology; Interest in philosophical-ethical questions in the life sciences

## LS2800 H - OS MLS: Part of the module H: (WPBScEwbio)

| Duration: | Turnus of offer: | Credit points: | Max. group size: |
|---|---|---|---|
| 1 Semester | each summer semester | 4 | 5 |

**Course of study, specific field and term:**

- Bachelor MLS (module part), life sciences, 4th semester

**Classes and lectures:**

- Entwicklungsbiologie in vitro und in vivo (seminar / exercises, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Cultivation of murine embryonic stem cells
- Differentiation of murine embryonic stem cells in vitro into cardiomyocytes, skeletal muscle cells and chondrocytes
- Characterisation of differentiated cell types by analysing marker gene expression
- Comparison of in vitro cell differentiation with mouse embryogenesis

**Qualification-goals/Competencies:**

- Students are able to list basic priciples of cell differentiation and to explain how to characterize differentiated cells
- Students are able to explain what stem cells are and which differences exist between somatic and embryonic stem cells

**Grading through:**

- attendance, >90%
- protocols

**Responsible for this module:**

- Siehe Hauptmodul

**Teacher:**

- Institute of Virology and Cell Biology
- Prof. Dr. rer. nat. Jürgen Rohwedel

**Literature:**

- Wolpert: Principles of Development

**Language:**

- offered only in German

**Notes:**

Part of the module LS2800

## CS1012-KP08, CS1012 - Introduction to Computer Science 1 (EinInfo1)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each winter semester | 8 |

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), computer science, 5th semester
- Bachelor MLS (compulsory), computer science, 5th semester
- Bachelor MLS starting 2018 (compulsory), computer science, 5th semester

**Classes and lectures:**

- Introduction to Computer Science 1 (lecture, 4 SWS)
- Introduction to Computer Science 1 (exercise, 3 SWS)

**Workload:**

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

**Contents of teaching:**

- Information and data
- Computer hardware
- Computer software
- The concept of algorithms
- Imperative programming
- The Java programming language
- Elementary data structures
- Strings
- Arrays
- Small-scale and large-scale modularization
- Recursion
- Searching and sorting
- Lists
- Trees and search trees
- OO-programming
- Page description languages

**Qualification-goals/Competencies:**

- Students are able to describe how information processing systems are designed and implemented.
- Furthermore, they can apply IT-systems in research and development projects
- They are able to adapt algorithms and data structures to special-purpose applications.
- They can familiarize themselves easily with new areas of computed science, when lead in advanced courses.

**Grading through:**

- Exercises
- written exam

**Is requisite for:**

- Introduction to Computer Science 2 (CS1013)

**Responsible for this module:**

- Prof. Dr. rer. nat. Till Tantau

**Teacher:**

- Institute for Theoretical Computer Science
- Prof. Dr. rer. nat. Till Tantau

**Literature:**

- Heinz-Peter Gumm, Manfred Sommer: Einführung in die Informatik - Oldenbourg Verlag, 6. Auflage, 2006

**Language:**

- offered only in German

## CS1400-KP04, CS1400 - Introduction to Bioinformatics (EinBioinfo)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2018 (compulsory), life sciences, 5th semester
- Bachelor MES since 2014 (optional subject), computer science and electrical engineering
- Bachelor Computer Science since 2016 (optional subject), Introductory Module Computer Science, 1st semester
- Bachelor Computer Science since 2016 (compulsory), Canonical Specialization Bioinformatics, 1st semester
- Bachelor MLS starting 2016 (compulsory), life sciences, 5th semester
- Bachelor Medical Informatics since 2014 (compulsory), medical computer science, 3rd semester
- Bachelor Computer Science 2014 and 2015 (compulsory), specialization field bioinformatics, 1st semester
- Bachelor Medical Informatics before 2014 (compulsory), medical computer science, 3rd semester
- Bachelor MLS (compulsory), life sciences, 5th semester
- Bachelor CLS (compulsory), specialization field bioinformatics, 5th semester
- Bachelor MES before 2014 (optional subject), Medical Engineering Science, 3rd or 5th semester
- Bachelor Computer Science before 2014 (compulsory), specialization field bioinformatics, 1st semester

**Classes and lectures:**

- Introduction to Bioinformatics (lecture, 2 SWS)
- Introduction to Bioinformatics (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Life, Evolution & the Genome
- Sequence assembly - Industrial reading of genetic information
- DNA sequence models & hidden markov models
- Viterbi-Algoritm
- Sequence alignment & dynamic programming
- Unsupervised data analysis (k-means, PCA, ICA)
- DNA microarrays & GeneChip technologies

**Qualification-goals/Competencies:**

- Students are able to explain the basic concepts of coding, transcription and translation of information in living beings.
- They are able to explain how a solution of the shortest common superstring problem can be estimated with a simple greedy algorithm.
- They are able to create a Markov chain or a Hidden Markov Model (HMM) for a given modelling problem.
- They are able to give examples on how to solve a problem using dynamic programming.
- They are able to implement the introduced algorithms (in Matlab)
- They are able to use unsupervised learning methods and they are able to interpret the results.
- They are able to explain basic Microarray-and DNA-Chip-Technologies.

**Grading through:**

- portfolio exam - the concrete examination elements and their weights will be published in the course

**Responsible for this module:**

- Prof. Dr. rer. nat. Amir Madany Mamlouk

**Teacher:**

- Institute for Neuro- and Bioinformatics
- Prof. Dr. rer. nat. Amir Madany Mamlouk

**Literature:**


- H. Lodish, A. Berk, S. L. Zipursky and J. Darnell: Molekulare Zellbiologie - Spektrum Akademischer Verlag, 4. Auflage, 2001, ISBN-13: 978-3827410771
- A. M. Lesk: Introduction to Bioinformatics - Oxford University Press, 3. Auflage, 2008, ISBN-13: 978-0199208043
- R. Merkl and S. Waack: Bioinformatik Interaktiv: Grundlagen, Algorithmen, Anwendungen - Wiley-VCH Verlag, 2. Auflage, 2009, ISBN-13: 978-3527325948

- M. S. Waterman: Introduction to Computational Biology - Chapman and Hall, 1995

**Language:**

- offered only in German

**Notes:**

For students of the master programme Infection Biology, this is not a stand-alone module, but rather part of the module CS4011.

Computer Science students get a B certificate.

## LS3150 - Molecular Biology (MolBio)

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

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 5th semester

**Classes and lectures:**

- Molecular Biology (lecture, 2 SWS)
- Molecular Biology (seminar, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:Lectures will be oriented with respect to chosen cases of eminent pathophysical, agricultural, technological and methodological conditions. Typically, 5 coherent blocks will be lectured.
- Basics: genetic engineering and gene regulation
- Growth and aging: molecular processes during ontogenetic differentiation, maintenance and loss of function during aging of cells and organisms
- Nucleic-acids: molecular basis, polymorphism, RNA-regulation. Diagnostic and possible therapeutic aspects
- Molecular biology of plants: molecular basis as well as economic and ecological aspects of transgenic plants and herbicide resistance
- Gene-therapeutic approaches and recombinant vaccines
- Exercises:Reading of scientific articles and oral presentation
- Conceptual design of publications
- English as lingua franca in science

**Qualification-goals/Competencies:**

- Students are able to present basic steps of genetic engineering
- They can explain basic mechanisms of gene expression
- They are able to formulate basic mechanisms of RNA-regulated biological systems
- They can present examples for the relationship between pathophysiological processes and their molecular basis
- They are able to explain principles of gene therapy
- They acquire the competence to handle english literature and to present it in a scientific oral presentation

**Grading through:**

- attendance, >90%
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Jürgen Rohwedel

**Teacher:**

- Institute of Molecular Medicine
- Medical Clinic II
- Department of Neurosurgery
- Institute of Virology and Cell Biology

- Prof. Dr. rer. nat. Jürgen Rohwedel
- Prof. Dr. rer. nat. Norbert Tautz
- PD Dr. rer. nat. Christina Zechel
- Dr. rer. nat. Rosel Kretschmer-Kazemi Far
- Dr. rer. nat. Olaf Isken
- Prof. Dr. rer. nat. Jeanette Erdmann

**Literature:**

- Alberts et al.: Molecular Biology of Cells - Garland Science
- Lodish et al.: Molecular Cell Biology - Freeman
- Buchanan et al.: Biochemistry and Molecular Biology of Plants - Wiley Verlag
- : Versuchsanleitungen
- :

**Language:**

- offered only in German

## LS3160 - Practical Course Molecular Biology (PrakMolBio)

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

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), life sciences, 5th semester

**Classes and lectures:**

- Practical Course Molecular Biology (practical course, 3 SWS)
- Practical Course Molecular Biology (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Practical course (in groups of 2):Safe handling of DNA and RNA
- Detection of gene expression at the level of mRNA, ligation and transformation of plasmid DNA
- Procaryotic expression of protein and identification of isolated proteins
- Design of PCR-primers; specialized PCR techniques and identification of PCR products by electrophoresis
-

**Qualification-goals/Competencies:**

- They have skills in basic molecular-biological techniques
- They have the basic knowledge of safety at work in molecular-biological labs
- They know the basics of scientific documentation techniques and can work in a team
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**Grading through:**

- certificates and protocols
- continuous, successful participation in practical course

**Requires:**

- Molecular Biology (LS3150)
- Biochemistry 2 (LS2510-MLS)
- Biochemistry 1 (LS2000-MLS)

**Responsible for this module:**

- Prof. Dr. rer. nat. Norbert Tautz

**Teacher:**

- Institute of Virology and Cell Biology

- Prof. Dr. rer. nat. Norbert Tautz
- Dr. rer. nat. Olaf Isken
- MSc Danilo Dubrau

**Literature:**

- : - Course script

**Language:**

- offered only in German

## LS3250 A - Part of module LS3250 A: Tissue Engineering (TissEn)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (module part), life sciences, 5th semester
- Bachelor MLS (module part), life sciences, 5th semester
- Bachelor MLS starting 2018 (module part), life sciences, 5th semester

**Classes and lectures:**

- Tissue Engineering (seminar with practical exercises, 2 SWS)
- Tissue Engineering (lecture, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:Mamalia cells in their natural environment and under in vitro culture as an example of industrial application.
- Aging of cells in vitro
- Established cell lines
- Diverse in vitro culturing conditions
- Proliferation and differentiation under in vitro conditions
- Stem cell biology
- Materials for medical applications
- Fermentors, bioreactors and protein purification
- Home work e. g. Tissue transplantation and rejection
- Practical course (in groups of 2):Principles of aseptic manipulations, working in sterile containments, object and selfprotection, use of autoclaves
- Preparation of sterile media, additives and other reagents
- Slicing of tissue samples, transfer into tissue culture flasks for explant cultures
- Microscopy and documentation of growing cells
- Cell count, passaging by trypsinisation
- Viability test, freezing of cells and reseeding after thawing
- Adherence of cells to various matrices
- Immunohistochemistry of intracellular and extracellular proteins
-
-

**Qualification-goals/Competencies:**

- Students are able to explain principles of cell- and tissue culture to generate biocomposites from differentiated and pluripotent cells
- They are able to explain basic principles of pro- and eukaryotic gene expression systems
- They are able to explain basic principles of matrix biology
- They can reproduce the aspects of stem cell biology
- They acquire the ability to assess ethical aspects of tissue engineering
- They improve their competence for correct documentation and team working skills
-

**Grading through:**

- continuous, successful participation in course, at most one missed attendance
- protocols
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Jürgen Rohwedel

**Teacher:**

- Fraunhofer Research Institution for Marine Biotechnology
- Lübeck University of Applied Sciences
- Department of Dermatology, Allergology and Venerology
- Institute of Virology and Cell Biology

- Prof. Dr. rer. nat. Holger Notbohm
- Prof. Dr. med. Jürgen Brinckmann
- Prof. Dr. Uwe Englisch
- Dr. rer. nat. Heyke Diddens-Tschoeke
- Prof. Dr. rer. nat. Jürgen Rohwedel
- Dr. C. Probst
- Dr. rer. nat. Daniel Hans Rapoport
- Dr. med. vet. Jennifer Kloepper
- Prof. Dr. med. Ralf Ludwig

**Literature:**

- Lanza, Langer, Vacanti: Principles of Tissue Engineering

**Language:**

- offered only in German

**Notes:**

Knowledge in Cell biology is a prerequisite for this course. Entrance requirement for the seminar with practical parts: certificate of the course Biochemistry 1 or 2.

## LS3250 B - Module part LS3250 B: Metabolic Medicine (Metabol)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (module part), life sciences, 5th semester
- Bachelor MLS (module part), life sciences, 5th semester
- Bachelor MLS starting 2018 (module part), life sciences, 5th semester

**Classes and lectures:**

- Metabolic Medicine (lecture, 2 SWS)
- Tissue Engineering (seminar with practical exercises, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Metabolic physiology
- glucose metabolism & diabetes
- lipid metabolism & obesity, adipokines
- gastroenterology
- thyroid
- central appetite regulation
- circadian clocks & metabolism
- sleep & metabolism

**Qualification-goals/Competencies:**

- Understanding the principles of energy homeostasis
- Understanding physiological interactions of different compartments in the context of energy metabolism
- Students know the symptoms of major metabolic disorders and their pathophysiological causes

**Grading through:**

- continuous, successful participation in course, at most one missed attendance
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Henrik Oster

**Teacher:**

- Department of Dermatology, Allergology and Venerology
- Medical Clinic I

- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. med. Sebastian Schmid
- Prof. Dr. med. Christian Sina
- Dr. med. Volker Ott
- Dr. rer. nat. Carla Schulz
- Prof. Dr. rer. nat. Jens Mittag
- Prof. Dr. med. Jürgen Brinckmann
- Dr. rer. nat. Heyke Diddens-Tschoeke

**Literature:**

- Keith N. Frayn: Metabolic Regulation: A Human Perspective - Wiley & Blackwell, 2010

**Language:**

- German and English skills required

**Notes:**

Principle knowldege in physiology and biochemistry required.
To this module belongs the seminar with a practical part of the module LS3250.
Entrance requirement for the seminar: certificate of the course Biochemistry 1 or 2.

## LS3250-KP05, LS3250 - Applied MLS (AngMLS)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 5th semester
- Bachelor MLS (compulsory), life sciences, 5th semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 5th semester

**Classes and lectures:**

- Tissue Engineering (seminar with practical exercises, 2 SWS)
- See LS3250 A: Tissue Engineering (lecture, 2 SWS)
- See LS3250 B: Metabolic Medicine (lecture, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Lecture: see LS3250-A and LS3250-B

**Qualification-goals/Competencies:**

- see LS3250-A and LS3250-B

**Grading through:**

- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Jürgen Rohwedel

**Teacher:**

- Medical Clinic I
- Fraunhofer Research Institution for Marine Biotechnology
- Lübeck University of Applied Sciences
- Department of Dermatology, Allergology and Venerology
- Institute of Virology and Cell Biology

- Prof. Dr. rer. nat. Holger Notbohm
- Prof. Dr. med. Jürgen Brinckmann
- Prof. Dr. Uwe Englisch
- Prof. Dr. rer. nat. Henrik Oster
- Prof. Dr. rer. nat. Jürgen Rohwedel
- Dr. C. Probst
- Dr. rer. nat. Daniel Hans Rapoport
- Dr. med. vet. Jennifer Kloepper
- Prof. Dr. med. Ralf Ludwig

**Language:**

- offered only in German

**Notes:**

Knowledge in cell biology is a prerequisite for this course. Entrance requirement for the tutorial with practical exercise: certificate of the course Biochemistry 1 or 2. Lecture: Either, lecture LS3250A or LS3250 B, must be chosen, the tutorial is obligatory. Obligatory registration is necessary for the written examination. The date and the compulsory optional subject will then be defined.

## MZ3000-KP06, MZ3000 - Microbiology (MikroBio)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 5th semester
- Bachelor MLS (compulsory), life sciences, 5th semester

**Classes and lectures:**

- Microbiology (lecture, 2 SWS)
- Microbiology (practical course, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Systematics of microorganisms
-
- Bacterial cell wall
- Bacterial growth
- Bacterial toxins
-
- Medical microbiology
-
- Immunology
- Decomposition of natural substances
- Industrial microbiology
- Practical course: General bacteriology, bacteriological techniques
- Differentiation of bacteria
- Bacterial growth and how we can inhibit it
- Biochemistry

**Qualification-goals/Competencies:**

- Studying major groups of microorganisms, understanding of basic microbiological concepts
- Learning of basic microbiological lab techniques
- Studying major infectious diseases and the causative organisms
- Studying basic mechanisms of the immune response
- Acquiring basic knowledge of safety at work by handling with microorganisms
- Improving the ability of scientific documentation techniques, presentation of data and working in a team
- Basic skills to design and perform their own experiments

**Grading through:**

- term paper
- continuous, successful participation in practical course, >80%
- written exam

**Requires:**

- Biology 1 (LS1000-MLS)

**Responsible for this module:**

- Prof. Ph.D. Tamás Laskay

**Teacher:**

- Research Center Borstel
- Department of Infectious Diseases and Microbiology

- Prof. Ph.D. Tamás Laskay
- Prof. Dr. rer. nat. Stefan Niemann
- Dr. Katarzyna Duda
- Dr. med. Susanne Hauswaldt
- Dr. rer. nat. Simon Graspeuntner

- Dr. rer. nat. Dirk Friedrich

**Literature:**

- Michael T. Madigan, u. a.: Brock Mikrobiologie - Pearson Studium 13. Auflage, 2013

**Language:**

- offered only in German

## CS1013 - Introduction to Computer Science 2 (EinInfo2)

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

**Course of study, specific field and term:**

- Bachelor MLS (compulsory), computer science, 6th semester

**Classes and lectures:**

- Introduction to Computer Science 2 (lecture, 2 SWS)
- Introduciton to Computer Science 2 (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Complexity of problems and algorithms
- Optimization problems
- Approximation and heuristics
- Databases
- IT-Security
- Encryption

**Qualification-goals/Competencies:**

- Students can assess the computational complexity of problems and can apply appropriate methods for solving them.
- They can create databases, manage them and create complex database queries.
- They can name basic questions of IT-security as well as solutions to basic security problems.

**Grading through:**

- Exercises
- written exam

**Responsible for this module:**

- Prof. Dr. rer. nat. Till Tantau

**Teacher:**

- Institute for Theoretical Computer Science
- Prof. Dr. rer. nat. Till Tantau

**Literature:**

- Gumm, Sommer: Einführung in die Informatik - Oldenbourg Verlag, 2005

**Language:**

- offered only in German

## LS3500 - Introduction into Structural Analysis (EinStrukAn)

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

**Course of study, specific field and term:**

- Master CLS (compulsory), computational life science / life sciences, 2nd semester
- Bachelor MLS (compulsory), life sciences, 6th semester

**Classes and lectures:**

- Introduction into Structural Analysis (lecture, 2 SWS)
- Introduction into Structural Analysis (seminar / exercises, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Part A: Protein structure analysis by crystal X-ray diffraction:
- Crystal growth: precipitant and phasediagram
- Crystal morphology: symmetry and space groups
- X-ray diffraction: Bragg's law, reciprocal lattice and the Ewald-sphere construction
- Phase determination: Patterson map and molecular replacement
- Part B: Basic NMR spectroscopy for the investigation of biomolecular structures: Basics of NMR spectroscopy: NMR experiments, Spin systems, the classical vector model
- The nuclear Overhauser effect
- Identification and characterisation of protein-ligand interactions: The transfer nOe, the STD-NMR-experiment, the HSQC experiment, the cross-saturation experiment
- Building blocks for NMR experiments
- Part C: Basics of mass spectrometry:Indroduction and basics
- Ion sources and their fields of application
- Mass analysers
- Structural analysis of biomolecules

**Qualification-goals/Competencies:**

- The students will acquire basic skills in selected biophysical techniques to analyze the structure and dynamics of biological macromolecules. The emphasis is on understanding the concepts behind these techniques.
- Furthermore, the students will learn how to elucidate the structure of small organic molecules
-

**Grading through:**

- attendance at exercises
- attendance, >90%
- presentation
- written exam

**Responsible for this module:**

- Prof. Dr.  rer. nat. Thomas Peters

**Teacher:**

- Research Center Borstel
- Institute of Biochemistry
- Institute of Chemistry and Metabolomics

- Prof. Dr.  rer. nat. Thomas Peters
- Prof. Dr. rer. nat. Rolf Hilgenfeld
- Dr. math. et dis. nat. Jeroen Mesters
- PD Dr. rer. nat. Karsten Seeger
- Dr. Dominik Schwudke

**Literature:**

- Wird den aktuellen Gegebenheiten angepasst und in der Vorlesung angegeben. Siehe auch in den entsprechenden Skripten:

- Teil B: Horst Friebolin: Ein- und zweidimensionale NMR-Spektroskopie. Eine Einführung - Wiley-VCH
- Alexander Mc Pherson: Introduction to Macromolecular Crystallography - 1st edition, 2003, Wiley

**Language:**

- offered only in German

## LS3990-KP12, LS3990 - Bachelor Thesis (BScArbeit)

| Duration: | Turnus of offer: | Credit points: |
|---|---|---|
| 1 Semester | each semester | 12 |

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (compulsory), life sciences, 6th semester
- Bachelor MLS (compulsory), life sciences, 6th semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 6th semester

**Classes and lectures:**

- Practical work (practical course, 2 SWS)
- Authoring of the Bachelor Thesis (autonomous practical studies , 1 SWS)
- Colloquium (presentation (incl. preparation), 1 SWS)

**Workload:**

- 360 Hours in-classroom work

**Contents of teaching:**

- Research in the range of molecular biosciences

**Qualification-goals/Competencies:**

- Ability to solve a preformulated simpel scientific problem mostly independent in a defined period of time and to present and defende the experimental results
- Basic skills to design and perform their own experiments

**Grading through:**

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

**Responsible for this module:**

- Studiengangsleitung MLS

**Teacher:**

- Institutes of natural science
- Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges

**Literature:**

- : - will be announced by the lecturer

**Language:**

- thesis can be written in German or English

**Notes:**

Minimum of 120 ECTS
Thesis must be written in German. Except: if the examinator is an English nativ speaker

## MA1600-KP04, MA1600, MA1600-MML - Biostatistics 1 (BioStat1)

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

**Course of study, specific field and term:**

- Bachelor Medical Informatics since 2019 in planning (compulsory), medical computer science, 6th semester
- Bachelor MLS starting 2018 (compulsory), life sciences, 6th semester
- Bachelor Nutritional Medicine starting 2018 (compulsory), mathematics / computer science, 6th semester
- Bachelor CLS starting 2016 (compulsory), mathematics, 2nd semester
- Bachelor CLS (compulsory), mathematics, 2nd semester
- Bachelor Computer Science since 2016 (optional subject), advanced curriculum, arbitrary semester
- Bachelor Computer Science since 2016 (compulsory), Canonical Specialization Bioinformatics, 4th semester
- Bachelor MLS starting 2016 (compulsory), life sciences, 6th semester
- Bachelor Biophysics (compulsory), Elective Computer Science, 4th semester
- Bachelor Nutritional Medicine (compulsory), mathematics / computer science, 6th semester
- Bachelor Medical Informatics since 2014 (compulsory), medical computer science, 4th semester
- Bachelor Computer Science 2014 and 2015 (compulsory), specialization field bioinformatics, 6th semester
- Master MES before 2014 (advanced curriculum), biophysics and biomedical optics, 2nd semester
- Bachelor Medical Informatics before 2014 (compulsory), medical computer science, 4th semester
- Master Computer Science before 2014 (optional subject), specialization field bioinformatics, 2nd or 3rd semester
- Master Computer Science before 2014 (compulsory), advanced curriculum stochastics, 2nd semester
- Bachelor Computer Science before 2014 (optional subject), specialization field bioinformatics, 6th semester
- Bachelor MLS (compulsory), life sciences, 6th semester
- Bachelor MES before 2014 (optional subject), Medical Engineering Science, 6th semester
- Bachelor Computer Science before 2014 (compulsory), specialization field medical informatics, 6th semester

**Classes and lectures:**

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

**Workload:**

- 66 Hours private studies
- 39 Hours in-classroom work
- 15 Hours exam preparation

**Contents of teaching:**

- Descriptive statistics
- Probability theory, including random variables, density, and cumulative distribution function
- Normal distribution, other distributions
- Diagnostic tests, reference range, normal range, coefficient of variation
- Statistical testing
- Sample size calculations
- Confidence intervals
- Selected statistical tests I
- Selected statistical tests II
- Linear simple regression
- Analysis of variance (one-way-classification)
- Clinical trials
- Multiple Testing: Bonferroni, Bonferroni-Holm, Bonferroni-Holm-Shaffer, Wiens, hierarchical Testing

**Qualification-goals/Competencies:**

- The students are able to calculate descriptive statistics.
- They are able to calculate quantiles and surfaces of the normal distribution.
- They are able to explain terms of diagnostic testing, such as sensitivity or specificity.
- They are able to list the basic principles of statistical testing, sample size calculation and confidence interval construction.
- They are able to carry out a set of elementary statistical tests, such as t-test, test of proportions, X2 independence test, and to interpret the results.
- They are able to explain the basic principles of linear regression.
- They are able to apply the linear simple regression.
- They are able to explain the basic idea for the one-way analysis of variance (ANOVA).
- They are able to explain the results table for the one-way and two-way ANOVA.
- They are able to interpret the results of the ANOVA.

- They know the basic principles of clinical therapeutic studies.
- They know the assumptions that need to be fulfilled for the application of specific statistical tests.
- They are able to calculate simple adjustments for multiple comparisons.

**Grading through:**

- written exam

**Is requisite for:**

- Module part: Biostatistics 2 (MA2600 T)
- Biostatistics 2 (MA2600-KP07)
- Biostatistics 2 (MA2600-KP04, MA2600)

**Responsible for this module:**

- Prof. Dr. rer. biol. hum. Inke König

**Teacher:**

- Institute of Medical Biometry and Statistics

- Prof. Dr. rer. biol. hum. Inke König
- MitarbeiterInnen des Instituts
- Dr. Reinhard Vonthein

**Literature:**

- Matthias Rudolf, Wiltrud Kuhlisch: Biostatistik: Eine Einführung für Biowissenschaftler - 1. Auflage, Pearson: Deutschland
- Lothar Sachs, Jürgen Hedderich: Angewandte Statistik: Methodensammlung mit R - 15. Auflage, Springer: Heidelberg

**Language:**

- offered only in German

## PS1030-KP04, PS1030 - English for Bachelor and Master students MLS (Engl)

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

**Course of study, specific field and term:**

- Bachelor MLS starting 2016 (optional suject), interdisciplinary competence, arbitrary semester
- Bachelor Biophysics (optional subject), no specific field, 6th semester
- Master MES since 2014 (optional subject), no specific field, 2nd semester
- Bachelor MES since 2014 (optional subject), no specific field, 4th or 6th semester
- Master MLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor Computer Science before 2014 (optional subject), computer science, arbitrary semester
- Bachelor MES before 2014 (optional subject), Medical Engineering Science, arbitrary semester
- Master CLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor MLS (optional subject), interdisciplinary competence, arbitrary semester
- Bachelor MLS starting 2018 (optional subject), interdisciplinary competence, arbitrary semester

**Classes and lectures:**

- English for Bachelor and Master students MLS (exercise, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Exercise:The content follows a curriculum, modified depending on the given skills and the thematic interests of the participants.
- Creating a CV in English

**Qualification-goals/Competencies:**

- Acquisition of basic skills in spoken and written English
- Improvement of communication in English
- Improvement of reading and writing of texts in English, including technical literature

**Grading through:**

- Exercises
- continuous, successful participation in course
- written exam

**Responsible for this module:**

- B. Sc. Sara Meitner

**Teacher:**

-

- B. Sc. Sara Meitner

**Literature:**

- : - Publications and articles

**Language:**

- offered only in English