



UNIVERSITÄT ZU LÜBECK

Module Guide for the Study Path

# Bachelor Biophysics 2016



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**LS1610-KP04 - Practical Course Chemistry (ACPKP04)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor CLS 2023 (compulsory), life sciences, 4th semester
- Bachelor Biophysics 2024 (compulsory), life sciences, 1st and 2nd semester
- Bachelor CLS 2016 (compulsory), life sciences, 4th semester
- Bachelor Biophysics 2016 (compulsory), life sciences, 1st and 2nd semester

**Classes and lectures:**

- Practical Course Chemistry (practical course, 4 SWS)

**Workload:**

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

**Contents of teaching:**

- Practical course:
- The students work independently under supervision with regards to the role of GSP of the University of Lübeck
- Selected experiments related to topics of the lectures general and organic chemistry

**Qualification-goals/Competencies:**

- From their independent work in the lab course students have fundamental practical skills to perform simple experiments and analyzes in the chemical laboratory within the roles of Good Scientific Praxis of the University of Lübeck. They are competent in basic techniques of the handling of hazardous materials according to GHS (Globally Harmonized System of Classification and Labeling of Chemicals).
- Students are capable to document, interpret and present the results of conducted experiments (laboratory journal and concluding discussion) with regards to the role of GSP of the University of Lübeck and the DFG-guidelines.

**Grading through:**

- Continuous, successful participation in practical course. All experiments have to be conducted.

**Requires:**

- General Chemistry (LS1100-KP04)

**Responsible for this module:**

- PD Dr. phil. nat. Thomas Weimar

**Teacher:**

- [Institute of Medical Engineering](#)
- [Dr. rer. nat. Kerstin Lüdtké-Buzug](#)

**Literature:**

- Thomas Weimar: Script of the practical course

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- Passing of LS1100-L1 and participation in the general health and safety briefing

Prerequisites for admission to the examination:

- Successful participation in the practical course with all tests

Module exam:

- In order to pass the course students have to conduct experiments within defined error margins and present an experiment of the course in a talk. Not graded, 100%.

**LS1100-KP04 - General Chemistry (ACKP04)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

4

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

- Bachelor CLS 2023 (compulsory), life sciences, 3rd semester
- Bachelor Biophysics 2024 (compulsory), life sciences, 1st semester
- Bachelor Computer Science 2019 (optional subject), Extended optional subjects, Arbitrary semester
- Bachelor Computer Science 2019 (optional subject), Canonical Specialization Bioinformatics and Systems Biology, 3rd semester
- Bachelor MES 2020 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor Medical Informatics 2019 (optional subject), medical computer science, 4th to 6th semester
- Bachelor Computer Science 2016 (optional subject), advanced curriculum, Arbitrary semester
- Bachelor Medical Informatics 2014 (optional subject), medical computer science, 5th or 6th semester
- Bachelor Computer Science 2016 (optional subject), Canonical Specialization Bioinformatics, 3rd semester
- Bachelor CLS 2016 (compulsory), life sciences, 3rd semester
- Bachelor Biophysics 2016 (compulsory), life sciences, 1st semester

**Classes and lectures:**

- General Chemistry (lecture, 3 SWS)
- General Chemistry (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:
- The structure of atoms and the periodic table of the elements
- Chemical bonds, molecules and ions
- Reaction equations 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 matter and radiation - Molecular spectroscopy
- Thermodynamics
- Chemical kinetics
- Roles of Environmental and occupational health and safety in the handling of hazardous materials (Globally Harmonized System of Classification and Labeling of Chemicals (GHS)) and of GSP of the University of Lübeck and of the DFG-guidelines
- Exercises:
- Students discuss problems covering all topics of the lectures on the black board

**Qualification-goals/Competencies:**

- Students have fundamental knowledge of general and inorganic chemistry.
- Students understand the fundamental concepts of general and inorganic chemistry and can apply them to reactions and general scientific topics.
- Students are able to perform chemical calculations from all subareas of the course.
- They know the roles for GSP of the University of Lübeck.
- They can transfer the acquired knowledge to problems of other branches in chemistry and related sciences and are thus able to participate in continuative courses.

**Grading through:**

- written exam

**Is requisite for:**

- Practical Course Chemistry (LS1610-KP04)
- Organic Chemistry (LS1600-KP04)

**Responsible for this module:**



- PD Dr. phil. nat. Thomas Weimar

**Teacher:**

- [Institute of Chemistry and Metabolomics](#)

- PD Dr. phil. nat. Thomas Weimar

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**Literature:**

- Schmuck et al.: Chemie für Mediziner - Pearson Studium
- Binnewies et al.: Allgemeine und Anorganische Chemie - Spektrum Verlag

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**Language:**

- offered only in German

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**Notes:**

Admission requirements for taking the module:

- None

Admission requirements for participation in module examination(s):

- Successful completion of homework assignments as specified at the beginning of the semester

Modul exam(s):

- LS1100-L1: General Chemistry, written exam, 90 min, 100% of module grade

**MA1000-KP08, MA1000 - Linear Algebra and Discrete Structures 1 (LADS1)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

8

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

- Minor in Teaching Mathematics, Bachelor of Arts 2023 (compulsory), mathematics, 3rd semester
- Bachelor CLS 2023 (compulsory), mathematics, 1st semester
- Bachelor Biophysics 2024 (compulsory), mathematics, 1st semester
- Bachelor Biophysics 2024 (compulsory), mathematics, 1st semester
- Bachelor MES 2020 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Media Informatics 2020 (compulsory), mathematics, 3rd semester
- Bachelor Computer Science 2019 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Medical Informatics 2019 (compulsory: aptitude test), mathematics, 1st semester
- Minor in Teaching Mathematics, Bachelor of Arts 2017 (compulsory), mathematics, 3rd semester
- Bachelor Computer Science 2016 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor CLS 2016 (compulsory), mathematics, 1st semester
- Bachelor IT-Security 2016 (compulsory), mathematics, 1st semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Biophysics 2016 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Medical Informatics 2014 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor MES 2014 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Media Informatics 2014 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Computer Science 2014 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Medical Informatics 2011 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Computer Science 2012 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor MES 2011 (compulsory), mathematics, 1st semester
- Bachelor CLS 2010 (compulsory), mathematics, 1st semester

**Classes and lectures:**

- Linear Algebra and Discrete Structures 1 (lecture, 4 SWS)
- Linear Algebra and Discrete Structures 1 (exercise, 2 SWS)

**Workload:**

- 125 Hours private studies and exercises
- 90 Hours in-classroom work
- 25 Hours exam preparation

**Contents of teaching:**

- Fundamentals: logic, sets, mappings
- Relations, equivalence relations, orderings
- Proof by induction
- Groups: fundamentals, finite groups, permutations, matrices
- Rings, fields, congruencies
- Complex numbers: calculus, representation, roots of unity
- Vector spaces: bases, dimension, scalar product, norms

**Qualification-goals/Competencies:**

- Students understand the fundamental concepts of linear algebra.
- They understand basic thought processes and methods of proof.
- They can explain fundamental relationships in linear algebra.
- They can apply fundamental concepts and methods of proof to algebraic problems.
- They have an understanding of abstract thought processes.
- Interdisciplinary qualifications:
- Students have basic competency in modelling.
- They can transfer fundamental theoretical concepts to similar applications.
- They can work on elementary mathematics problems within a team.
- They can present elementary solutions to their problems to a group.

**Grading through:**

- written exam



**Is requisite for:**

- Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)

**Responsible for this module:**

- [Prof. Dr. rer. nat. Jan Modersitzki](#)

**Teacher:**

- [Institute of Mathematics and Image Computing](#)
- [Prof. Dr. rer. nat. Jan Modersitzki](#)
- [Prof. Dr. rer. nat. Jan Lellmann](#)

**Literature:**

- G. Fischer: Lineare Algebra: Eine Einführung für Studienanfänger - Vieweg+Teubner
- G. Strang: Lineare Algebra - Springer
- K. Jänich: Lineare Algebra - Springer
- D. Lau: Algebra und diskrete Mathematik I + II - Springer
- G. Strang: Introduction to Linear Algebra - Cambridge Press
- K. Rosen: Discrete Mathematics and Its Applications - McGraw-Hill

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Successful completion of homework assignments during the semester
- Successful completion of e-tests during the semester
- Presentation of homework assignment

Module exam:

- MA1000-L1: Linear Algebra and Discrete Structures 1, written exam, 90 min, 100 % of module grade



**MA2000-KP08, MA2000 - Analysis 1 (Ana1KP08)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

8

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

- Bachelor CLS 2023 (compulsory), mathematics, 1st semester
- Minor in Teaching Mathematics, Bachelor of Arts 2023 (compulsory), mathematics, 5th semester
- Bachelor Biophysics 2024 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor MES 2020 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Media Informatics 2020 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Computer Science 2019 (compulsory), mathematics, 1st semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Medical Informatics 2019 (compulsory), mathematics, 1st semester
- Minor in Teaching Mathematics, Bachelor of Arts 2017 (compulsory), mathematics, 5th semester
- Bachelor Computer Science 2016 (compulsory), mathematics, 1st semester
- Bachelor CLS 2016 (compulsory), mathematics, 1st semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor IT-Security 2016 (compulsory), mathematics, 1st semester
- Bachelor Biophysics 2016 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Medical Informatics 2014 (compulsory), mathematics, 1st semester
- Bachelor Media Informatics 2014 (compulsory), mathematics, 1st semester
- Bachelor MES 2014 (compulsory: aptitude test), mathematics, 1st semester
- Bachelor Computer Science 2014 (compulsory), mathematics, 1st semester
- Bachelor Medical Informatics 2011 (compulsory), mathematics, 3rd semester
- Bachelor CLS 2010 (compulsory), mathematics, 1st semester
- Bachelor MES 2011 (compulsory), mathematics, 1st semester
- Bachelor Computer Science 2012 (compulsory), mathematics, 3rd semester

**Classes and lectures:**

- Analysis 1 (lecture, 4 SWS)
- Analysis 1 (exercise, 2 SWS)

**Workload:**

- 125 Hours private studies
- 90 Hours in-classroom work
- 25 Hours exam preparation

**Contents of teaching:**

- Sequences and series
- Functions and continuity
- Differentiability, Taylor series
- Metric and normalized spaces, basic topological concepts
- Multivariate differential calculus

**Qualification-goals/Competencies:**

- Students understand the basic terms of analysis, especially the concept of convergence.
- Students understand the basic thoughts and proof techniques and are able to use them for the analytical treatment of scientifically or technically motivated problems.
- Students can explain basic relationships in real analysis.
- Students can apply the basic concepts and proof techniques of differential calculus.
- Students have an understanding for abstract structures.
- Interdisciplinary qualifications:
- Students have a basic competence in modeling.
- Students can transfer theoretical concepts to similar applications.
- Students can work as a group on elementary mathematical problems.

**Grading through:**

- written exam

**Is requisite for:**

- Analysis 2 (MA2500-KP09)
- Analysis 2 (MA2500-KP08)



- Analysis 2 (MA2500-KP05, MA2500-MLS)
- Analysis 2 (MA2500-KP04, MA2500)

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**Responsible for this module:**

- [Prof. Dr. rer. nat. Jürgen Prestin](#)

**Teacher:**

- [Institute for Mathematics](#)
- [Prof. Dr. rer. nat. Jürgen Prestin](#)
- [Dr. rer. nat. Jörn Schnieder](#)

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**Literature:**

- K. Fritzsche: Grundkurs Analysis 1 + 2
- H. Heuser: Lehrbuch der Analysis 1 + 2
- K. Burg, H. Haf, F. Wille, A. Meister: Höhere Mathematik für Ingenieure
- R. Lasser, F. Hofmaier: Analysis 1 + 2

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**Language:**

- offered only in German

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**Notes:**

Admission requirements for taking the module:

- None

Admission requirements for participation in module examination(s):

- Successful completion of homework assignments during the semester
- Successful completion of e-tests

Modul exam:

- MA2000-L1: Analysis 1, written exam, 90 min, 100 % of module grade

<b>ME1010-KP08, ME1010 - Physics 1 (Phy1)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 8
<b>Course of study, specific field and term:</b>		
<ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory: aptitude test), physics, 1st semester</li> <li>• Bachelor MES 2020 (compulsory: aptitude test), physics, 1st semester</li> <li>• Bachelor Biophysics 2016 (compulsory: aptitude test), physics, 1st semester</li> <li>• Bachelor MES 2014 (compulsory: aptitude test), physics, 1st semester</li> <li>• Bachelor MES 2011 (compulsory), physics, 1st semester</li> </ul>		
<b>Classes and lectures:</b>		<b>Workload:</b>
<ul style="list-style-type: none"> <li>• Physics 1 (lecture, 4 SWS)</li> <li>• Physics 1 (exercise, 2 SWS)</li> </ul>		<ul style="list-style-type: none"> <li>• 110 Hours private studies</li> <li>• 90 Hours in-classroom work</li> <li>• 40 Hours exam preparation</li> </ul>
<b>Contents of teaching:</b>		
<ul style="list-style-type: none"> <li>• Physical values, units, accuracy, measurement errors</li> <li>• Mathematical methods and notations</li> <li>• Kinematics of point mass, Newton's Axioms, contact forces, modulus, virtual forces, Newton's equation of motion, differential equations</li> <li>• Work and energy, power and efficiency, momentum, inertia, physical pendulum, momentum of rotation</li> <li>• Conservation laws and symmetries</li> <li>• Gravitation, oscillation, waves, acoustics, Doppler effect</li> <li>• Resting and flowing gases and liquids, effects of surfaces and interfaces</li> <li>• Temperature, thermometer, therm. expansion, state equations, kinetic gas theory</li> <li>• Van-der-Waals state equation, heat capacity, heat conduction, 1st law of thermodynamics, volume work, p-V diagram</li> <li>• Adiabatic processes, 2nd law of thermodynamics, thermal engines and Carnot cycle, efficiency, heat pump</li> <li>• Entropy, disorder and probability, 3rd law of thermodynamics</li> </ul>		
<b>Qualification-goals/Competencies:</b>		
<ul style="list-style-type: none"> <li>• You can name the basic laws of physics</li> <li>• You can measure according to physics rules</li> <li>• You can explain physical laws based on observations</li> <li>• You can formally analyze physical problems</li> <li>• You can judge which concept is best suited to solve a certain problem</li> <li>• You can design novel physical experiments on your own</li> </ul>		
<b>Grading through:</b>		
<ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Is requisite for:</b>		
<ul style="list-style-type: none"> <li>• Physics 2 (ME1020-KP08, ME1020)</li> </ul>		
<b>Responsible for this module:</b>		
<ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Christian Hübner</li> </ul>		
<b>Teacher:</b>		
<ul style="list-style-type: none"> <li>• <a href="#">Institute of Biomedical Optics</a></li> <li>• <a href="#">Institute of Physics</a></li> <li>• <a href="#">Institute of Medical Engineering</a></li> <li>• <a href="#">Prof. Dr. rer. nat. Thorsten Buzug</a></li> <li>• Prof. Dr. rer. nat. Christian Hübner</li> <li>• PD Dr. rer. nat. Hauke Paulsen</li> <li>• Prof. Dr. rer. nat. Alfred Vogel</li> <li>• <a href="#">Prof. Dr. rer. nat. Robert Huber</a></li> </ul>		



**Literature:**

- Giancoli: Physics

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for admission to the written examination:

- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

Module exam:

- ME1010-L1: written exam, 120 min, 100 % module grade

**LS1600-KP04 - Organic Chemistry (OCKP04)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor CLS 2023 (compulsory), life sciences, 4th semester
- Bachelor Biophysics 2024 (compulsory), life sciences, 2nd semester
- Master Medical Informatics 2019 (optional subject), bioinformatics, 1st or 2nd semester
- Master Medical Informatics 2014 (optional subject), bioinformatics, 1st or 2nd semester
- Bachelor CLS 2016 (compulsory), life sciences, 4th semester
- Bachelor Biophysics 2016 (compulsory), life sciences, 2nd semester

**Classes and lectures:**

- Organic Chemistry (lecture, 3 SWS)
- Organic Chemistry (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Lectures:
- Alkanes, cycloalkanes
- Alkenes and Alkynes
- Aromatics
- Stereochemistry
- Substitution and elimination reactions
- Alcohols, phenols and thiols
- Ether and epoxides
- Aldehydes and ketones
- Carboxylic acids and derivativs
- Amines and derivativs
- Heterocycles
- Lipids
- Carbohydrates
- Amino acids and peptides
- Nucleotides and nucleic acids
- Exercises:
- Students discuss problems covering all topics of the lectures on the black board

**Qualification-goals/Competencies:**

- After successful completion of the course, students have a fundamental knowledge of organic chemistry. They are confident using structural formulas of substance classes and functional groups presented in the course. They are confident in the nomenclature and can correctly describe relative and absolute configurations of molecules.
- Students know the most important reactions, reaction types and reaction principles of organic chemistry. They understand the structural properties of functional groups and are able to formulate organic chemical reaction mechanisms of these groups.
- Students can transfer and apply the acquired skills to problems of other branches of chemistry and related sciences and are thus able to participate in continuative courses.

**Grading through:**

- written exam

**Requires:**

- General Chemistry (LS1100-KP04)

**Responsible for this module:**

- PD Dr. phil. nat. Thomas Weimar

**Teacher:**

- [Institute of Chemistry and Metabolomics](#)
- PD Dr. phil. nat. Thomas Weimar

**Literature:**

- 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:**

Knowledge of basic chemistry (such as from LS1100-INF) is required.

Prerequisites for attending the module:

- None (The competencies of the modules listed under 'Requires' are needed for this module, but are not a formal prerequisite)

Prerequisites for the exam:

- Examination prerequisites can be defined at the beginning of the semester. If preliminary work is defined, it must have been completed and positively evaluated before the first examination.

Module exam:

LS1600-L1: Organic Chemistry, written exam, 90 min, 100 of % module grade

**MA1500-KP08, MA1500 - Linear Algebra and Discrete Structures 2 (LADS2)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

8

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

- Minor in Teaching Mathematics, Bachelor of Arts 2023 (compulsory), mathematics, 4th semester
- Bachelor CLS 2023 (compulsory), mathematics, 2nd semester
- Bachelor Biophysics 2024 (compulsory), mathematics, 2nd semester
- Bachelor MES 2020 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science 2019 (compulsory: aptitude test), mathematics, 2nd semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 2nd semester
- Bachelor Medical Informatics 2019 (compulsory), mathematics, 2nd semester
- Minor in Teaching Mathematics, Bachelor of Arts 2017 (compulsory), mathematics, 4th semester
- Bachelor Computer Science 2016 (compulsory: aptitude test), mathematics, 2nd semester
- Bachelor CLS 2016 (compulsory), mathematics, 2nd semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 2nd semester
- Bachelor IT-Security 2016 (compulsory), mathematics, 2nd semester
- Bachelor Biophysics 2016 (compulsory), mathematics, 2nd semester
- Bachelor Medical Informatics 2014 (compulsory), mathematics, 2nd semester
- Bachelor MES 2014 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science 2014 (compulsory: aptitude test), mathematics, 2nd semester
- Bachelor Medical Informatics 2011 (compulsory), mathematics, 2nd semester
- Bachelor CLS 2010 (compulsory), mathematics, 2nd semester
- Bachelor MES 2011 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science 2012 (compulsory: aptitude test), mathematics, 2nd semester

**Classes and lectures:**

- Linear Algebra and Discrete Structures 2 (lecture, 4 SWS)
- Linear Algebra and Discrete Structures 2 (exercise, 2 SWS)

**Workload:**

- 125 Hours private studies and exercises
- 90 Hours in-classroom work
- 25 Hours exam preparation

**Contents of teaching:**

- Systems of linear equations, matrices
- Determinants
- Linear mappings
- Orthogonality
- Eigenvalues

**Qualification-goals/Competencies:**

- The students understand advanced concepts of linear algebra.
- They understand advanced thought processes and methods of proof.
- They can apply advanced concepts and methods of proof to algebraic problems.
- They can explain advanced relationships in linear algebra.
- Interdisciplinary qualifications:
- Students can transfer advanced theoretical concepts to similar applications.
- They have an advanced competency in modeling.
- They can solve complex problems within a group.
- They can present the solution to complex problems to a group.

**Grading through:**

- written exam

**Is requisite for:**

- Image Registration (MA5030-KP05)
- Image Registration (MA5030-KP04, MA5030)
- Mathematical Methods of Image Processing (MA4500-KP05)
- Mathematical Methods in Image Processing (MA4500-KP04, MA4500)
- Optimization (Advanced Mathematics) (MA4031-KP08)

- Module part: Optimization (MA4030 T)
- Optimization (MA4030-KP08, MA4030)

**Requires:**

- Linear Algebra and Discrete Structures 1 (MA1000-KP08, MA1000)

**Responsible for this module:**

- [Prof. Dr. rer. nat. Jan Modersitzki](#)

**Teacher:**

- [Institute of Mathematics and Image Computing](#)
- [Prof. Dr. rer. nat. Jan Modersitzki](#)
- [Prof. Dr. rer. nat. Jan Lellmann](#)

**Literature:**

- G. Fischer: Lineare Algebra: Eine Einführung für Studienanfänger - Vieweg+Teubner
- G. Strang: Lineare Algebra - Springer
- K. Jänich: Lineare Algebra - Springer
- D. Lau: Algebra und diskrete Mathematik I + II - Springer
- G. Strang: Introduction to Linear Algebra - Cambridge Press
- K. Rosen: Discrete Mathematics and Its Applications - McGraw-Hill

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- None (The competencies of the modules listed under 'Requires' are needed for this module, but are not a formal prerequisite)

Prerequisites for the exam:

- Successful completion of homework assignments during the semester
- Successful completion of e-tests during the semester
- Presentation of homework assignment

Module exam:

- MA1500-L1: Linear Algebra and Discrete Structures 2, written exam, 90 min, 100 % of module grade



<b>MA2500-KP08 - Analysis 2 (Ana2KP08)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester	<b>Credit points:</b> 8
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), mathematics, 2nd semester</li> <li>• Bachelor IT-Security 2016 (optional subject), specific, Arbitrary semester</li> <li>• Bachelor MES 2014 (compulsory), mathematics, 2nd semester</li> <li>• Bachelor MES 2020 (compulsory), mathematics, 2nd semester</li> <li>• Bachelor Biophysics 2016 (compulsory), mathematics, 2nd semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Analysis 2 (lecture, 4 SWS)</li> <li>• Analysis 2 (exercise, 2 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 125 Hours private studies</li> <li>• 90 Hours in-classroom work</li> <li>• 25 Hours exam preparation</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Advanced multivariate differential calculus</li> <li>• Integral calculus for functions of one real variable (indefinite integrals, antiderivatives, substitution, partial fractions, definite integrals, fundamental theorem of calculus)</li> <li>• Curvilinear integrals, bounded variation</li> <li>• Function series, power series</li> <li>• Fourier series (trigonometric polynomials, convergence)</li> <li>• Linear operators in Hilbert spaces</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Students understand the advanced terms of analysis, such as even convergence.</li> <li>• Students understand the advanced thoughts and proof techniques.</li> <li>• Students can apply the advanced concepts and proof techniques.</li> <li>• Students can explain advanced relationships in analysis.</li> <li>• Interdisciplinary qualifications:               <ul style="list-style-type: none"> <li>• Students can transfer advanced theoretical concepts to similar applications.</li> <li>• Students have an advanced competence in modeling.</li> <li>• Students can work as a group on complex mathematical problems.</li> </ul> </li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Requires:</b> <ul style="list-style-type: none"> <li>• Analysis 1 (MA2000-KP09)</li> <li>• Analysis 1 (MA2000-KP08, MA2000)</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• <a href="#">Prof. Dr. rer. nat. Jürgen Prestin</a></li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute for Mathematics</a></li> <li>• <a href="#">Prof. Dr. rer. nat. Jürgen Prestin</a></li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• H. Heuser: Lehrbuch der Analysis 1+2</li> <li>• K. Fritzsche: Grundkurs Analysis 1+2</li> <li>• K. Burg, H. Haf, F. Wille, A. Meister: Höhere Mathematik für Ingenieure</li> <li>• R. Lasser, F. Hofmaier: Analysis 1 + 2</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		



**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Successful completion of homework assignments during the semester.
- Successful completion of e-tests

Modul exam:

- MA2500-L1: Analysis 2, written exam, 90 min, 100 % module grade

<b>ME1020-KP08, ME1020 - Physics 2 (Physik2)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester	<b>Credit points:</b> 8
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), physics, 2nd semester</li> <li>• Bachelor MES 2020 (compulsory), physics, 2nd semester</li> <li>• Bachelor Biophysics 2016 (compulsory), physics, 2nd semester</li> <li>• Bachelor MES 2014 (compulsory), physics, 2nd semester</li> <li>• Bachelor MES 2011 (compulsory), physics, 2nd semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Physics 2 (lecture, 4 SWS)</li> <li>• Physics 2 (exercise, 2 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 130 Hours private studies</li> <li>• 90 Hours in-classroom work</li> <li>• 20 Hours exam preparation</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Electric charge, Coulomb force, electric field, electric potential, capacity</li> <li>• Stationary electric current, resistor, Kirchhoff's laws</li> <li>• Magnetic field, magnetic dipole, electric current and magnetic field</li> <li>• Electromagnetic induction, resonant circuit</li> <li>• Nonstationary electric and magnetic fields, displacement current, Maxwell's equations</li> <li>• Refraction, reflexion</li> <li>• Geometrical optics, image generation, lenses, aberrations, optical instruments</li> <li>• Interference, diffraction, resolution power</li> <li>• Polarization, birefringence, Brewster's angle</li> <li>• Relativity theory</li> <li>• Bohr's atomic model, spectral lines, quantum mechanical atomic model</li> <li>• Molecules and solid bodies</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• You can name the basic laws of physics</li> <li>• You can measure according to physics rules</li> <li>• You can explain physical laws based on observations</li> <li>• You can formally analyze physical problems</li> <li>• You can judge which concept is best suited to solve a certain problem</li> <li>• You can design novel physical experiments on your own</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• Written or oral exam as announced by the examiner</li> </ul>		
<b>Requires:</b> <ul style="list-style-type: none"> <li>• Physics 1 (ME1010-KP08, ME1010)</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Christian Hübner</li> <li>• Prof. Dr. rer. nat. Thorsten Buzug</li> <li>• Prof. Dr. rer. nat. Robert Huber</li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• Institute of Biomedical Optics</li> <li>• Institute of Physics</li> <li>• Institute of Medical Engineering</li> <li>• Prof. Dr. rer. nat. Thorsten Buzug</li> <li>• Prof. Dr. rer. nat. Christian Hübner</li> <li>• Prof. Dr. rer. nat. Robert Huber</li> </ul>		



**Literature:**

- Giancoli: Physics

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- None (The competences of the required modules are required for this module, but the modules are not a prerequisite for admission.)

Prerequisites for the exam:

- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

Modul exam:

- ME1020-L1: Physics 2, written exam, 90 min, 100 % module grade

**BP2040-KP05 - Classical and statistical mechanics (KSM)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

5

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

- Bachelor Biophysics 2024 (compulsory), physics, 3rd semester
- Bachelor Biophysics 2016 (compulsory), physics, 3rd semester

**Classes and lectures:**

- Classical and statistical mechanics (lecture, 2 SWS)
- Classical and statistical mechanics (exercise, 2 SWS)

**Workload:**

- 70 Hours private studies
- 60 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**

- Die Studierenden bearbeiten Übungsaufgaben selbständig unter Berücksichtigung der Richtlinie der GWP der Universität zu Lübeck und gemäß den DFG-Leitlinien.

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**Qualification-goals/Competencies:**

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**Grading through:**

- written exam

**Requires:**

- Analysis 2 (UngenutztMA2500-MIWSJ14)

**Responsible for this module:**

- PD Dr. rer. nat. Hauke Paulsen

**Teacher:**

- [Institute of Physics](#)

**Literature:**

- [Randy Harris: Moderne Physik - Pearson Studium](#)
- :

**Language:**

- offered only in German

LS1000-KP06 - Biology 1 (Bio1_BP)		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 6
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor Biophysics 2016 (compulsory), life sciences, 3rd semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Biology (lecture, 4 SWS)</li> </ul>	<b>Workload:</b> <ul style="list-style-type: none"> <li>• 100 Hours private studies</li> <li>• 60 Hours in-classroom work</li> <li>• 20 Hours exam preparation</li> </ul>	
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>•</li> <li>•</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Enno Hartmann</li> </ul> <b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute for Biology</a></li> <li>• Prof. Dr. rer. nat. Enno Hartmann</li> <li>• <a href="#">Prof. Dr. rer. nat. Rainer Duden</a></li> <li>• PD Dr. rer. nat. Kai-Uwe Kalies</li> <li>• <a href="#">PD Dr. rer. nat. Bärbel Kunze</a></li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Campbell: Biology</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b> <p>Prerequisites for the modul: - nothing</p> <p>Prerequisites for admission to the written examination: - nothing</p> <p>Modul exam: - LS1000-L1: Biology, written exam, 90 min, 100% modul grade</p>		

LS2000-KP06 - Biochemistry 1 (Bioche1_06)		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 6
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor Biophysics 2016 (compulsory), life sciences, 3rd semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Biochemistry for Biophysics (lecture, 4 SWS)</li> </ul>	<b>Workload:</b> <ul style="list-style-type: none"> <li>• 90 Hours private studies</li> <li>• 60 Hours in-classroom work</li> <li>• 30 Hours exam preparation</li> </ul>	
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Characteristics of biosystems, biomolecules</li> <li>• Proteins: structure and dynamics</li> <li>• Enzymes: structure, function and regulation</li> <li>• Intermediary metabolism</li> <li>• Biomembranes and cell respiration</li> <li>• DNA Replication, transcription, translation</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Understanding structures and functions of biochemical important biomolecules</li> <li>• Understanding biochemical interrelations and their importance for cellular metabolism</li> <li>• Knowledge of biochemical analysis procedures</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. Thomas Krey</li> </ul> <b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Biochemistry</a></li> <li>• Prof. Dr. Thomas Krey</li> <li>• Prof. Dr. Lars Redecke</li> <li>• PD Dr. rer. nat. Guido Hansen</li> <li>• Dr. rer. nat. Janna Bigalke</li> <li>• Dr. Mariana Grieben</li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Berg/Tymoczko/Stryer: Biochemistry 7th ed.</li> <li>• Voet/Voet: Biochemistry 4th ed.</li> <li>• Lehninger: Principles of Biochemistry 5th ed.</li> <li>• Alberts et al.: Molecular Biology of the Cell 5th ed.</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in English</li> </ul>		
<b>Notes:</b>		



Prerequisites for the module:

- nothing

Prerequisites for admission to the written examination:

- nothing

Module exam:

- LS2001-L1: Biochemistry, written exam, 120 min, 100 % module grade



<b>LS2200-KP04, LS2200 - Introduction into Biophysics (EinBiophy)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 4
<b>Course of study, specific field and term:</b>		
<ul style="list-style-type: none"> <li>• Bachelor CLS 2023 (optional subject), life sciences, 5th semester</li> <li>• Bachelor Biophysics 2024 (compulsory), biophysics, 3rd semester</li> <li>• Bachelor Molecular Life Science 2024 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor MES 2020 (optional subject), mathematics / natural sciences, 3rd semester at the earliest</li> <li>• Bachelor MLS 2018 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor MLS 2016 (compulsory), life sciences, 3rd and 4th semester</li> <li>• Bachelor CLS 2016 (optional subject), life sciences, 5th semester</li> <li>• Bachelor Nutritional Medicine 2016 (compulsory), biophysics, 3rd semester</li> <li>• Bachelor Biophysics 2016 (compulsory), biophysics, 3rd semester</li> <li>• Bachelor MES 2014 (optional subject), mathematics / natural sciences, 3rd or 5th semester</li> <li>• Bachelor MLS 2009 (compulsory), life sciences, 3rd and 4th semester</li> <li>• Bachelor CLS 2010 (optional subject), life sciences, 5th semester</li> <li>• Bachelor MES 2011 (compulsory), medical engineering science, 5th semester</li> </ul>		
<b>Classes and lectures:</b>		<b>Workload:</b>
<ul style="list-style-type: none"> <li>• Introduction into Biophysics (lecture, 2 SWS)</li> <li>• Biophysics (Exercise or practical course, 1 SWS)</li> </ul>		<ul style="list-style-type: none"> <li>• 50 Hours private studies</li> <li>• 45 Hours in-classroom work</li> <li>• 15 Hours written report</li> <li>• 10 Hours exam preparation</li> </ul>
<b>Contents of teaching:</b>		
<ul style="list-style-type: none"> <li>• Biological macro molecules, structure, forces</li> <li>• Proteins, structure, properties</li> <li>• Biomembranes, structure, properties</li> <li>• Mechanical properties of cells</li> <li>• Thermo dynamics of biological processes</li> </ul>		
<b>Qualification-goals/Competencies:</b>		
<ul style="list-style-type: none"> <li>• You can assign forces in biological systems</li> <li>• You become familiar with the basic aspects of living matter</li> <li>• You gain the expertise to simplify complex living systems</li> <li>• You can choose and apply appropriate experimental methods for the study of living matter</li> </ul>		
<b>Grading through:</b>		
<ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b>		
<ul style="list-style-type: none"> <li>• Dr. Young-Hwa Song</li> </ul>		
<b>Teacher:</b>		
<ul style="list-style-type: none"> <li>• <a href="#">Institute of Physics</a></li> <li>• Dr. Young-Hwa Song</li> <li>• Prof. Dr. rer. nat. Christian Hübner</li> </ul>		
<b>Literature:</b>		
<ul style="list-style-type: none"> <li>• Volker Schünemann: Biophysik: Eine Einführung</li> <li>• Werner Mäntele: Biophysik</li> </ul>		
<b>Language:</b>		
<ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b>		



Prerequisites for the module:

- None

Prerequisites for admission to the written examination:

- Successful participation in the exercises as specified at the beginning of the semester

Module exam:

- LS2200-L1: Introduction into Biophysics, written exam, 120 min, 100 % of module grade

The lecture and exercises take place in the winter semester, the practical course in the summer semester.

Whether exercises or a practical course take place is specified in the SGO of the respective study program.

Prerequisite for the understanding of the lecture is the knowledge of the basics of inorganic and organic chemistry.

**MA3400-KP05 - Biomathematics (BioMaKP05)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

5

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

- Bachelor CLS 2023 (compulsory), mathematics, 3rd semester
- Bachelor Biophysics 2024 (compulsory), mathematics, 3rd semester
- Bachelor Computer Science 2019 (optional subject), Extended optional subjects, Arbitrary semester
- Bachelor Computer Science 2019 (compulsory), Canonical Specialization Bioinformatics and Systems Biology, 5th semester
- Bachelor Medical Informatics 2019 (optional subject), medical computer science, 4th to 6th semester
- Master MLS 2018 (optional subject), interdisciplinary competence, 1st semester
- Bachelor Computer Science 2016 (optional subject), advanced curriculum, Arbitrary semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization Bioinformatics, 5th semester
- Master MLS 2016 (optional subject), mathematics / computer science, 1st semester
- Bachelor CLS 2016 (compulsory), mathematics, 3rd semester
- Bachelor Biophysics 2016 (compulsory), mathematics, 3rd semester

**Classes and lectures:**

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

**Workload:**

- 70 Hours private studies and exercises
- 60 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

**Qualification-goals/Competencies:**

- Students are able to explain basic notions from the theory of ordinary differential equations.
- Students can explain bad phenomena of solutions of differential equations using examples.
- Students can specify conditions under which good phenomena of solutions are guaranteed by applying theorems from the theory of ordinary differential equations.
- Students are able to find explicit solutions of simple differential equations.
- Students are able to explain how solutions of differential equations can be analysed qualitatively.
- Students are able to present important models of the natural sciences which can be 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

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**Language:**

- offered only in German

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**Notes:**

Admission requirements for taking the module:

- None (The competencies of the modules listed under 'Requires' are needed for this module, but are not a formal prerequisite)

Admission requirements for participation in module examination(s):

- Successful completion of homework assignments during the semester

Module exam(s):

- MA3400-L1: Biomathematics, written exam, 90 min, 100 % of module grade

**ME2053-KP04, ME2053 - Physics Lab Course (PhysPrakt)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

4

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

- Bachelor Biophysics 2024 (compulsory), physics, 3rd semester
- Bachelor Molecular Life Science 2024 (compulsory), physics, 3rd semester
- Bachelor MES 2020 (compulsory), physics, 3rd semester
- Bachelor MLS 2018 (compulsory), life sciences, 3rd semester
- Bachelor Biophysics 2016 (compulsory), physics, 3rd semester
- Bachelor MES 2014 (compulsory), physics, 3rd semester
- Bachelor MLS 2009 (compulsory), life sciences, 3rd semester
- Bachelor MES 2011 (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:**

- The students can practically work out the physical connections to the mentioned contents of the practical course with regard to the roles of GSP of the University of Lübeck and of the DFG-guidelines..
- They can use measuring instruments correctly.
- They can display measurement results graphically.
- They can analyze collected data quantitatively.
- They can estimate and evaluate the accuracy of the measurement data and the results of the analysis.
- They can document measurement results correctly.
- They can draw meaningful conclusions from measurement data.
- They can name the principles of occupational health and safety in physical laboratories and comply with them at work.

**Grading through:**

- certificates and protocols

**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

**Notes:**

Prerequisites for attending the module:

- Prerequisite for participation in the internship is physics 1 or 2.

Prerequisites for the exam:

- Certificates and protocols

Modul exam:

- ME2053-L1: Practical Course Physics, course, ungraded practical course, 0 % module grade, has to be passed

**BP2600-KP05 - Atom and Molecule Physics (AtomMolPhy)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

5

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

- Bachelor Biophysics 2024 (compulsory), physics, 4th semester
- Bachelor Biophysics 2016 (compulsory), physics, 4th semester

**Classes and lectures:**

- Atom and Molecule Physics (lecture, 2 SWS)
- Atom and Molecule Physics (exercise, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Mass, size, and structure of atoms and the electron
- Bohr's hydrogen model
- Orbital and spin magnetism, fine structure
- The atom in electric and magnetic field
- Many-electron atoms
- X-ray spectra, nuclear spin, hyperfine structure
- Mass, size, and structure of molecules
- Theory of the chemical bond
- Molecular spectroscopy (IR, Raman, etc)
- Nuclear and electron spin resonance
- Guideline for GSP of the University at Lübeck and corresponding DFG guidelines

**Qualification-goals/Competencies:**

- Students can name the components of atoms and explain their structure
- They can explain the formation and shape of atomic and molecular spectra.
- They can apply their knowledge of the structure of atoms and molecules in the biophysical context.
- They can explain the structure of molecules
- You know the rules of good scientific practice

**Grading through:**

- written exam

**Requires:**

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

**Responsible for this module:**

- Prof. Dr. rer. nat. Christian Hübner

**Teacher:**

- [Institute of Physics](#)
- Prof. Dr. rer. nat. Christian Hübner
- MitarbeiterInnen des Instituts

**Literature:**

- [Wolfgang Demtröder: Atoms, Molecules and Photons: An Introduction to Atomic-, Molecular- and Quantum Physics - Springer](#)
- :

**Language:**

- offered only in German

**Notes:**



**Admission requirements for the module:**

- Successful completion of the modules Physics 1 and Physics 2 (ME1010 and ME1020).

**Admission requirements for the examination:**

- Successful participation in the exercises

**Module Exam:**

- BP2600-L1: Atomic and Molecular Physics, written exam, 90 min, 100% module grade.



**LS2300-KP08, LS2301 - Biophysical Chemistry (BPCKP08)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

8

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

- Master CLS 2023 (compulsory), MML with specialization in Life Science, 2nd semester
- Bachelor Biophysics 2024 (compulsory), biophysics, 4th semester
- Bachelor Molecular Life Science 2024 (compulsory), Chemistry, 4th semester
- Bachelor MLS 2018 (compulsory), Chemistry, 4th semester
- Bachelor MLS 2016 (compulsory), Chemistry, 4th semester
- Master CLS 2016 (compulsory), MML with specialization in Life Science, 2nd semester
- Bachelor Biophysics 2016 (compulsory), biophysics, 4th semester
- Master CLS 2010 (optional subject), computational life science / life sciences, 2nd semester
- Bachelor MLS 2009 (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
  - Molecular Mechanics
- Practical works:
  - 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 with regard to the roles of GSP of the University of Lübeck and of the DFG-guidelines.
- 

**Grading through:**

- written exam

**Requires:**

- 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
- [James Keeler and Peter Wothers: Chemical Structure and Reactivity: An integrated approach - Oxford University Press, 2008; second ed. 2013](#)

**Language:**

- offered only in German

**Notes:**

Prerequisites for the modul:

- None

Prerequisites for admission to the written examination:

- Successful completion of the excercises as specified at the beginning of the semester

Modul exam(s):

- LS2300-L1: Biophysical Chemistry, written exam, 90 min, 100 % of module grade

- LS2300-L2: Practical course Biophysical Chemistry, ungraded practical course, 0 % of module grade, has to be passed

MML: Optional course in the 2nd semester master program with specialisation in Life Science

Biophysics: some specific practicals

The practical course takes place in September as compact course. Prerequisite LS1600 and LS2600

The module is better understandable if the modules Physics 1 or 2 have been attended before.

(Share of Institute of Physics in practical course is 25%.)

<b>LS2700-KP04 - Cell Biology (ZellbioKP4)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester	<b>Credit points:</b> 4
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), Elective Chemistry/Biology, 4th semester</li> <li>• Bachelor Biophysics 2016 (compulsory), Elective Chemistry/Biology, 4th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Cell Biology (lecture, 3 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 75 Hours private studies</li> <li>• 45 Hours in-classroom work</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Special structure of cells</li> <li>• Cell cycle and apoptosis</li> <li>• Introduction into developmental biology</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Principle of the basic function of the eukaryotic cells</li> <li>• Detailed knowledge in all areas of cell biology covered by the lecture (see</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Enno Hartmann</li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Medical and Marine Biotechnology</a></li> <li>• <a href="#">Institute for Biology</a></li> <li>• Prof. Dr. rer. nat. Enno Hartmann</li> <li>• PD Dr. rer. nat. Kai-Uwe Kalies</li> <li>• <a href="#">Prof. Dr. rer. nat. Charli Kruse</a></li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Lodish: Molecular Cell Biology</li> <li>• Pollard: Cell Biology</li> <li>• Wolpert: Principles of Development</li> <li>• Alberts: Molecular Biology of the Cell</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b> <p>Prerequisites for the modul: - nothing</p> <p>Prerequisites for admission to the written examination: - nothing</p> <p>Modul exam: - LS2700-L1: Cellbiology, written exam, 90 min, 100 % module grade</p>		

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

<b>Duration:</b>	<b>Turnus of offer:</b>	<b>Credit points:</b>
1 Semester	each summer semester	4

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

- Bachelor CLS 2023 (compulsory), mathematics, 2nd semester
- Bachelor Biophysics 2024 (compulsory), Elective Computer Science, 4th semester
- Bachelor Nutritional Medicine 2024 (compulsory), mathematics / natural sciences, 4th semester
- Bachelor MES 2014 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor Computer Science 2019 (optional subject), Extended optional subjects, Arbitrary semester
- Bachelor Computer Science 2019 (compulsory), Canonical Specialization Bioinformatics and Systems Biology, 6th semester
- Bachelor Medical Informatics 2019 (compulsory), medical computer science, 6th semester
- Bachelor MLS 2018 (compulsory), life sciences, 6th semester
- Bachelor Nutritional Medicine 2018 (compulsory), mathematics / computer science, 6th semester
- Bachelor CLS 2016 (compulsory), mathematics, 2nd semester
- Bachelor CLS 2010 (compulsory), mathematics, 2nd semester
- Bachelor Computer Science 2016 (optional subject), advanced curriculum, Arbitrary semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization Bioinformatics, 4th semester
- Bachelor MLS 2016 (compulsory), life sciences, 6th semester
- Bachelor Biophysics 2016 (compulsory), Elective Computer Science, 4th semester
- Bachelor Nutritional Medicine 2016 (compulsory), mathematics / computer science, 6th semester
- Bachelor Medical Informatics 2014 (compulsory), medical computer science, 4th semester
- Bachelor Computer Science 2014 (compulsory), specialization field bioinformatics, 6th semester
- Master MES 2011 (advanced curriculum), biophysics and biomedical optics, 2nd semester
- Bachelor Medical Informatics 2011 (compulsory), medical computer science, 4th semester
- Master Computer Science 2012 (optional subject), specialization field bioinformatics, 2nd or 3rd semester
- Master Computer Science 2012 (compulsory), advanced curriculum stochastics, 2nd semester
- Bachelor Computer Science 2012 (optional subject), specialization field bioinformatics, 6th semester
- Bachelor MLS 2009 (compulsory), life sciences, 6th semester
- Bachelor MES 2011 (optional subject), medical engineering science, 6th semester
- Bachelor Molecular Life Science 2024 (compulsory), mathematics / computer science, 4th 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:**

- With regard to the roles of GSP of the University of Lübeck and of the DFG-guidelines the student were able to work with the following statistical methods: 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, X<sup>2</sup> 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

**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

**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Active and regular participation in the exercise groups as specified at the beginning of the semester.

Module exam:

-MA1600-L1: Biostatistics 1, written exam, 90 min, 100 % of module grade

<b>ME2060-KP05 - Fields and Quanta (FQ_BioPhy)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester	<b>Credit points:</b> 5
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), physics, 4th semester</li> <li>• Bachelor Biophysics 2016 (compulsory), physics, 4th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Fields and Quanta (lecture, 2 SWS)</li> <li>• Fields and Quanta (exercise, 2 SWS)</li> </ul>	<b>Workload:</b> <ul style="list-style-type: none"> <li>• 60 Hours in-classroom work</li> <li>• 60 Hours private studies</li> <li>• 30 Hours exam preparation</li> </ul>	
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Scalar and vector fields</li> <li>• electric charge, electr. Potential, electr. field</li> <li>• Current density, continuity equation</li> <li>• magnetic field</li> <li>• electromagnetic induction</li> <li>• Maxwell equations</li> <li>• Wave-particle duality</li> <li>• Uncertainty</li> <li>• Wave functions, operators and measurement</li> <li>• Schrödinger equation</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Students are able to calculate the propagation of electromagnetic waves in homogeneous media.</li> <li>• They can enumerate the main axioms of quantum mechanics.</li> <li>• They can explain the terms operator, wave function, quantum numbers and measurements, and the relationships between them.</li> <li>• They can calculate the eigenstates of simple quantum mechanical systems.</li> <li>• They can describe the stationary states of the hydrogen atom and calculate the associated energy values.</li> <li>• They are using the terms and concepts of theoretical physics such an extent that you can acquire further representations on their own.</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Requires:</b> <ul style="list-style-type: none"> <li>• Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)</li> <li>• Linear Algebra and Discrete Structures 1 (MA1000-KP08, MA1000)</li> <li>• Analysis 2 (MA2500-KP08)</li> <li>• Analysis 1 (MA2000-KP08, MA2000)</li> <li>• Physics 2 (ME1020-KP08, ME1020)</li> <li>• Physics 1 (ME1010-KP08, ME1010)</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• <a href="#">Prof. Dr. rer. nat. Magdalena Rafecas</a></li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Medical Engineering</a></li> <li>• <a href="#">Prof. Dr. rer. nat. Magdalena Rafecas</a></li> <li>• <a href="#">Prof. Dr. rer. nat. Martin Koch</a></li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• D. J. Griffiths: Elektrodynamik: Eine Einführung - Pearson, Hallbergmoos 2011</li> <li>• D. J. Griffiths: Quantenmechanik: Lehr- und Übungsbuch - Pearson, Hallbergmoos 2012</li> </ul>		
<b>Language:</b>		



- offered only in German

**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Successful completion of homework assignments and presentation of own solutions in the course.

Format of the module exam:

- ME2060-L1: Fields and Quanta, Written exam, 90 min, 100 % of Module note

**ME2100 T - Module part: Introduction into Biomedical Optics (EinBMO)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor Biophysics 2024 (Module part of a compulsory module), physics, 4th semester
- Bachelor MES 2020 (Module part of a compulsory module), medical engineering science, 4th semester
- Bachelor Biophysics 2016 (Module part of a compulsory module), physics, 4th semester
- Bachelor MES 2014 (Module part of a compulsory module), medical engineering science, 4th semester

**Classes and lectures:**

- Introduction into Biomedical Optics (lecture, 2 SWS)
- Biomedical Optics/Excercises (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Absorption and light scattering in biological tissues (Mie, Rayleigh)
- Measurement of optical tissue parameters, Mathematical description of light propagation
- Fundamentals of photophysics
- Spectroscopy, fluorescent markers, and flow cytometry of photophysics
- Lasers for biomedicine
- Fundamentals of photochemistry and photobiology
- Thermal effects on biomolecules and tissue, photocoagulation
- Pulsed laser tissue ablation
- Nonlinear absorption and plasma-mediated dissection of transparent tissues
- Intraocular photodisruption, laser lithotripsy, refractive surgery, and cell surgery
- Fundamentals of light, fluorescence, and laser scanning microscopy

**Qualification-goals/Competencies:**

- The students are able to name and describe the fundamental physical phenomena and laws regarding light propagation and absorption in tissue.
- They can explain the interaction of light and tissue and describe it mathematically.
- They attain an overview of diagnostic and therapeutic techniques in the field of biomedical optics and can list, describe and compare them.
- They acquire an overview of optical instruments for biomedical applications and are able to explain their function.
- They are able to assess the capabilities and limits of microscopic imaging.
- They are able to transfer their knowledge to practical applications.
- The students have the professional, social and communication skills to discuss and solve Biomedical Optics exercises in tutorial groups.

**Grading through:**

- Written or oral exam as announced by the examiner

**Responsible for this module:**

- Siehe Hauptmodul

**Teacher:**

- [Institute of Biomedical Optics](#)
- Dr. rer. nat. Norbert Linz

**Literature:**

- H.P. Berlien, G. Müller (eds): Applied Laser Medicine - Springer 2003
- M. Niemz: Laser-Tissue Interactions - 3rd Edition, Springer 2007

**Language:**

- offered only in German

**Notes:**





Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

**ME2102 T - Module part: Photonics (Photonik)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor MES 2020 (Module part of a compulsory module), medical engineering science, 4th semester
- Bachelor Biophysics 2016 (Module part of a compulsory module), physics, 4th semester
- Bachelor MES 2014 (Module part of a compulsory module), medical engineering science, 4th semester
- Bachelor Biophysics 2024 (Module part of a compulsory module), physics, 4th semester

**Classes and lectures:**

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

**Workload:**

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

**Contents of teaching:**

- Historical introduction
- Light as EM wave, physical parameters of the light wave field
- Detection and detection of light
- Geometric optics, raytracing
- Optical Instruments
- Optics of the eye
- Polarization
- Diffraction
- Optical fibres
- Integrated optics
- Optoelectronics
- Laser
- Nonlinear Optics

**Qualification-goals/Competencies:**

- The students can name the essential concepts of optics (geometric optics, wave optics, quantum optics) and distinguish them from each other.
- The students can name and explain the essential optical phenomena.
- The students can explain the function and application of the most important photonic components.

**Grading through:**

- Written or oral exam as announced by the examiner

**Responsible for this module:**

- Siehe Hauptmodul

**Teacher:**

- [Institute of Biomedical Optics](#)
- Prof. Dr. rer. nat. Gereon Hüttmann

**Literature:**

- E. Hecht: Optics - Addison-Wesley, (dt: Optik, Oldenbourg)
- Frank L. Pedrotti, Leno S. Pedrotti: Introduction to optics - Prentice-Hall
- Frank Pedrotti: Optik eine Einführung - Prentice Hall
- B.E.A. Saleh, M.C. Teich: Fundamentals of Photonics - Wiley 2007 (dt.: Grundlagen der Photonik, Wiley-VCH)
- Matt Young: Optics and Lasers : Including Fibers and Optical Waveguides - Springer 2000

**Language:**

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

**Notes:**



Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

<b>ME2600-KP08, ME2600 - Introduction to Biomedical Optics and Photonics (EinfBMOPho)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester	<b>Credit points:</b> 8
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), physics, 4th semester</li> <li>• Bachelor MES 2020 (compulsory), medical engineering science, 4th semester</li> <li>• Bachelor Biophysics 2016 (compulsory), physics, 4th semester</li> <li>• Bachelor MES 2014 (compulsory), medical engineering science, 4th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• ME2100 T: Module part: Introduction to Biomedical Optics (4 ECTS) (course, 3 SWS)</li> <li>• ME2102 T: Module part: Photonics (4 ECTS) (course, 3 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 110 Hours private studies</li> <li>• 90 Hours in-classroom work</li> <li>• 40 Hours exam preparation</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• as described for the module parts</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• as described for the module parts</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Gereon Hüttmann</li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Biomedical Optics</a></li> <li>• Dr. rer. nat. Norbert Linz</li> <li>• Prof. Dr. rer. nat. Gereon Hüttmann</li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Haferkorn, H.: Optik - Wiley-VCH</li> <li>• P.N. Prasad: Introduction to Biophotonics - Wiley 2003</li> <li>• M. Niemz: Laser-Tissue Interactions - 3rd Edition, Springer 2007</li> <li>• D. B. Murphy: Fundamentals of Light Microscopy and Electronic Imaging - Wiley-Liss 2001</li> <li>• E. Hecht: Optics - 5th Edition, 2016, Pearson</li> <li>• Frank L. Pedrotti, Leno S. Pedrotti: Introduction to optics - Prentice Hall</li> <li>• Paul A. Tipler, Gene Mosca: Physik: für Wissenschaftler und Ingenieure (Teil 5: Optik) - Springer 2000</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b> <p>Prerequisites for attending the module: - None</p> <p>Prerequisites for the exam: - None</p> <p>Format of the module exam: - ME2600-L1: Introduction to Biomedical Optics and Photonics, Written exam, 90 min, 100 % Module note</p>		

<b>BP3100-KP07 - Seminar and Practical Course Biophysics (SemBiophys)</b>		
<b>Duration:</b> 2 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 7 (Typ B)
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), biophysics, 5th and 6th semester</li> <li>• Bachelor Biophysics 2016 (compulsory), biophysics, 5th and 6th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Bachelor Seminar Biophysics (seminar, 2 SWS)</li> <li>• Advanced Practical Course Biophysics (practical course, 3 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 200 Hours (see module parts)</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>•</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>•</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• continuous, successful participation in practical course</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Christian Hübner</li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institutes of the Department of Computer Science/ Engineering</a></li> <li>• <a href="#">Institutes of natural science</a></li> <li>• <a href="#">Institute of Physics</a></li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• German and English skills required</li> </ul>		

<b>BP3102 T - Bachelor Seminar Biophysics (SemBP)</b>	
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (Module part of a compulsory module), biophysics, 5th semester</li> <li>• Bachelor Biophysics 2016 (Module part of a compulsory module), biophysics, 5th semester</li> </ul>	
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Bachelor Seminar (seminar, 2 SWS)</li> </ul>	<b>Workload:</b> <ul style="list-style-type: none"> <li>• 30 Hours in-classroom work</li> <li>• 20 Hours private studies</li> <li>• 20 Hours written report</li> <li>• 10 Hours oral presentation (including preparation)</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> </ul>	
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Students can apply for a scientific degree. Thoroughly work through the topic.</li> <li>• They can present the results in a written elaboration and in an oral presentation in an understandable way.</li> <li>• They can present and discuss a scientific question in English.</li> </ul>	
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• Oral presentation and written report</li> </ul>	
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Christian Hübner</li> </ul>	
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• Institutes of natural science</li> <li>• <a href="#">Institutes of the Department of Computer Science/ Engineering</a></li> </ul>	
<b>Language:</b> <ul style="list-style-type: none"> <li>• German and English skills required</li> </ul>	

**CS1500-KP04, CS1500 - Introduction to Robotics and Automation (ERA)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

4

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

- Bachelor IT-Security 2016 (optional subject), interdisciplinary, Arbitrary semester
- Bachelor Biophysics 2024 (compulsory), Elective Computer Science, 5th semester
- Bachelor Computer Science 2019 (optional subject), Introductory Module Computer Science, 1st semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory), Robotics and Autonomous Systems, 1st semester
- Bachelor Medical Informatics 2019 (optional subject), medical computer science, 4th to 6th semester
- Bachelor Computer Science 2016 (optional subject), Introductory Module Computer Science, 1st semester
- Bachelor Biophysics 2016 (compulsory), Elective Computer Science, 5th semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 1st semester
- Bachelor Medical Informatics 2014 (optional subject), medical computer science, 5th or 6th semester
- Bachelor Computer Science 2014 (compulsory), specialization field robotics and automation, 1st semester
- Bachelor CLS 2010 (optional subject), computer science, 5th or 6th semester
- Bachelor MES 2011 (optional subject), medical engineering science, 5th semester
- Bachelor Computer Science 2012 (compulsory), specialization field robotics and automation, 1st semester

**Classes and lectures:**

- Introduction to Robotics and Automation (lecture, 2 SWS)
- Introduction to Robotics and Automation (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Introduction
- Control systems
- Programmable Logic Controller (PLC)
- Combinatorial control
- Sequential control
- Feedback control systems
- Plants
- PID controller
- Controller parameterization
- Autonomous mobile robots
- AI-paradigms
- Elementary and emergent behaviors
- Signal acquisition and processing
- Actuators
- According to the rules of GSP of the UzL

**Qualification-goals/Competencies:**

- The students are able to explain the principles of control systems.
- The students are able to design combinatorial and sequential control systems.
- The students are able to program simple application problems as PLC-program in the IEC-languages.
- The students are able to analyze closed-loop controlled systems (plants) and to select and parameterize a suitable feedback PID controller.
- The students are able to present the principal structure and functionality of autonomous wheel-driven robots.
- The students are able to program simple autonomous robots in a behavior-based way..

**Grading through:**

- written exam

**Responsible for this module:**

- [Prof. Dr.-Ing. Mladen Berekovic](#)

**Teacher:**

- [Institute of Computer Engineering](#)

- Dr. rer. nat. Javad Ghofrani

**Literature:**

- J. L. Jones, D. Roth: Robot Programming - A Practical Guide to Behavior-Based Robotics - New York: Mc Graw Hill 2004
- J. Knespl: Automatisierungstechnik 1 - Regelungstechnik - Köln: Stam-Verlag 1999
- R. R. Murphy: Introduction to AI Robotics - Cambridge, MA: The MIT Press 2000
- G. Wellenreuther, D. Zastrow: Automatisieren mit SPS - Theorie und Praxis - Braunschweig: Vieweg 2008

**Language:**

- offered only in German

**Notes:**

-Computer Science students are issued a B certificate, after having finished entire assignments including the tests and having passed the written exam at the end of the term.

Students of other majors are issued an A-certificate after having passed the written exam.

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Successful completion of homework assignments during the semester.

Written exam:

-CS1500-L1: Introduction to Robotics and Automation, written exam, 60 - 120 min, 100% modul grade.



**CS1601-KP04, CS1601 - Basics of Multimedia Systems (MMTechnik)**

**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

4

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

- Bachelor Biophysics 2016 (optional subject), computer science, 5th semester
- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Media Informatics 2020 (compulsory), media informatics, 3rd semester
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), media informatics, 5th or 6th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 4th or 6th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor Media Informatics 2014 (compulsory), media informatics, 3rd semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th semester
- Bachelor Computer Science 2012 (optional subject), central topics of computer science, 6th semester
- Bachelor CLS 2010 (optional subject), computer science, 6th semester
- Bachelor Computer Science 2012 (compulsory), specialization field media informatics, 2nd semester
- Bachelor Biophysics 2024 (optional subject), computer science, 5th semester

**Classes and lectures:**

- Basics of Multimedia Systems (lecture, 2 SWS)
- Basics of Multimedia Systems (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Sensation and Perception
- Analog Media Technology
- Digitalisation
- Digital Audio, Image and Video Technology
- Media storage (compression / formats)
- Media Transmission (Broadcast / Streaming)

**Qualification-goals/Competencies:**

- Students are able to present to essential functions and principles of multimedia systems.
- They are able to judge possibilities and limitations of human perception.
- They are able to classify the conditions and technologies for capturing, processing, storing, transmitting and perception of multimedia.
- They can balance the specific advantages and disadvantages of analog and digital media technology.
- They are able to apply appropriate technical components and processes for the design of multimedia systems.

**Grading through:**

- Written or oral exam as announced by the examiner

**Responsible for this module:**

- [Prof. Dr.-Ing. Andreas Schrader](#)

**Teacher:**

- [Institute of Telematics](#)
- [Prof. Dr.-Ing. Andreas Schrader](#)

**Literature:**

- Thomas Görne: Tontechnik - 4. Auflage, Hanser 2014
- Ulrich Schmidt: Professionelle Videotechnik - 6. Auflage, Springer 2013

**Language:**

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

**Notes:**



Admission requirements for taking the module:

- None

Admission requirements for participation in module examination(s):

- Successful completion of exercise slips as specified at the beginning of the semester.

Module Exam(s):

- CS1601-L1 Fundamentals of Multimedia Technology, as determined by the instructor: Written exam, 90min, 100% of module grade OR oral exam, 100% of module grade.

**CS2300-KP06, CS2300SJ14 - Software Engineering (SWEng14)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

6

**Max. group size:**

12

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

- Bachelor Biophysics 2024 (optional subject), computer science, 5th semester
- Bachelor Media Informatics 2020 (compulsory), computer science, 3rd semester
- Bachelor Computer Science 2019 (compulsory), foundations of computer science, 3rd semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory), computer science, 3rd semester
- Bachelor Medical Informatics 2019 (compulsory), computer science, 3rd semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory), computer science, 3rd semester
- Bachelor IT-Security 2016 (compulsory), computer science, 3rd semester
- Bachelor Biophysics 2016 (optional subject), computer science, 5th semester
- Bachelor Computer Science 2016 (compulsory), foundations of computer science, 3rd semester
- Bachelor Media Informatics 2014 (compulsory), foundations of computer science, 3rd semester
- Bachelor Medical Informatics 2014 (compulsory), computer science, 3rd semester
- Bachelor Computer Science 2014 (compulsory), foundations of computer science, 3rd semester

**Classes and lectures:**

- Software Engineering (lecture, 3 SWS)
- Software Engineering (exercise, 1 SWS)

**Workload:**

- 100 Hours private studies and exercises
- 60 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**

- overview on major fields of software engineering
- Software development, software process models
- Project plan and workload estimation
- Software management and quality assurance
- System Analysis and requirements analysis
- Basics of UML
- Software architectures and design patterns
- Validation and verification
- Legal aspects: copyright, standards, liability, licenses

**Qualification-goals/Competencies:**

- The students understand software design as an engineering process.
- They can argue about major software process models.
- They can explain important techniques and factors of software management.
- They can describe and evaluate measures for quality assurance.
- They are able to model software systems on different levels of abstraction.
- They can apply the basic concepts of object-oriented modelling and design.
- They are able to apply design patterns in a useful way.
- They can discuss about legal aspects of software development.

**Grading through:**

- Written or oral exam as announced by the examiner

**Is requisite for:**

- Safe Software (CS3250-KP08)
- Lab Course Software Engineering (CS2301-KP06, CS2301)

**Requires:**

- Algorithms and Data Structures (CS1001-KP08, CS1001)
- Introduction to Programming (CS1000-KP10, CS1000SJ14)

**Responsible for this module:**

- [Prof. Dr. Martin Leucker](#)

**Teacher:**

- Institute of Software Technology and Programming Languages
- Prof. Dr. Martin Leucker
- Prof. Dr. Diedrich Wolter

**Literature:**

- H. Balzert: Lehrbuch der Software-Technik: Software-Entwicklung - Spektrum Akademischer Verlag 2001
- B. Brügge, A. H. Dutoit: Objektorientierte Softwaretechnik mit UML, Entwurfsmustern und Java - Pearson Studium 2004
- I. Sommerville: Software Engineering - Addison-Wesley 2006
- B. Oestereich: Analyse und Design mit der UML 2.1 - Objektorientierte Softwareentwicklung - Oldenbourg 2006
- D. Bjorner: Software Engineering 1-3 - Springer 2006

**Language:**

- offered only in German

**Notes:**

Admission requirements for taking the module:

- None (the competences of the modules mentioned under `Requires` are needed for this module, but are not a formal prerequisite).

Admission requirements for participation in module examination(s):

- Successful completion of exercises as specified at the beginning of the semester.

Module exam(s):

- CS2300-L1: Software Engineering, written exam, 90min, 100% of the module grade.

Passing this module is a formal requirement for participation in the module CS2301-KP06 Lab Course Software Engineering. It is recommended to do the internship directly in the following semester.

**CS3100-KP08, CS3100SJ14 - Signal Processing (SignalV14)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

8

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

- Master CLS 2023 (compulsory), mathematics, 1st semester
- Bachelor Biophysics 2024 (compulsory), computer science, 5th semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory), Robotics and Autonomous Systems, 5th semester
- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2019 (compulsory), Canonical Specialization Bioinformatics and Systems Biology, 5th semester
- Bachelor MES 2020 (compulsory), computer science, 5th semester
- Bachelor Media Informatics 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science 2014 (compulsory), specialization field robotics and automation, 5th semester
- Bachelor Computer Science 2014 (compulsory), specialization field bioinformatics, 5th semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization Bioinformatics, 5th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization Web and Data Science, 5th semester
- Master CLS 2016 (compulsory), mathematics, 1st semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 5th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor Biophysics 2016 (compulsory), computer science, 5th semester
- Bachelor Medical Informatics 2014 (compulsory), computer science, 5th semester
- Bachelor MES 2014 (compulsory), computer science, 5th semester
- Bachelor Media Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 5th semester

**Classes and lectures:**

- Signal Processing (lecture, 2 SWS)
- Signal Processing (exercise, 1 SWS)
- Image Processing (lecture, 2 SWS)
- Image Processing (exercise, 1 SWS)

**Workload:**

- 110 Hours private studies
- 90 Hours in-classroom work
- 40 Hours exam preparation

**Contents of teaching:**

- Linear time-invariant systems
- Impulse response
- Convolution
- Fourier transform
- Transfer function
- Correlation and energy density of deterministic signals
- Sampling
- Discrete-time signals and systems
- Discrete-time Fourier transform
- z-Transform
- FIR and IIR filters
- Block diagrams
- FIR filter design
- Discrete Fourier transform (DFT)
- Fast Fourier transform (FFT)
- Characterization and processing of random signals
- Introduction, interest of visual information
- 2D Sampling
- Image enhancement
- Edge detection
- Multiresolution concepts: Gaussian and Laplacian Pyramid, wavelets
- Principles of image compression
- Segmentation
- Morphological image processing

- Students work self-actively and independently with regard to the roles of GSP of the University of Lübeck.

**Qualification-goals/Competencies:**

- Students are able to explain the fundamentals of linear system theory.
- They are able to define and competently explain the essential elements of signal processing mathematically.
- They will have a command of mathematical methods for the description and analysis of continuous-time and discrete-time signals and systems.
- They are able to design digital filters and know various structures for their implementation.
- They are able to explain the basic techniques for describing and processing of random signals.
- They will have basic knowledge of two-dimensional system theory.
- They are able to describe the main techniques for image analysis and image enhancement.
- They are able to apply the learned principles in practice.

**Grading through:**

- written exam

**Responsible for this module:**

- [Prof. Dr.-Ing. Alfred Mertins](#)

**Teacher:**

- [Institute for Signal Processing](#)
- [Prof. Dr.-Ing. Alfred Mertins](#)

**Literature:**

- A. Mertins: Signaltheorie: Grundlagen der Signalbeschreibung, Filterbänke, Wavelets, Zeit-Frequenz-Analyse, Parameter- und Signalschätzung - Springer-Vieweg, 3. Auflage, 2013
- A. K. Jain: Fundamentals of Digital Image Processing - Prentice Hall, 1989
- Rafael C. Gonzalez, Richard E. Woods: Digital Image Processing - Prentice Hall 2003

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Successful completion of homework assignments during the semester (at least 50% of max. points).

Module exam:

- CS3100-L1: Signal Processing, written exam, 90 min, 100% of module grade

<b>LS3150-KP04 - Molecular Biology (MolBioKP04)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 4
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), Elective Chemistry/Biology, 5th semester</li> <li>• Bachelor Biophysics 2016 (compulsory), Elective Chemistry/Biology, 5th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Molecular Biology (lecture, 2SWS) (lecture, 2 SWS)</li> <li>• Molecular Biology (seminar, 2 SWS) (seminar, 2 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 75 Hours private studies</li> <li>• 45 Hours in-classroom work</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Lectures: Typically, 5 coherent blocks will be lectured.</li> <li>• Basics: genetic engineering and gene regulation</li> <li>• Growth and aging: molecular processes during ontogenetic differentiation, maintenance and loss of function during aging of cells and organisms</li> <li>• Nucleic-acids: molecular basis, polymorphism, RNA-regulation. Diagnostic and possible therapeutic aspects</li> <li>• Molecular biology of plants: molecular basis as well as economic and ecological aspects of transgenic plants and herbicide resistance</li> <li>• Gene-therapeutic approaches and recombinant vaccines</li> <li>• Conceptual design of publications</li> <li>• English as lingua franca in science</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Students are able to present basic steps of genetic engineering</li> <li>• They can explain basic mechanisms of gene expression</li> <li>• They are able to formulate basic mechanisms of RNA-regulated biological systems</li> <li>• They can present examples for the relationship between pathophysiological processes and their molecular basis</li> <li>• They are able to explain principles of gene therapy</li> <li>• They acquire the competence to handle english literature and to present it in a scientific oral presentation</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Norbert Tautz</li> </ul> <b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Virology and Cell Biology</a></li> <li>• <a href="#">Department of Neurosurgery</a></li> <li>• <a href="#">Institute of Medical and Marine Biotechnology</a></li> <li>• Dr. rer. nat. Olaf Isken</li> <li>• Prof. Dr. rer. nat. Norbert Tautz</li> <li>• PD Dr. rer. nat. Christina Zechel</li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Alberts et al.: Molecular Biology of Cells - Garland Science</li> <li>• Lodish et al.: Molecular Cell Biology - Freeman</li> <li>• Buchanan et al.: Biochemistry and Molecular Biology of Plants - Wiley Verlag</li> <li>• : Versuchsanleitungen</li> <li>• : Course script</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b>		



Prerequisites for attending the module:

- None

Prerequisites for the exam:

- None

Module exam:

- LS3150-L1: Molekular Biology, written exam, 90 min, 100 % module grade



LS3251-KP05 - Tissue Engineering (TissueEng)		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 5
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Molecular Life Science 2024 (optional subject), life sciences, 5th semester</li> <li>• Bachelor Biophysics 2016 (optional subject), life sciences, 5th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Tissue Engineering (seminar with practical exercises, 2 SWS)</li> <li>• Tissue Engineering (lecture, 2 SWS)</li> </ul>	<b>Workload:</b> <ul style="list-style-type: none"> <li>• 90 Hours private studies</li> <li>• 60 Hours in-classroom work</li> </ul>	
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Lectures: Mamalia cells in their natural environment and under in vitro culture as an example of industrial application.</li> <li>• Aging of cells in vitro</li> <li>• Established cell lines</li> <li>• Diverse in vitro culturing conditions</li> <li>• Proliferation and differentiation under in vitro conditions</li> <li>• Stem cell biology</li> <li>• Materials for medical applications</li> <li>• Fermentors, bioreactors and protein purification</li> <li>• Home work e. g. Tissue transplantation and rejection</li> <li>• Practical course (in groups of 2): Principles of aseptic manipulations, working in sterile containments, object and selfprotection, use of autoclaves</li> <li>• Preparation of sterile media, additives and other reagents</li> <li>• Slicing of tissue samples, transfer into tissue culture flasks for explant cultures</li> <li>• Microscopy and documentation of growing cells</li> <li>• Cell count, passaging by trypsinisation</li> <li>• Viability test, freezing of cells and reseeding after thawing</li> <li>• Adherence of cells to various matrices</li> <li>• Immunohistochemistry of intracellular and extracellular proteins</li> <li>•</li> <li>•</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Students are able to explain principles of cell- and tissue culture to generate biocomposites from differentiated and pluripotent cells</li> <li>• They are able to explain basic principles of pro- and eukaryotic gene expression systems</li> <li>• They are able to explain basic principles of matrix biology</li> <li>• They can reproduce the aspects of stem cell biology</li> <li>• They acquire the ability to assess ethical aspects of tissue engineering</li> <li>• They improve their competence for correct documentation and team working skills</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• <a href="#">Prof. Dr. rer. nat. Charli Kruse</a></li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Medical and Marine Biotechnology</a></li> <li>• <a href="#">Lübeck University of Applied Sciences</a></li> <li>• <a href="#">Department of Dermatology, Allergology and Venerology</a></li> <li>• <a href="#">Institute of Virology and Cell Biology</a></li> <li>• Prof. Dr. rer. nat. Holger Notbohm</li> <li>• Prof. Dr. med. Jürgen Brinckmann</li> <li>• Prof. Dr. Uwe Englisch</li> </ul>		



- Prof. Dr. rer. nat. Markus Hoffmann, Dr. med.
- [Prof. Dr. rer. nat. Charli Kruse](#)
- Dr. C. Probst
- Dr. rer. nat. Daniel Hans Rapoport
- Prof. Dr. med. vet. Jennifer Hundt
- Prof. Dr. med. Ralf Ludwig
- Dr. rer. nat. Olaf Isken

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**Literature:**

- Lanza, Langer, Vacanti: Principles of Tissue Engineering

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**Language:**

- offered only in German

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**Notes:**

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

<b>LS3252-KP05 - Metabolic Medicine (MetabolMed)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 5
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Molecular Life Science 2024 (optional subject), life sciences, 5th semester</li> <li>• Bachelor Biophysics 2024 (optional subject), life sciences, 5th semester</li> <li>• Bachelor Biophysics 2016 (optional subject), life sciences, 5th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Metabolic Medicine (lecture, 2 SWS)</li> <li>• Tissue Engineering (seminar with practical exercises, 2 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 90 Hours private studies</li> <li>• 60 Hours in-classroom work</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Metabolic physiology</li> <li>• glucose metabolism &amp; diabetes</li> <li>• lipid metabolism &amp; obesity, adipokines</li> <li>• gastroenterology</li> <li>• thyroid</li> <li>• central appetite regulation</li> <li>• circadian clocks &amp; metabolism</li> <li>• sleep &amp; metabolism</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Understanding the principles of energy homeostasis</li> <li>• Understanding physiological interactions of different compartments in the context of energy metabolism</li> <li>• Students know the symptoms of major metabolic disorders and their pathophysiological causes</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Requires:</b> <ul style="list-style-type: none"> <li>• Biochemistry 1 (LS2000-KP06)</li> <li>• Physiology (MZ2200-KP06)</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• <a href="#">Prof. Dr. rer. nat. Henrik Oster</a></li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Neurobiology</a></li> <li>• Institute for Endocrinology and Diabetes</li> <li>• <a href="#">Prof. Dr. rer. nat. Henrik Oster</a></li> <li>• <a href="#">Dr. rer. nat. Violetta Pilorz</a></li> <li>• Dr. rer. nat. Isabel Heyde</li> <li>• <a href="#">Dr. rer. nat. Rebecca Ölkzug</a></li> <li>• <a href="#">Dr. rer. nat. Carla Schulz</a></li> <li>• Prof. Dr. rer. nat. Jens Mittag</li> <li>• PD Dr. Britta Wilms</li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Keith N. Frayn: Metabolic Regulation: A Human Perspective - Wiley &amp; Blackwell, 2010</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• German and English skills required</li> </ul>		
<b>Notes:</b>		



Principle knowledge in physiology and biochemistry required.

To this module belongs the seminar Tissue Engineering.

Entrance requirement for the seminar: certificate of the course Biochemistry 1 or 2.

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

1 Semester

**Turnus of offer:**

each semester

**Credit points:**

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
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**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
- Dipl.-Ing. Henning Schönwald

- 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 safety:
- 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:**

Prerequisites for the module:

-The attendance of the radiation protection briefing

Prerequisites for admission to the written examination:

- succesful participation in 90 % of the practical course

Module exam:

- ME5050-L1: Biophysics of Ionizing Radiation and Radiation Safety, written exam, 120 min, 100 % module grade for MIW, none-graded for MLS, minimum of 50 % of the points have to be reached

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

Rules for the

<b>MZ2200-KP06 - Physiology (PhysioKP06)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each winter semester	<b>Credit points:</b> 6
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), life sciences, 5th semester</li> <li>• Bachelor Nutritional Medicine 2024 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor Molecular Life Science 2024 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor MLS 2018 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor Nutritional Medicine 2018 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor MLS 2016 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor Nutritional Medicine 2016 (compulsory), life sciences, 3rd semester</li> <li>• Bachelor Biophysics 2016 (compulsory), life sciences, 5th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Physiology (lecture, 4 SWS)</li> <li>• Physiology (seminar, 1 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 120 Hours private studies</li> <li>• 60 Hours in-classroom work</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Cell physiology &amp; cell-to-cell communication</li> <li>• Sensory &amp; neuronal physiology</li> <li>• Motor systems and respiration</li> <li>• Cardiovascular and immune system</li> <li>• Kidney physiology, electrolyte homeostasis and pH regulation</li> <li>• Energy metabolism and homeostasis</li> <li>• Endocrine system</li> <li>• Circadian rhythms and sleep</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• The students understand the cellular and molecular processes in living organisms.</li> <li>• They understand the integrative processes in healthy humans.</li> <li>• They are capable to interpret the physiological functions in a scientific way.</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• written exam</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• <a href="#">Prof. Dr. rer. nat. Henrik Oster</a></li> </ul> <b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Neurobiology</a></li> <li>• <a href="#">Prof. Dr. rer. nat. Henrik Oster</a></li> <li>• <a href="#">Dr. rer. nat. Violetta Pilorz</a></li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Schmidt et al.: Physiologie des Menschen - Springer, Heidelberg</li> <li>• Rhoades et al.: Medical Physiology - Lippincott Raven, Philadelphia</li> <li>• Speckmann et al.: Physiologie - Elsevier, Amsterdam</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b>		



Prerequisites for the modul:

- nothing

Prerequisites for admission to the written examination:

- succesful participation in the seminar

Modul exam:

- MZ2200-L1: Physiologie, written exam, 90 min, 100 % module grade



**PY1200-KP04, PY1200-MIW - General Psychology 1 (APKP04)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

4

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

- Bachelor MES 2014 (optional subject), no specific field, Arbitrary semester
- Master MES 2014 (optional subject), no specific field, 1st or 2nd semester
- Master MES 2020 (optional subject), interdisciplinary, Arbitrary semester
- Bachelor MES 2020 (optional subject), interdisciplinary, Arbitrary semester
- Bachelor Biophysics 2016 (optional subject), no specific field, 5th semester

**Classes and lectures:**

- General Psychology 1 (lecture, 2 SWS)

**Workload:**

- 90 Hours private studies and exercises
- 30 Hours in-classroom work

**Contents of teaching:**

- Acquisition of basic knowledge in the topics perception, action, cognition and language
- Teaching of basic ideas, concepts and theories of perception and cognitive psychology
- Learning basic principles of experimental psychology work for planning and conducting experiments
- Understanding and judgment of basic ideas, theories and methods of perception, cognition and language

**Qualification-goals/Competencies:**

- Students can explain and apply psychological concepts in the areas of perception, action, cognition and language.
- They can translate psychological research questions into empirical research.
- They can use their knowledge in basic psychological research to scientifically reason, think and discuss.
- They have acquired social competence through discussion skills and knowledge transfer.
- They have acquired self-competence in the areas of concentrated absorption of knowledge, critical reflection and dealing with scientific literature.
- They can structure newly acquired knowledge themselves.

**Grading through:**

- written exam

**Responsible for this module:**

- [Prof. Dr. rer. nat. Ulrike Krämer](#)

**Teacher:**

- [Department of Neurology](#)
- [Prof. Dr. rer. nat. Ulrike Krämer](#)
- [Dr. rer. nat. Dipl.-Psych. Frederike Beyer](#)

**Literature:**

- Goldstein: Wahrnehmungspsychologie - Spektrum, 2007
- Müsseler (Hrsg.): Allgemeine Psychologie - Spektrum, 2007
- Anderson: Kognitive Psychologie (7. Auflage) - Springer, 2013

**Language:**

- offered only in German

**Notes:**

Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

<b>BP3900 T - Advanced Practical Course Biophysics (FortPrakBP)</b>	
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (Module part of a compulsory module), physics, 6th semester</li> <li>• Bachelor Biophysics 2016 (Module part of a compulsory module), biophysics, 6th semester</li> </ul>	
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Advanced Practical Course Biophysics (practical course, 3 SWS)</li> </ul>	<b>Workload:</b> <ul style="list-style-type: none"> <li>• 120 Hours work on project</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>• Familiarization with a scientific topic</li> <li>• Collaboration in current research projects of the supervising institute</li> <li>• Evaluation and analysis of measurement data</li> <li>• Documentation and presentation of research results, according to the guidelines of good scientific practice of the UZL.</li> </ul>	
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• The students master the handling of laboratory equipment</li> <li>• They are able to correctly assess work allocation and requirements</li> <li>• They can correctly evaluate, analyze, and interpret research results/data.</li> <li>• They can document and present research results</li> <li>• They know the rules of good scientific practice</li> </ul>	
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• continuous, successful participation in practical course</li> </ul>	
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Christian Hübner</li> </ul>	
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• <a href="#">Institute of Physics</a></li> <li>• MitarbeiterInnen des Instituts</li> </ul>	
<b>Literature:</b> <ul style="list-style-type: none"> <li>• : Scientific publications - Scientific publications</li> </ul>	
<b>Language:</b> <ul style="list-style-type: none"> <li>• offered only in German</li> </ul>	

<b>BP3990-KP12 - Bachelorarbeit Biophysik (BABP)</b>		
<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each semester	<b>Credit points:</b> 12
<b>Course of study, specific field and term:</b> <ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (compulsory), biophysics, 6th semester</li> <li>• Bachelor Biophysics 2016 (compulsory), biophysics, 6th semester</li> </ul>		
<b>Classes and lectures:</b> <ul style="list-style-type: none"> <li>• Bachelor Thesis (supervised self studies, 1 SWS)</li> <li>• Colloquium (presentation (incl. preparation), 1 SWS)</li> </ul>		<b>Workload:</b> <ul style="list-style-type: none"> <li>• 360 Hours private studies</li> </ul>
<b>Contents of teaching:</b> <ul style="list-style-type: none"> <li>•</li> </ul>		
<b>Qualification-goals/Competencies:</b> <ul style="list-style-type: none"> <li>• Ability to solve a preformulated simple scientific problem mostly independent in a defined period of time and to present and defend the experimental results with regard to the roles of Good Scientific Practice (GSP) of the University of Lübeck and of the DFG-guidelines.</li> <li>• They can answer expert questions on their subject understand.</li> <li>• They can present complex content in written and oral presentations.</li> </ul>		
<b>Grading through:</b> <ul style="list-style-type: none"> <li>• Written report</li> </ul>		
<b>Responsible for this module:</b> <ul style="list-style-type: none"> <li>• Studiengangsleitung</li> </ul>		
<b>Teacher:</b> <ul style="list-style-type: none"> <li>• Institutes of natural science</li> <li>• Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges</li> </ul>		
<b>Literature:</b> <ul style="list-style-type: none"> <li>• Topical literature about the subject:</li> </ul>		
<b>Language:</b> <ul style="list-style-type: none"> <li>• thesis can be written in German or English</li> </ul>		
<b>Notes:</b> <p>Prerequisites for the module: - Minimum of 120 ECTS</p> <p>Prerequisites for admission to the written examination: - successful work on a topic of MLS</p> <p>Module exam: - BP3990-L1: Bachelor Thesis MLS, written documentation of a practical work of an MLS topic and colloquium, 60 min, 100 % module grade</p> <p>If the Bachelor 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.</p> <p>Thesis must be written in German. Except: if the examiner is an English native speaker</p>		

**CS1020-KP05 - Introduction Into Databases and Systems Biology (EinfDBSB)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

5

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

- Bachelor Biophysics 2024 (compulsory), bioinformatics, 6th semester
- Bachelor Nutritional Medicine 2024 (compulsory), life sciences, 6th semester
- Bachelor Molecular Life Science 2024 (compulsory), life sciences, 6th semester
- Bachelor MLS 2018 (compulsory), computer science, 6th semester
- Bachelor Nutritional Medicine 2018 (compulsory), computer science, 6th semester
- Bachelor MLS 2016 (compulsory), computer science, 6th semester
- Bachelor Biophysics 2016 (compulsory), bioinformatics, 6th semester
- Bachelor Nutritional Medicine 2016 (compulsory), computer science, 6th semester

**Classes and lectures:**

- Introduction into databases and system biology (lecture, 2 SWS)
- Introduction into databases and system biology (exercise, 1 SWS)
- Introduction into databases and system biology (practical course, 1 SWS)

**Workload:**

- 75 Hours private studies
- 45 Hours in-classroom work
- 30 Hours exam preparation

**Contents of teaching:**

- Entity-Relationship-Models
- Relation algebras
- Database systems
- Structured query language
- bio-databases
- Basic terms of system biology
- Cellular networks

**Qualification-goals/Competencies:**

- Students can create databases, manage them and create complex database queries.
- They can explain the basic terms of system biology and classify them correctly.
- Students know different bio-databases and can use and access them to solve problems from bioinformatics and system biology.

**Grading through:**

- written exam

**Responsible for this module:**

- [Prof. Dr. rer. nat. Till Tantau](#)

**Teacher:**

- [LIED | Lübecker Institut für experimentelle Dermatologie \(Lübeck Institute of Experimental Dermatology\)](#)
- [Institute for Theoretical Computer Science](#)
- [Prof. Dr. rer. nat. Till Tantau](#)
- [Prof. Dr. Hauke Busch](#)

**Literature:**

- Edda Klipp et al.: Systems Biology - A Textbook - Weinheim Wiley-VCH Verlag GmbH & Co. KGaA [2016]
- Sarah E Hunt et al.: Ensembl variation resources , Database Volume 2018 - doi.org/10.1093/database/bay119 T. Hubbard et al. The Ensembl genome database project., Nucleic Acids Research 2002 30(1):38-41.
- Gumm, Sommer: Einführung in die Informatik - 2012, De Gruyter Studium Kemper
- Kemper, Eickler: Datenbanksysteme: Eine Einführung - 2015, De Gruyter Studium

**Language:**

- offered only in German



**Notes:**

Prerequisites for the module:

- nothing

Prerequisites for admission to the written examination:

- succesful work on the exercises

Module exam:

- CS1020-L1: Introduction into databases and system biology, written exam, 90 min, 100 % module grade

**CS1200-KP06, CS1200SJ14 - Fundamentals of Computer Engineering 1 (TG11)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

6

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

- Bachelor MES 2020 (compulsory), computer science, 4th semester
- Bachelor Media Informatics 2020 (compulsory), computer science, 2nd semester
- Bachelor Computer Science 2019 (compulsory), foundations of computer science, 2nd semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory: aptitude test), computer science, 2nd semester
- Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science 2016 (compulsory), foundations of computer science, 2nd semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory: aptitude test), computer science, 2nd semester
- Bachelor IT-Security 2016 (compulsory), computer science, 2nd semester
- Bachelor Biophysics 2016 (optional subject), computer science, 6th semester
- Bachelor Medical Informatics 2014 (compulsory), computer science, 2nd semester
- Bachelor Media Informatics 2014 (compulsory), computer science, 2nd semester
- Bachelor MES 2014 (compulsory), foundations of computer science, 4th semester
- Bachelor Computer Science 2014 (compulsory), foundations of computer science, 2nd semester
- Bachelor Biophysics 2024 (optional subject), computer science, 6th semester

**Classes and lectures:**

- Fundamentals of Computer Engineering 1 (lecture, 2 SWS)
- Fundamentals of Computer Engineering 1 (exercise, 2 SWS)

**Workload:**

- 100 Hours private studies
- 60 Hours in-classroom work
- 20 Hours exam preparation

**Contents of teaching:**

- Von-Neumann computer
- Switching algebra and switching functions
- Technological realization
- Combinatorial and sequential circuits
- Memories
- Microprocessors
- Assembler programming
- Microcontrollers
- Input/Output programming
- Basic processor architectures

**Qualification-goals/Competencies:**

- The students can explain the principal organization of a computer and the execution of a program according to the Von-Neumann principle.
- They can elucidate the principal functioning of combinatorial and sequential circuits and describe them formally using switching algebra.
- They can demonstrate the basic circuits for the technological realization of logic gates with bipolar and MOS transistors.
- They can explain the structure and operation of registers and memories.
- They can elucidate the instruction set of a microprocessor exemplarily and to be able to use it for assembly programming.
- Sie können die Ein/Ausgabe-Schnittstellen eines Mikrocontrollers beschreiben und in Assemblersprache programmieren (mit Polling bzw. Interrupt).
- They can program microcontrollers for simple applications in assembly language.
- They can discuss and compare basic processor architectures and their instruction sets.

**Grading through:**

- written exam

**Is requisite for:**

- Embedded Systems (CS2101-KP04, CS2101)
- Computer Architecture (CS2100-KP04, CS2100SJ14)
- Fundamentals of Computer Engineering 2 (CS1202-KP06, CS1202)



**Responsible for this module:**

- Prof. Dr.-Ing. Mladen Berekovic

**Teacher:**

- Institute of Computer Engineering
- Dr.-Ing. Kristian Ehlers

**Literature:**

- C. Hamacher, Z. Vranesic, S. Zaky, N. Manjikian: Computer Organisation and Embedded Systems - McGraw-Hill 2012
- M. M. Mano, C. R. Kime: Logic and Computer Design Fundamentals - Pearson 2007
- D. A. Patterson, J. L. Hennessy: Computer Organisation & Design - The Hardware/Software Interface - Morgan Kaufmann 2011
- T. Ungerer, U. Brinkschulte: Mikrocontroller und Mikroprozessoren - Springer 2010

**Language:**

- offered only in German

**Notes:**

Admission requirements for taking the module:  
- None

Admission requirements for participation in module examination(s):  
- Successful completion of practical exercises as specified at the beginning of the semester.

Module examination(s):  
- CS1200-L1: Technical Foundations of Computer Science 1, written exam 120min, 100% of module grade.

**CS2101-KP04, CS2101 - Embedded Systems (ES)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor Robotics and Autonomous Systems 2020 (optional subject), Additionally recognized elective module, Arbitrary semester
- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2019 (optional subject), Canonical Specialization SSE, 6th semester
- Bachelor MES 2020 (optional subject), computer science / electrical engineering, 3rd semester at the earliest
- Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2016 (optional subject), Canonical Specialization SSE, 6th semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor Biophysics 2016 (optional subject), computer science, 6th semester
- Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor MES 2014 (optional subject), computer science / electrical engineering, 4th or 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science 2014 (compulsory), specialization field robotics and automation, 4th semester
- Bachelor Medical Informatics 2011 (optional subject), computer science, 4th to 6th semester
- Bachelor MES 2011 (compulsory), computer system science, 6th semester
- Bachelor Biophysics 2024 (optional subject), computer science, 6th semester

**Classes and lectures:**

- Embedded Systems (lecture, 2 SWS)
- Embedded Systems (exercise, 1 SWS)

**Workload:**

- 60 Hours private studies and exercises
- 45 Hours in-classroom work
- 15 Hours exam preparation

**Contents of teaching:**

- Target architectures (microcontrollers, FPGAs etc.)
- Conceptual models
- Peripheral buses
- Scheduling algorithms and real-time operating systems
- Specification languages
- Transformation from specification to implementation
- Development tools
- Programming of embedded systems using C

**Qualification-goals/Competencies:**

- Students are able to explain the differences between desktop systems and embedded systems.
- They are able to select an appropriate hardware architecture for an embedded system.
- They are able to select appropriate communication protocols for interfacing peripheral components.
- They are able to control peripheral components with a microcontroller.
- They are able to model embedded systems conceptually and to specify them formally.
- They are well acquainted with the model-based design and tool-based implementation and of simple embedded systems.
- They can independently implement the specifications of the embedded system through C programming
- They can use real-time operating systems to implement embedded systems with real-time capability and deterministic time behavior

**Grading through:**

- written exam

**Requires:**

- Introduction to Programming (CS1000-KP10, CS1000SJ14)
- Fundamentals of Computer Engineering 1 (CS1200-KP06, CS1200SJ14)

**Responsible for this module:**

- [Prof. Dr.-Ing. Mladen Berekovic](#)





**Teacher:**

- [Institute of Computer Engineering](#)
- [Prof. Dr.-Ing. Mladen Berekovic](#)

**Literature:**

- P. Marwedel: Eingebettete Systeme - Berlin: Springer 2007
- W. Wolf: Computers as Components - Principles of Embedded Computing System Design - San Francisco: Morgan Kaufmann 2012
- D.D. Gajski, F. Vahid, S. Narayan, J. Gong: Specification and Design of Embedded Systems - Englewood Cliffs: Prentice Hall 1994
- U. Brinkschulte, T. Ungerer: Mikrocontroller und Mikroprozessoren - Berlin: Springer 2010
- H. Woern, U. Brinkschulte: Echtzeitsysteme - Berlin: Springer 2005

**Language:**

- offered only in German

**Notes:**

- Admission requirements for taking the module:
- None (the competencies of the modules listed under

**CS2700-KP04, CS2700 - Databases (DB)**
**Duration:**

1 Semester

**Turnus of offer:**

each winter semester

**Credit points:**

4

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

- Bachelor MES 2020 (optional subject), computer science / electrical engineering, 3rd semester at the earliest
- Bachelor Media Informatics 2020 (compulsory), computer science, 5th semester
- Bachelor Computer Science 2019 (compulsory), foundations of computer science, 3rd semester
- Bachelor Robotics and Autonomous Systems 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Medical Informatics 2019 (compulsory), computer science, 3rd semester
- Bachelor Computer Science 2016 (compulsory), foundations of computer science, 4th semester
- Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester
- Bachelor IT-Security 2016 (compulsory), computer science, 3rd semester
- Bachelor Biophysics 2016 (optional subject), computer science, 6th semester
- Bachelor MES 2011 (optional subject), computer science, 4th or 6th semester
- Bachelor Medical Informatics 2014 (compulsory), computer science, 4th semester
- Bachelor MES 2014 (optional subject), computer science / electrical engineering, 4th or 6th semester
- Bachelor Media Informatics 2014 (compulsory), foundations of computer science, 4th semester
- Bachelor Computer Science 2014 (compulsory), foundations of computer science, 4th semester
- Bachelor Medical Informatics 2011 (compulsory), computer science, 2nd semester
- Master CLS 2010 (optional subject), computer science, 2nd semester
- Bachelor CLS 2010 (optional subject), computer science, 6th semester
- Bachelor Computer Science 2012 (compulsory), foundations of computer science, 4th semester
- Bachelor Biophysics 2024 (optional subject), computer science, 6th semester

**Classes and lectures:**

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

**Workload:**

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

**Contents of teaching:**

- Introduction, conceptual view of database systems, conceptual data modeling with the Entity-Relationship (ER) modeling language
- The relational data model\* Referential integrity, keys, foreign keys, functional dependencies (FDs)\* Canonical mapping of entity types and relationships into the relational data model\* Update, insertions, and deletion anomalies\* Relational algebra as a query language\* Database normalization, closure w.r.t. FD set, canonical cover of FD sets, normal forms, correct and dependency preserving decomposition of relation schemata, multi-value dependencies, inclusion dependencies
- Practical query language: SQL\* Selection, projection, join, aggregation, grouping, sorting, difference, relational algebra in SQL\* Data management\* Integrity constraints
- Storage structures and database architecture\* Characteristics of storage media, I/O complexity\* DBMS architecture: disk space manager, buffer manager, files and access methods, record allocation strategies (row-wise, column-wise, mixed)
- Query processing\* Indexing techniques, ISAM index, B+-tree index, hash index\* Sorting: Two-way merge sort, blockwise processing, selection trees, query execution plans, join operator: nested loops join, blockwise nested loops join, index-based joins, sort-merge join, partition-based join with hashing\* Addition operators: grouping and duplicate elimination, selection, projection, pipeline principle
- Datalog\* Syntax, semantics, treatment of negation (stratification)\* Evaluation strategies (naive, semi naive, magic set transformation)
- Query optimization\* Cost metrics, Estimating sizes of intermediate tables, selectivity\* Join optimization, physical plan properties, interesting orders, query transformation\* Index cuts, bitmap indexes
- Transactions and recovery\* ACID, anomalies, serializability, locks, 2-phase commit protocol, concurrent access to index structures, isolation levels\* Implementation of transaction w.r.t. ACID, shadow pages, write ahead log, snapshots

**Qualification-goals/Competencies:**

- For all subjects mentioned in the course contents under the indents students should name the central ideas, which can define relevant terms and explain the functioning of algorithms by means of application examples.

**Grading through:**

- written exam

**Is requisite for:**

- Nonstandard Databases and Data Mining (CS3130-KP08)

- Nonstandard Database Systems (CS3202-KP04, CS3202)

**Requires:**

- Algorithms and Data Structures (CS1001-KP08, CS1001)
- Introduction to Programming (CS1000-KP08, CS1000SJ14-MML/MI, CS1000SJ14-MIW)
- Introduction to Programming (CS1000-KP10, CS1000SJ14)

**Responsible for this module:**

- [Prof. Dr. rer. nat. habil. Ralf Möller](#)

**Teacher:**

- [Institute of Information Systems](#)
- [Prof. Dr. rer. nat. habil. Ralf Möller](#)

**Literature:**

- A. Kemper, A. Eickler: Datenbanksysteme - Eine Einführung - Oldenbourg-Verlag

**Language:**

- offered only in German

**Notes:**

Admission requirements for taking the module:

- None (the competences of the modules mentioned under "requires" are needed for this module, but are not a formal prerequisite).

Admission requirements for participation in module examination(s):

- Successful completion of exercise sheets as specified at the beginning of the semester.

Module Exam(s):

- CS2700-L1: Databases, written exam, 90min, 100% of the module grade.

**CS3204-KP04, CS3204 - Artificial Intelligence 1 (K11)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor Robotics and Autonomous Systems 2020 (compulsory), Robotics and Autonomous Systems, 6th semester
- Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester
- Bachelor MES 2020 (optional subject), computer science / electrical engineering, 3rd semester at the earliest
- Bachelor Media Informatics 2020 (optional subject), computer science, 5th or 6th semester
- Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester
- Bachelor MES 2014 (optional subject), computer science / electrical engineering, 3rd semester at the earliest
- Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester
- Bachelor Computer Science 2016 (compulsory), Canonical Specialization Web and Data Science, 6th semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 6th semester
- Bachelor IT-Security 2016 (optional subject), computer science, Arbitrary semester
- Bachelor Biophysics 2016 (optional subject), computer science, 6th semester
- Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Media Informatics 2014 (optional subject), computer science, 5th or 6th semester
- Bachelor Computer Science 2014 (optional subject), central topics of computer science, 6th semester
- Bachelor Computer Science 2014 (compulsory), specialization field robotics and automation, 6th semester
- Bachelor Medical Informatics 2011 (optional subject), Applied computer science, 4th to 6th semester
- Bachelor CLS 2010 (optional subject), computer science, 6th semester
- Bachelor MES 2011 (optional subject), medical engineering science, 6th semester
- Bachelor Computer Science 2012 (compulsory), specialization field robotics and automation, 4th semester
- Bachelor Computer Science 2012 (optional subject), central topics of computer science, 5th or 6th semester
- Bachelor Biophysics 2024 (optional subject), computer science, 6th semester

**Classes and lectures:**

- Artificial Intelligence (lecture, 2 SWS)
- Artificial Intelligence (exercise, 2 SWS)

**Workload:**

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

**Contents of teaching:**

- Part 1: Search strategies As an introduction and a prerequisite for most of the principles of artificial intelligence search strategies are introduced and explained. We will introduce uninformed, informed, local search, adversarial search as well as heuristic search. The concept of agents will be presented.
- Part 2: Learning and reasoning Revision of the foundations of mathematical logic and probability. Principles of machine learning (supervised and unsupervised) are introduced. An introduction to fuzzy logic is also included.
- Part 3: Applications of artificial intelligence Typical applications in the fields of robotics, machine vision, and industrial image and data processing are identified. Ethical issues and risks of the development of artificial intelligence are discussed.

**Qualification-goals/Competencies:**

- The students are able to handle scope-oriented tutorials with a mathematical background in a team, and timely.
- They have developed an understanding for the benefits and disadvantages of the different search and problem solving techniques.
- The students are in a position to choose and apply independently appropriate algorithms for search and learning issues.
- They have gained an insight into the complex development of systems with artificial intelligence and the distinction of its various forms.
- The students have an understanding of the risks and possible technological consequences of the development of systems with strong AI.

**Grading through:**

- written exam

**Requires:**

- Analysis 2 (MA2500-KP04, MA2500)
- Algorithms and Data Structures (CS1001-KP08, CS1001)

**Responsible for this module:**

- Prof. Dr. rer. nat. Floris Ernst

**Teacher:**

- [Institute for Robotics and Cognitive Systems](#)
- MitarbeiterInnen des Instituts
- Prof. Dr. rer. nat. Floris Ernst

**Literature:**

- G. Görz (Hrsg.): Handbuch der Künstlichen Intelligenz - München: Oldenbourg Wissenschaftsverlag, 2003
- C-M. Bishop: Pattern Recognition and Machine Learning - Springer Verlag, 2007
- Russell/Norvig: Artificial Intelligence: a modern approach - (3rd Ed.), Prentice Hall, 2009
- Mitchell: Machine Learning - McGraw-Hill, 1997
- Luger: Artificial Intelligence: Structures and Strategies for Complex Problem Solving - (6th Ed.), Addison-Wesley, 2008

**Language:**

- offered only in German

**Notes:**

Admission requirements for taking the module

- None (the competences of the modules mentioned under **Requires** are needed for this module, but are not a formal prerequisite).

Admission requirements for participation in module examination(s):

- Successful completion of exercises as specified at the beginning of the semester.

Module Exam(s):

- CS3204-L1: Artificial Intelligence, written exam, 90min, 100% of the module grade

**CS4340-KP04, CS4340SJ14 - Health Economy (GOEK14)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor MES 2020 (optional subject), medical engineering science, 3rd semester at the earliest
- Master Medical Informatics 2019 (advanced module), medical computer science, 1st or 2nd semester
- Bachelor Biophysics 2016 (optional subject), no specific field, 6th semester
- Bachelor MES 2014 (optional subject), medical engineering science, 4th or 6th semester
- Master Medical Informatics 2014 (compulsory), medical computer science, 1st or 2nd semester

**Classes and lectures:**

- Health Economy (lecture, 2 SWS)
- Health Economy (exercise, 1 SWS)

**Workload:**

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

**Contents of teaching:**

- Healthcare systems (international comparison)
- PART 1: MACRO-ECONOMICS ASPECTS
- Health Technology Assessment (HTA) as an instrument of evidence-based decision support
- Medical cost-benefit assessment
- Health economic evaluations
- Resource allocation and priority setting
- PART 2: BUSINESS ECONOMICS ASPECTS
- Players in the health care system, social legislation and health care reforms
- Hospital organization and service provision
- Payment modalities in the outpatient and inpatient sector, especially the G-DRG system
- Internal and external accounting: cost & service allocation
- DRG-related cost unit accounting and analysis tools
- Innovation financing for medical technology products and processes

**Qualification-goals/Competencies:**

- Students can assess the necessity of doing business from the perspective of single actors in the health care market as well as from the perspective of solidarity communities of all insured persons - in the statutory health insurance (GKV).
- They can name and discuss variants of national health systems with alternative control principles and financing models.
- PART 1: MACRO-ECONOMIC PERSPECTIVE
- They can explain the relevance and working methods of the Federal Joint Committee (G-BA) for the approval of procedures and products, including their eligibility for reimbursement in health care in the context of statutory health insurances (GKV).
- They can explain HTA as an instrument to support health-related decisions at system level.
- They can explain clinically relevant endpoints and surrogate parameters, as well as appropriate measures of morbidity.
- They can discuss suitable study forms, their validity (evidence levels) and applications as well as variants and quality criteria of meta-analyses for the demonstration of benefits.
- They can explain cost types and measurement approaches for their determination in health economic studies.
- In addition to the benefit (efficacy), they can also include clinical safety (undesired efficacy).
- They can assess the suitability of data sources for health economic studies and perform sensitivity analysis by changing assumptions and data sources.
- They can apply the acquired knowledge to analyze and critically evaluate concrete HTA reports on the efficacy and cost-effectiveness of medical products and procedures.
- They can identify ethical requirements for approval and reimbursability issues, including the tension between the health care of a population and that of an individual.
- PART 2: BUSINESS ECONOMIC PERSPECTIVE
- They can name variants and conditions for the reimbursement of investment costs and operating costs in outpatient and inpatient care in standard care, including new selective forms of care.
- They can explain the functions and effects of G-DRGs for case-mix-based reimbursement of inpatient treatment cases and calculate and discuss the case mix (index) for specific case constellations.
- They can explain the role of internal accounting (including the delimitation of operational costs and services from expenses and income from financial accounting in accordance with KHBV) for the economic assessment of operational events.
- They can explain the terms fixed/variable and direct/indirect costs, as well as cost type, cost center and cost unit accounting, incl. the

relevance of contribution margin analysis.

- They can outline the analysis of costs and activities in the hospital on the basis of DRG-related cost unit accounting according to the national calculation handbook (InEK Institute).
- In particular, they can carry out internal cost allocation of indirect costs.
- They can interpret the national G-DRG cost modules published annually by the InEK and define their role for benchmarking economical projects of individual hospitals.
- They can perform case mix (profit) optimization with respect to resource constraints using the Simplex algorithm.
- They can explain the mechanisms and conditions of NUBs for innovation financing and the delay of several years for introducing them into the reimbursement catalogues of the statutory health insurance (GKV).

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**Grading through:**

- Written or oral exam as announced by the examiner

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**Responsible for this module:**

- [Prof. Dr. rer. nat. habil. Josef Ingenerf](#)

**Teacher:**

- [Institute for Social Medicine and Epidemiology - Section for Research and Teaching in Nursing](#)
- [Institute of Medical Informatics](#)
  
- [Prof. Dr. Katrin Balzer](#)
- [Prof. Dr. rer. nat. habil. Josef Ingenerf](#)

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**Literature:**

- Roeder N., Hensen P., Franz D. (Hrsg): Gesundheitsökonomie, Gesundheitssystem und öffentliche Gesundheitspflege Ein praxisorientiertes Kurzlehrbuch - 2. aktualisierte Auflage. Köln: Deutscher Ärzte-Verlag 2013 (ISBN 978-3-769-13514-5)
- Fleßa S., Greiner W.: Grundlagen der Gesundheitsökonomie Eine Einführung in das wirtschaftliche Denken im Gesundheitswesen - 3. aktualisierte Auflage. Berlin: Springer Gabler 2013 (ISBN 978-3-642-30918-2)
- Graumann M., Schmidt-Graumann A.: Rechnungslegung und Finanzierung der Krankenhäuser - 2. aktualisierte Auflage. Herne/Berlin: NWB 2011 (ISBN: 978-3-482-57572-3)
- Perleth M., Busse R., Gerhardus A., Gibis B., Lühmann D. (Hrsg): Health Technology Assessment : Konzepte, Methoden, Praxis für Wissenschaft und Entscheidungsfindung - Berlin: MWV, 1. Aufl. 2007 (ISBN: 978-3-939069-22-5)

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**Language:**

- offered only in German

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**Notes:**

Admission requirements for taking the module:

- None

Admission requirements for participation in module examination(s):

- Successful participation in group presentations as specified at the beginning of the semester
- Successful completion of exercise assignments as specified at the beginning of the semester.

Module Exam(s):

- CS4340-L1: Health Economics, written exam, 90min, 100% of module grade

LS2803-KP04 - Model organisms in molecular biology research (BioModOrg)			
<b>Duration:</b>	<b>Turnus of offer:</b>	<b>Credit points:</b>	<b>Max. group size:</b>
1 Semester	each summer semester	4	16
<b>Course of study, specific field and term:</b>			
<ul style="list-style-type: none"> <li>• Bachelor Biophysics 2024 (optional subject), life sciences, 6th semester</li> <li>• Bachelor Molecular Life Science 2024 (optional subject), life sciences, 4th or 6th semester</li> <li>• Bachelor MLS 2018 (optional subject), life sciences, 4th semester</li> <li>• Bachelor MLS 2016 (optional subject), life sciences, 4th semester</li> <li>• Bachelor Biophysics 2016 (optional subject), life sciences, 6th semester</li> </ul>			
<b>Classes and lectures:</b>		<b>Workload:</b>	
<ul style="list-style-type: none"> <li>• Model organisms in molecular biology research (lecture, 1 SWS)</li> <li>• Model organisms in molecular biology research (exercise, 2 SWS)</li> </ul>		<ul style="list-style-type: none"> <li>• 70 Hours private studies</li> <li>• 45 Hours in-classroom work</li> </ul>	
<b>Contents of teaching:</b>			
<ul style="list-style-type: none"> <li>• Microorganisms <i>Saccharomyces cerevisiae</i></li> <li>• Green plants <i>Arabidopsis thaliana</i></li> <li>• Invertebrates I <i>Caenorhabditis elegans</i></li> <li>• Invertebrates II <i>Drosophila melanogaster</i></li> <li>• Vertebrates <i>Mus musculus</i></li> <li>• Phylogeny of model organisms</li> </ul>			
<b>Qualification-goals/Competencies:</b>			
<ul style="list-style-type: none"> <li>• basic understanding of the biology of the organisms presented</li> <li>• basic understanding of the advantages and disadvantages of the different model organisms for biological research</li> <li>• basic practical abilities in self-acting handling these organisms</li> </ul>			
<b>Grading through:</b>			
<ul style="list-style-type: none"> <li>• continuous, successful participation in course</li> </ul>			
<b>Requires:</b>			
<ul style="list-style-type: none"> <li>• Biology 1 (LS1000-KP06)</li> </ul>			
<b>Responsible for this module:</b>			
<ul style="list-style-type: none"> <li>• Prof. Dr. rer. nat. Enno Hartmann</li> </ul>			
<b>Teacher:</b>			
<ul style="list-style-type: none"> <li>• <a href="#">Institute for Biology</a></li> <li>• Prof. Dr. rer. nat. Enno Hartmann</li> <li>• <a href="#">Prof. Dr. rer. nat. Rainer Duden</a></li> <li>• Prof. Dr. rer. nat. Christian Schmidt</li> <li>• Prof. Dr. rer. nat. Walther Traut</li> </ul>			
<b>Literature:</b>			
<ul style="list-style-type: none"> <li>• :- zur Einführung: Campbell Allgemeine Biologie die entsprechenden Kapitel</li> </ul>			
<b>Language:</b>			
<ul style="list-style-type: none"> <li>• offered only in German</li> </ul>			



**LS3500-KP05, LS3500 - Introduction into Structural Analysis (EinStruA05)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

5

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

- Bachelor Biophysics 2024 (compulsory), life sciences, 6th semester
- Bachelor Molecular Life Science 2024 (compulsory), life sciences, 6th semester
- Bachelor MLS 2018 (compulsory), life sciences, 6th semester
- Bachelor Biophysics 2016 (compulsory), life sciences, 6th semester
- Bachelor MLS 2016 (compulsory), life sciences, 6th semester

**Classes and lectures:**

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

**Workload:**

- 90 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: Introduction 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
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**Grading through:**

- written exam

**Responsible for this module:**

- [Dr. Alvaro Mallagaray de Benito](#)

**Teacher:**

- [Research Center Borstel, Leibniz Lung Center](#)
- [Institute of Biochemistry](#)
- [Institute of Chemistry and Metabolomics](#)
- Prof. Dr. Thomas Krey
- Dr. math. et dis. nat. Jeroen Mesters
- [Dr. Alvaro Mallagaray de Benito](#)
- Dr. Dominik Schwudke

**Literature:**

- actual papers:
- Teil B: Horst Friebolin: Ein- und zweidimensionale NMR-Spektroskopie. Eine Einführung - Wiley-VCH



- Alexander Mc Pherson: Introduction to Macromolecular Crystallography - 1st edition, 2003, Wiley

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**Language:**

- offered only in German

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**Notes:**

Prerequisites for the module:

- nothing

Prerequisites for admission to the written examination:

- nothing

Module exam:

- LS3500-L1: Introduction into Structural Analysis, written exam, 90 min, 100 % module grade

**MA2510-KP04, MA2510 - Stochastics 1 (Stoch1)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Minor in Teaching Mathematics, Bachelor of Arts 2023 (compulsory), mathematics, 8th semester
- Bachelor CLS 2023 (compulsory), mathematics, 2nd semester
- Bachelor MES 2020 (optional subject), mathematics / natural sciences, 3rd semester at the earliest
- Bachelor Biophysics 2024 (optional subject), mathematics, 6th semester
- Bachelor Computer Science 2019 (compulsory), mathematics, 4th semester
- Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 4th semester
- Bachelor Medical Informatics 2019 (optional subject), mathematics, 4th to 6th semester
- Minor in Teaching Mathematics, Bachelor of Arts 2017 (compulsory), mathematics, 8th semester
- Bachelor Computer Science 2016 (compulsory), mathematics, 4th semester
- Bachelor CLS 2016 (compulsory), mathematics, 2nd semester
- Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 4th semester
- Bachelor IT-Security 2016 (compulsory), mathematics, 2nd semester
- Bachelor Biophysics 2016 (optional subject), mathematics, 6th semester
- Bachelor Medical Informatics 2014 (optional subject), mathematics, 5th or 6th semester
- Bachelor MES 2014 (optional subject), mathematics / natural sciences, 4th or 6th semester
- Bachelor Computer Science 2014 (compulsory), mathematics, 4th semester
- Bachelor Computer Science 2012 (compulsory), mathematics, 4th semester
- Bachelor MES 2011 (compulsory), mathematics, 4th semester
- Bachelor CLS 2010 (compulsory), mathematics, 2nd semester

**Classes and lectures:**

- Stochastics 1 (lecture, 2 SWS)
- Stochastic 1 (exercise, 1 SWS)

**Workload:**

- 65 Hours private studies and exercises
- 45 Hours in-classroom work
- 10 Hours exam preparation

**Contents of teaching:**

- probability spaces
- basics of combinatorics
- conditional probability and stochastic independency
- random variables
- important discrete and continuous one-dimensional probability distributions
- characteristics of distributions
- law of large numbers, central limit theorem
- modeling examples from the life sciences

**Qualification-goals/Competencies:**

- Students are able to explain basic stochastic models formally correct and in the context of their application
- They are able to formalize stochastic problems
- They are able to identify basic combinatorial patterns and to use them for solving stochastic problems
- They understand central statements of elementary stochastics

**Grading through:**

- written exam

**Is requisite for:**

- Stochastic processes (MA4610-KP05)
- Stochastic processes and modeling (MA4610-KP04, MA4610)
- Modeling Biological Systems (MA4450-KP08, MA4450-MML)
- Modeling Biological Systems (MA4450-KP07)
- Module part: Modeling Biological Systems (MA4450 T-INF)
- Module part: Modeling Biological Systems (MA4450 T)
- Modeling Biological Systems (MA4450)
- Modeling (MA4449-KP07)



- Module part: Stochastics 2 (MA4020 T)
- Stochastics 2 (MA4020-KP05)
- Stochastics 2 (MA4020-MML)
- Stochastics 2 (MA4020-KP04, MA4020)

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**Responsible for this module:**

- [Nachfolge von Prof. Dr. rer. nat. Karsten Keller](#)

**Teacher:**

- [Institute for Mathematics](#)
- [Nachfolge von Prof. Dr. rer. nat. Karsten Keller](#)

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**Literature:**

- N. Henze: Stochastik für Einsteiger - Vieweg
- U. Krengel: Einführung in die Wahrscheinlichkeitstheorie - Vieweg

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**Language:**

- offered only in German

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**Notes:**

Admission requirements for taking the module:  
- None

Admission requirements for participation in module examination(s):  
- Successful completion of homework assignments during the semester

Module exam(s):  
- MA2510-L1: Stochastics 1, written exam, 90 min, 100 % of module grade

**PS1030-KP04, PS1030 - English for Bachelor and Master students MLS (Engl)**
**Duration:**

1 Semester

**Turnus of offer:**

each summer semester

**Credit points:**

4

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

- Bachelor Molecular Life Science 2024 (optional subject), interdisciplinary competence, Arbitrary semester
- Master MES 2020 (optional subject), interdisciplinary, Arbitrary semester
- Bachelor MES 2020 (optional subject), interdisciplinary, Arbitrary semester
- Bachelor MLS 2018 (optional subject), interdisciplinary competence, Arbitrary semester
- Bachelor MLS 2016 (optional subject), interdisciplinary competence, Arbitrary semester
- Bachelor Biophysics 2016 (optional subject), no specific field, 6th semester
- Master MES 2014 (optional subject), no specific field, 2nd semester
- Bachelor MES 2014 (optional subject), no specific field, 4th or 6th semester
- Master MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester
- Bachelor MES 2011 (optional subject), medical engineering science, Arbitrary semester
- Master CLS 2010 (optional subject), interdisciplinary competence, Arbitrary semester
- Bachelor MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester

**Classes and lectures:**

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

**Workload:**

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

**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:**

- Students acquire basic knowledge of the English language in word and writing.
- They improve their communication in English.
- They improve their skills in reading and writing English texts, including specialist literature.

**Grading through:**

- written exam

**Responsible for this module:**

- B. Sc. Sara Meitner

**Teacher:**

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- B. Sc. Sara Meitner

**Literature:**

- :- Up-to-date publications and articles

**Language:**

- offered only in English

**Notes:**

Prerequisites for attending the module:  
- None

Prerequisites for the exam:  
- Preliminary examinations can be determined at the beginning of the semester. If preliminary work has been defined, it must have been completed and positively assessed before the initial examination.

**PY2904-KP04, PY2904 - Media Psychology (MedienPsy)**

<b>Duration:</b> 1 Semester	<b>Turnus of offer:</b> each summer semester	<b>Credit points:</b> 4
<b>Course of study, specific field and term:</b>		
<ul style="list-style-type: none"> <li>• Bachelor Psychology 2013 (optional subject), psychology, Arbitrary semester</li> <li>• Bachelor Media Informatics 2020 (compulsory), psychology, 4th semester</li> <li>• Bachelor Psychology 2016 (optional subject), psychology, Arbitrary semester</li> <li>• Bachelor Biophysics 2016 (optional subject), no specific field, 6th semester</li> <li>• Bachelor Psychology 2020 (optional subject), psychology, Arbitrary semester</li> <li>• Bachelor Media Informatics 2014 (compulsory), psychology, 4th semester</li> </ul>		
<b>Classes and lectures:</b>		<b>Workload:</b>
<ul style="list-style-type: none"> <li>• Media Psychology (lecture, 2 SWS)</li> <li>• Media Psychology (seminar, 1 SWS)</li> </ul>		<ul style="list-style-type: none"> <li>• 75 Hours private studies and exercises</li> <li>• 45 Hours in-classroom work</li> </ul>
<b>Contents of teaching:</b>		
<ul style="list-style-type: none"> <li>• Media selection, media use, media reception</li> <li>• Media effects</li> <li>• Media competency</li> <li>• Persuasive technology, gamification</li> <li>• Advertising, social networks</li> <li>• Public Relations</li> <li>• Human-computer interaction, companion technologies</li> </ul>		
<b>Qualification-goals/Competencies:</b>		
<ul style="list-style-type: none"> <li>• The students can explicate theories and findings of media psychology using digital media as examples.</li> <li>• They are able to draw conclusions from media psychology's scientific contributions regarding multimedia and interactive media and to judge media use and media effects based on knowledge of media psychology.</li> <li>• They are able to analyse and to evaluate digital media with methods from media psychology.</li> </ul>		
<b>Grading through:</b>		
<ul style="list-style-type: none"> <li>• portfolio exam - the concrete examination elements and their weights will be published in the course</li> </ul>		
<b>Responsible for this module:</b>		
<ul style="list-style-type: none"> <li>• <a href="#">Prof. Dr. rer. nat. Thomas Franke</a></li> </ul>		
<b>Teacher:</b>		
<ul style="list-style-type: none"> <li>• <a href="#">Institute for Multimedia and Interactive Systems</a></li> <li>• <a href="#">Prof. Dr. rer. nat. Thomas Franke</a></li> <li>• MitarbeiterInnen des Instituts</li> </ul>		
<b>Literature:</b>		
<ul style="list-style-type: none"> <li>• B. Batinic &amp; M. Appel (Hrsg.): Medienpsychologie - Heidelberg: Springer, 2008</li> <li>• S. Trepte &amp; L. Reinecke: Medienpsychologie - Stuttgart: Kohlhammer, 2013</li> <li>• :</li> </ul>		
<b>Language:</b>		
<ul style="list-style-type: none"> <li>• offered only in German</li> </ul>		
<b>Notes:</b>		



Prerequisites for attending the module:

- None

Prerequisites for the exam:

- Successful completion of homework assignments during the semester.

Exam(s):

- PY2904-L1 Medienpsychologie, Portfolioprfung, semesterbegleitend, 100% der Modulnote