

UNIVERSITÄT ZU LÜBECK

# Module Guide for the Study Path

# **Bachelor Biophysics 2016**

Version from 1. April 2025



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# 1st and 2nd semester

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LS1610-KP04 - Practical Course Chemistry (ACPKP04)			
Duration:	Turnus of offer:		Credit points:
1 Semester	each summer semester		4
Course of study, specific field and terms • Bachelor CLS 2023 (compulsory), li • Bachelor Biophysics 2024 (compulsory), li • Bachelor CLS 2016 (compulsory), li • Bachelor Biophysics 2016 (compulsory)	fe sciences, 4th semester sory), life sciences, 1st and 2 fe sciences, 4th semester sory), life sciences, 1st and 2	nd semester nd semester	
Classes and lectures:		Workload:	
Practical Course Chemistry (practic	cal course, 4 SWS)	<ul><li>80 Hours private</li><li>40 Hours in-class</li></ul>	e studies sroom work
Contents of teaching: • Practical course: • The students work independently • Selected experiments related to to	under supervision with rega pics of the lectures general a	rds to the role of GSP of th and organic chemistry	e University of Lübeck
<ul> <li>Qualification-goals/Competencies:</li> <li>From their independent work in the in the chemical laboratory within the of the handling of hazardous mate</li> <li>Students are capable to document discussion) with regards to the rol</li> </ul>	ne lab course students have f the roles of Good Scientific P erials according to GHS (Glob t, interpret and present the r e of GSP of the University of	fundamental practical skills raxis of the University of Li pally Harmonized System o esults of conducted experi Lübeck and the DFG-guide	s to perform simple experiments and analyzes übeck. They are competent in basic techniques f Classification and Labeling of Chemicals). ments (laboratory journal and concluding elines.
Grading through: • Continuous, successful participatic	on in practical course. All exp	eriments have to be condu	ucted.
Requires: • General Chemistry (LS1100-KP04)			
Responsible for this module:			
Teacher:			
Institute of Medical Engineering			
• Dr. rer. nat. Kerstin Lüdtke-Buzug			
Literature: • Thomas Weimar: Script of the prac	tical course		
Language: • offered only in German			
Notor			
Prerequisites for attending the modu - Passing of LS1100-L1 and participat	ıle: tion in the general health an	d safety briefing	
Prerequisites for admission to the ex - Successful participation in the prac	amination: tical course with all tests		
Module exam: - In order to pass the course student in a talk. Not graded, 100%.	s have to conduct experimer	nts within defined error ma	rgins and present an experiment of the course



LS1100-KP04 - General Chemistry (ACKP04)			
Duration:	Turnus of offer:		Credit points:
1 Semester	each winter semester		4
Course of study, specific field and term: Bachelor CLS 2023 (compulsory), life Bachelor Biophysics 2024 (compulso Bachelor Computer Science 2019 (op Bachelor Computer Science 2019 (op Bachelor MES 2020 (optional subject Bachelor Medical Informatics 2019 (op Bachelor Computer Science 2016 (op Bachelor Computer Science 2016 (op Bachelor Computer Science 2016 (op Bachelor CLS 2016 (compulsory), life Bachelor Biophysics 2016 (compulsor)	e sciences, 3rd semester ory), life sciences, 1st semester otional subject), Extended of otional subject), Canonical S t), mathematics / natural scie optional subject), medical co optional subject), medical co optional subject), medical co optional subject), Canonical S e sciences, 3rd semester ory), life sciences, 1st semester	er ptional subjects, Arbitrary pecialization Bioinformatic ences, 3rd semester at the omputer science, 4th to 6th urriculum, Arbitrary semes omputer science, 5th or 6th pecialization Bioinformatic er	semester cs and Systems Biology, 3rd semester earliest h semester ster h semester cs, 3rd semester
Classes and lectures:		Workload:	
General Chemistry (lecture, 3 SWS)		• 60 Hours in-class	room work
<ul> <li>Lectures:</li> <li>The structure of atoms and the period</li> <li>Chemical bonds, molecules and long</li> <li>Reaction equations and stoichiomet</li> <li>The threedimensional structure of m</li> <li>Special properties of water</li> <li>Chemical equilibrium</li> <li>Acids and bases</li> <li>Redox reactions and electrochemist</li> <li>Complexes and metal-ligand bonds</li> <li>Interactions between mater and rad</li> <li>Thermodynamics</li> <li>Chemical kinetics</li> <li>Roles of Environmental and occupate Classification and Labeling of Chemical</li> <li>Exercises:</li> <li>Students discuss problems covering</li> </ul>	odic table of the elements s ry nolecules: From the VSEPR m iation - Molecular spectrosco cional health and safety in th icals (GHS)) and of GSP of th all topics of the lectures on	nodel to molecular orbitals opy le handling of hazardous n e University of Lübeck and the black board	; naterials (Globally Harmonized System of d of the DFG-guidelines
<ul> <li>Qualification-goals/Competencies:</li> <li>Students have fundamental knowled</li> <li>Students understand the fundamental scientific topics.</li> <li>Students are able to perform chemical theory is a student of the student</li></ul>	dge of general and inorgani tal concepts of general and cal calculations from all suba Jniversity of Lübeck. vledge to problems of other	c chemistry. inorganic chemistry and ca areas of the course. branches in chemistry and	an apply them to reactions and general d related sciences and are thus able to
Grading through: • written exam			
Is requisite for: • Practical Course Chemistry (LS1610-I • Organic Chemistry (LS1600-KP04)	KP04)		
Responsible for this module:			



### • PD Dr. phil. nat. Thomas Weimar

Teacher:

- Institute of Chemistry and Metabolomics
- PD Dr. phil. nat. Thomas Weimar

### Literature:

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

### • offered only in German

### 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:	Turnus of offer:		Credit points:
1 Semester	each winter semester		8
Course of study, specific field and term: Minor in Teaching Mathematics, Back Bachelor CLS 2023 (compulsory), ma Bachelor Biophysics 2024 (compulso Bachelor Biophysics 2024 (compulso Bachelor MeS 2020 (compulsory: apt Bachelor Media Informatics 2020 (co Bachelor Computer Science 2019 (co Bachelor Robotics and Autonomous Bachelor Medical Informatics 2019 (co Bachelor Medical Informatics 2019 (co Bachelor Computer Science 2016 (co Bachelor CLS 2016 (compulsory), ma Bachelor CLS 2016 (compulsory), ma Bachelor Robotics and Autonomous Bachelor Robotics and Autonomous Bachelor Biophysics 2016 (compulso Bachelor Medical Informatics 2014 (co Bachelor Medical Informatics 2014 (co Bachelor Medical Informatics 2014 (co Bachelor Medical Informatics 2014 (co Bachelor Computer Science 2014 (co Bachelor Medical Informatics 2011 (co Bachelor Computer Science 2012 (co Bachelor CLS 2010 (compulsory), ma Bachelor CLS 2010 (compulsory), ma	helor of Arts 2023 (comput thematics, 1st semester ry), mathematics, 1st seme ry), mathematics, 1st seme itude test), mathematics, 1 mpulsory), mathematics, 3 mpulsory: aptitude test), r Systems 2020 (compulsor ompulsory: aptitude test), helor of Arts 2017 (compu mpulsory: aptitude test), r thematics, 1st semester ry), mathematics, 1st seme Systems 2016 (compulsor ry: aptitude test), mathem ompulsory: aptitude test), itude test), mathematics, 1 mpulsory: aptitude test), itude test), mathematics, 1 mpulsory: aptitude test), mpulsory:	lsory), mathematics, 3rd ser ester ester st semester rathematics, 1st semester mathematics, 1st semester lsory), mathematics, 3rd ser nathematics, 1st semester lsory), mathematics, 3rd ser nathematics, 1st semester ester y: aptitude test), mathemat atics, 1st semester mathematics, 1st semester nathematics, 1st semester nathematics, 1st semester mathematics, 1st semester mathematics, 1st semester mathematics, 1st semester mathematics, 1st semester	mester tics, 1st semester mester ics, 1st semester
Classes and lectures: • Linear Algebra and Discrete Structur • Linear Algebra and Discrete Structur	es 1 (lecture, 4 SWS) es 1 (exercise, 2 SWS)	Workload: • 125 Hours privat • 90 Hours in-class • 25 Hours exam p	e studies and exercises sroom work preparation
Contents of teaching: • Fundamentals: logic, sets, mappings • Relations, equivalence relations, orde • Proof by induction • Groups: fundamentals, finite groups, • Rings, fields, congruencies • Complex numbers: calculus, represent • Vector spaces: bases, dimension, sca	erings permutations, matrices ntation, roots of unity lar product, norms		
Qualification-goals/Competencies: Students understand the fundamental They understand basic thought process They can explain fundamental relation They can apply fundamental conceps They have an understanding of abstricts Interdisciplinary qualifications: Students have basic competency in the students have basic competency in th	cal concepts of linear algebresses and methods of pro onships in linear algebra. ts and methods of proof to ract thought processes. modelling. retical concepts to similar ematics problems within a ns to their problems to a g	ora. of. o algebraic problems. applications. team. group.	
• written exam			



<ul> <li>Is requisite for:</li> <li>Linear Algebra and Discrete Structures 2 (MA1500-KP08, MA1500)</li> </ul>
Responsible for this module:
Prof. Dr. rer. nat. Jan Modersitzki
Teacher:
Institute of Mathematics and Image Computing
<ul> <li>Prof. Dr. rer. nat. Jan Modersitzki</li> <li>Prof. Dr. rer. nat. Jan Lellmann</li> </ul>
Literature:
<ul> <li>G. Fischer: Lineare Algebra: Eine Einführung für Studienanfänger - Vieweg+Teubner</li> <li>G. Strang: Lineare Algebra - Springer</li> <li>K. Jänich: Lineare Algebra - Springer</li> <li>D. Lau: Algebra und diskrete Mathematik I + II - Springer</li> <li>G. Strang: Introduction to Linear Algebra - Cambridge Press</li> <li>K. Rosen: Discrete Mathematics and Its Applications - McGraw-Hill</li> </ul>
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: Tu	ırnus of offer:	Credit points:
1 Semester each winter semester 8		
Course of study, specific field and term: Bachelor CLS 2023 (compulsory), mathen Minor in Teaching Mathematics, Bachelor Bachelor Biophysics 2024 (compulsory: a Bachelor MES 2020 (compulsory: aptitude Bachelor Media Informatics 2020 (compu- Bachelor Computer Science 2019 (compo- Bachelor Robotics and Autonomous Systers Bachelor Medical Informatics 2019 (compo- Bachelor Medical Informatics 2019 (compo- Bachelor Medical Informatics 2019 (compo- Bachelor Medical Informatics 2019 (compo- Bachelor Computer Science 2016 (compo- Bachelor CLS 2016 (compulsory), mathen Bachelor Robotics and Autonomous Systers Bachelor Robotics 2016 (compulsory), Bachelor Medical Informatics 2014 (compo- Bachelor Medical Informatics 2014 (compo- Bachelor CLS 2010 (compulsory), mathen Bachelor CLS 2010 (compulsory), mathen Bachelor MES 2011 (compulsory), mathen Bachelor CLS 2011 (compulsory), mathen Bachelor Computer Science 2012 (compo- Bachelor Computer Science 2012 (compo- Bachelor CLS 2010 (compulsory), mathen Bachelor CLS 2011 (compulsory), mathen Bachelor Computer Science 2012 (compo- Bachelor Computer Science 2012 (compo-	matics, 1st semester or of Arts 2023 (compulsory aptitude test), mathematics de test), mathematics, 1st se ulsory: aptitude test), math oulsory), mathematics, 1st se tems 2020 (compulsory: ap ipulsory), mathematics, 1st or of Arts 2017 (compulsory oulsory), mathematics, 1st se matics, 1st semester tems 2016 (compulsory: ap mathematics, 1st semester aptitude test), mathematics, 1st ulsory), mathematics, 1st ulsory), mathematics, 1st se oulsory), mathematics, 1st se pulsory), mathematics, 1st se oulsory), mathematics, 1st se oulsory), mathematics, 1st se pulsory), mathematics, 3rd matics, 1st semester ematics, 1st semester ematics, 1st semester	y), mathematics, 5th semester s, 1st semester semester nematics, 1st semester semester ptitude test), mathematics, 1st semester semester y), mathematics, 5th semester semester otitude test), mathematics, 1st semester r s, 1st semester semester semester semester semester semester semester
Classes and lectures: • Analysis 1 (lecture, 4 SWS) • Analysis 1 (exercise, 2 SWS)	1	Workload: • 125 Hours private studies • 90 Hours in-classroom work • 25 Hours exam preparation
Contents of teaching:		
<ul> <li>Sequences and series</li> <li>Functions and continuity</li> <li>Differentiability, Taylor series</li> <li>Metric and normalized spaces, basic top</li> <li>Multivariate differential calculus</li> </ul>	pological concepts	
<ul> <li>Qualification-goals/Competencies:</li> <li>Students understand the basic terms of</li> <li>Students understand the basic thoughts technically motivated problems.</li> </ul>	analysis, especially the con s and proof techniques and	ncept of convergence. d are able to use them for the analytical treatment of scientifially or
<ul> <li>Students can explain basic relationships</li> <li>Students can apply the basic concepts a</li> <li>Students have an understanding for abs</li> <li>Interdisciplinary qualifications:</li> <li>Students have a basic competence in m</li> <li>Students can transfer theoretical conceptions</li> <li>Students can work as a group on element</li> </ul>	; in real analysis. and proof techniques of diff stract structures. nodeling. pts to similar applications. entary mathematical proble	fferential calculus. ems.
Grading through:		
• written exam		
Is requisite for: • Analysis 2 (MA2500-KP09) • Analysis 2 (MA2500-KP08)		



<ul> <li>Analysis 2 (MA2500-KP05, MA2500-MLS)</li> <li>Analysis 2 (MA2500-KP04, MA2500)</li> </ul>
Responsible for this module:
Prof. Dr. rer. nat. Jürgen Prestin
Teacher:
Institute for Mathematics
Prof. Dr. rer. nat. Jürgen Prestin
PD Dr. rer. nat. Jörn Schnieder
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. Hormaler: Analysis 1 + 2
Language:
offered only in German
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



ME1010-KP08, ME1010 - Physics 1 (Physik1)				
Duration:	Turnus of offer: Credit points:		Credit points:	
1 Semester	each winter semester		8	
Course of study, specific field and term Bachelor Biophysics 2024 (compul Bachelor MES 2020 (compulsory: a Bachelor Biophysics 2016 (compul Bachelor MES 2014 (compulsory: a Bachelor MES 2011 (compulsory),	: sory: aptitude test), physics, ptitude test), physics, 1st se sory: aptitude test), physics, ptitude test), physics, 1st se ohysics, 1st semester	1st semester mester 1st semester mester		
Classes and lectures:		Workload:		
<ul> <li>Physics 1 (lecture, 4 SWS)</li> <li>Physics 1 (exercise, 2 SWS)</li> </ul>		<ul> <li>110 Hours priva</li> <li>90 Hours in-clas</li> <li>40 Hours exam</li> </ul>	ate studies ssroom work preparation	
<ul> <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>				
<ul> <li>You can design novel physical experiments on your own</li> </ul>				
Grading through: • written exam				
Is requisite for: • Physics 2 (ME1020-KP08, ME1020)				
<ul> <li>Responsible for this module: <ul> <li>Prof. Dr. rer. nat. Christian Hübner</li> </ul> </li> <li>Teacher: <ul> <li>Institute of Biomedical Optics</li> <li>Institute of Physics</li> <li>Institute of Medical Engineering</li> <li>Prof. Dr. rer. nat. Martin Koch</li> <li>Prof. Dr. rer. nat. Christian Hübner</li> <li>PD Dr. rer. nat. Hauke Paulsen</li> <li>Prof. DrIng. Maik Rahlves</li> <li>Prof. Dr. rer. nat. Robert Huber</li> </ul> </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, 90 min, 100 % module grade



LS1600-KP04 - Organic Chemistry (OCKP04)				
Duration:	Turnus of offer:		Credit points:	
1 Semester	each summer semester		4	
<ul> <li>Course of study, specific field and term:</li> <li>Bachelor CLS 2023 (compulsory), life sciences, 4th semester</li> <li>Bachelor Biophysics 2024 (compulsory), life sciences, 2nd semester</li> <li>Master Medical Informatics 2019 (optional subject), bioinformatics, 1st or 2nd semester</li> <li>Master Medical Informatics 2014 (optional subject), bioinformatics, 1st or 2nd semester</li> <li>Bachelor CLS 2016 (compulsory), life sciences, 4th semester</li> <li>Bachelor Biophysics 2016 (compulsory), life sciences, 2nd semester</li> </ul>				
Classes and lectures:	W	orkload:		
<ul> <li>Organic Chemistry (lecture, 3 SWS)</li> <li>Organic Chemistry (exercise, 1 SWS)</li> </ul>		<ul> <li>60 Hours private</li> <li>60 Hours in-class</li> </ul>	studies room work	
<ul> <li>Organic Crientstry (exercise, 1 sws)</li> <li>Bot Hours Infectassion work</li> </ul> Contents of teaching: <ul> <li>Lectures:</li> <li>Alkanes, cycloalkanes</li> <li>Alkenes and Alkynes</li> <li>Aromatics</li> <li>Stereochemistry</li> <li>Substitution and elimination reactions</li> <li>Alcohols, phenols and thiols</li> <li>Ether and epoxides</li> <li>Aldehydes and ketones</li> <li>Carboxylic acids and derivativs</li> <li>Amines and derivativs</li> <li>Heterocycles</li> <li>Lipids</li> <li>Carbohydrates</li> <li>Amino acids and peptides</li> <li>Nucleotides and nucleic acids</li> <li>Exercises:</li> <li>Students discuss problems covering all topics of the lectures on the black board</li> </ul>				
<ul> <li>Qualification-goals/Competencies:</li> <li>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.</li> <li>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.</li> <li>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.</li> </ul>				
Grading through: <ul> <li>written exam</li> </ul>				
Requires: • General Chemistry (LS1100-KP04)				
Responsible for this module: <ul> <li>PD Dr. phil. nat. Thomas Weimar</li> </ul> <li>Teacher: <ul> <li>Institute of Chemistry and Metabolomics</li> <li>PD Dr. phil. nat. Thomas Weimar</li> </ul> </li>				



### 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.

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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:	Turnus of offer:		Credit points:	
1 Semester	each summer semester		8	
1 Semester       each summer semester       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 MES 2020 (compulsory), mathematics, 2nd semester         • Bachelor MES 2020 (compulsory), mathematics, 2nd semester         • Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 2nd semester         • Bachelor Medical Informatics 2019 (compulsory), mathematics, 2nd semester         • Bachelor Computer Science 2019 (compulsory), mathematics, 2nd semester         • Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 2nd semester         • Bachelor Computer Science 2019 (compulsory), mathematics, 2nd semester         • Bachelor Computer Science 2019 (compulsory), mathematics, 2nd semester         • Bachelor Computer Science 2016 (compulsory), mathematics, 2nd semester         • Bachelor Computer Science 2016 (compulsory), mathematics, 2nd semester         • Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 2nd semester         • Bachelor IT-Security 2016 (compulsory), mathematics, 2nd semester         • Bachelor Medical Informatics 2014 (compulsory), mathematics, 2nd semester         • Bachelor Medical Informatics 2011 (compulsory), mathematics, 2nd semester         • Bachelor Cuputer Science 2014 (compulsory: aptitude test), mathematics, 2nd semeste				
Classes and lectures: • Linear Algebra and Discrete St • Linear Algebra and Discrete St	Classes and lectures:       Workload:         • Linear Algebra and Discrete Structures 2 (lecture, 4 SWS)       • 125 Hours private studies and exercises         • Linear Algebra and Discrete Structures 2 (exercise, 2 SWS)       • 90 Hours in-classroom work         • 25 Hours exam preparation			
Contents of teaching: Systems of linear equations, m Determinants Linear mappings Orthogonality Eigenvalues Qualification-goals/Competencies: The students understand advar They understand advanced the They can apply advanced come They can explain advanced rel Interdisciplinary qualifications Students can transfer advanced They have an advanced comp They can solve complex proble They can present the solution	atrices inced concepts of linear algebra. ought processes and methods of cepts and methods of proof to alg ationships in linear algebra. : d theoretical concepts to similar etency in modeling. ems within a group. to complex problems to a group.	proof. gebraic problems. applications.		
Grading through: • written exam				
Is requisite for: Image Registration (MA5030-K Image Registration (MA5030-K Mathematical Methods of Imag Mathematical Methods in Imag Optimization (Advanced Math	P05) P04, MA5030) ge Processing (MA4500-KP05) ge Processing (MA4500-KP04, MA ematics) (MA4031-KP08)	4500)		



<ul> <li>Module part: Optimization (MA4030 T)</li> <li>Optimization (MA4030-KP08, MA4030)</li> </ul>
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:
<ul> <li>G. Fischer: Lineare Algebra: Eine Einführung für Studienanfänger - Vieweg+Teubner</li> <li>G. Strang: Lineare Algebra - Springer</li> <li>K. Jänich: Lineare Algebra - Springer</li> <li>D. Lau: Algebra und diskrete Mathematik I + II - Springer</li> <li>G. Strang: Introduction to Linear Algebra - Cambridge Press</li> <li>K. Rosen: Discrete Mathematics and Its Applications - McGraw-Hill</li> </ul>
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





MA2500-KP08 - Analysis 2 (Ana2KP08)				
Duration:	Turnus of offer:		Credit points:	
1 Semester	each summer semester		8	
Course of study, specific field and term: • Bachelor Biophysics 2024 (compulsory), mathematics, 2nd semester • Bachelor IT-Security 2016 (optional subject), specific, Arbitrary semester • Bachelor MES 2014 (compulsory), mathematics, 2nd semester • Bachelor MES 2020 (compulsory), mathematics, 2nd semester • Bachelor Biophysics 2016 (compulsory), mathematics, 2nd semester				
Classes and lectures:		Workload:		
<ul> <li>Analysis 2 (lecture, 4 SWS)</li> <li>Analysis 2 (exercise, 2 SWS)</li> </ul>		<ul> <li>125 Hours private</li> <li>90 Hours in-class</li> <li>25 Hours exam p</li> </ul>	e studies room work preparation	
Contents of teaching:				
<ul> <li>Advanced multivariate differential c</li> <li>Integral calculus for functions of one fundamental theorem of calculus)</li> <li>Curvilinear integrals, bounded variat</li> <li>Function series, power series</li> <li>Fourier series (trigonometric polyno Linear operators in Hilbert spaces</li> </ul>	alculus e real variable (indefinite in tion mials, convergence)	tegrals, antiderivatives, sub	ostitution, partial fractions, definite integrals,	
<ul> <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:</li> <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>				
Grading through: • written exam				
Requires: • Analysis 1 (MA2000-KP09) • Analysis 1 (MA2000-KP08, MA2000)				
Responsible for this module:         • Prof. Dr. rer. nat. Jürgen Prestin         Teacher:         • Institute for Mathematics         • Prof. Dr. rer. nat. Jürgen Prestin				
<ul> <li>Literature:</li> <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>				
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

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



ME1020-KP08, ME1020 - Physics 2 (Physik2)				
Duration:	Turnus of offer:		Credit points:	
1 Semester	each summer semester		8	
Course of study, specific field and term: • Bachelor Biophysics 2024 (compulsory), physics, 2nd semester • Bachelor MES 2020 (compulsory), physics, 2nd semester • Bachelor Biophysics 2016 (compulsory), physics, 2nd semester • Bachelor MES 2014 (compulsory), physics, 2nd semester • Bachelor MES 2011 (compulsory), physics, 2nd semester				
Classes and lectures: • Physics 2 (lecture, 4 SWS) • Physics 2 (exercise, 2 SWS)	Asses and lectures:Workload:• Physics 2 (lecture, 4 SWS)• 130 Hours private studies• Physics 2 (exercise, 2 SWS)• 90 Hours in-classroom work• 20 Hours exam preparation		e studies sroom work preparation	
<ul> <li>Contents of teaching:</li> <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>				
Qualification-goals/Competencies: <ul> <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 povel physical experiments on your own</li> </ul>				
Grading through: • Written or oral exam as announced b	by the examiner			
Requires: • Physics 1 (ME1010-KP08, ME1010)				
Responsible for this module: • Prof. Dr. rer. nat. Christian Hübner Teacher: • Institute of Biomedical Optics • Institute of Physics • Institute of Medical Engineering • Prof. Dr. rer. nat. Martin Koch • Prof. Dr. rer. nat. Christian Hübner • Prof. Dr. rer. nat. Robert Huber • Prof. DrIng. Maik Rahlves				
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



BP204	0-KP05 - Classical and	d statistical mechanic	s (KSM)	
Duration:	Turnus of offer:		Credit points:	
1 Semester	each winter semester		5	
Course of study, specific field and term: • Bachelor Biophysics 2024 (compulso • Bachelor Biophysics 2016 (compulso	ry), physics, 3rd semester ry), physics, 3rd semester			
Classes and lectures:Workload:• Classical and statistical mechanics (lecture, 2 SWS)• 70 Hours private studies• Classical and statistical mechanics (exercise, 2 SWS)• 60 Hours in-classroom work• 20 Hours exam preparation		studies room work reparation		
<ul> <li>Contents of teaching:</li> <li>Die Studierenden bearbeiten Übungsaufgaben selbständig unter Berücksichtigung der Richtlinie der GWP der Universität zu Lübeck und gemäß den DFG-Leitlinien.</li> <li>.</li> <li>.<!--</th--><th>chtlinie der GWP der Universität zu Lübeck</th></li></ul>			chtlinie der GWP der Universität zu Lübeck	
• Qualification-goals/Competencies: • • •				
• Analysis 2 (UngenutztMA2500-MIWSJ14)				
Responsible for this module: <ul> <li>PD Dr. rer. nat. Hauke Paulsen</li> </ul> Teacher: <ul> <li>Institute of Physics</li> </ul>				
Literature: • Randy Harris: Moderne Physik - Pearson Studium • :				
Language: • offered only in German				



LS1000-KP06 - Biology 1 (Bio1_BP)					
Duration:	Turnus of offer:		Credit points:		
1 Semester	each winter semester		6		
Course of study, specific field and ter • Bachelor Biophysics 2024 (comp • Bachelor Biophysics 2016 (comp	r <b>m:</b> pulsory), life sciences, 3rd seme: pulsory), life sciences, 3rd seme:	ster ster			
Classes and lectures:		Workload:			
• Biology (lecture, 4 SWS)	<ul> <li>100 Hours private studies</li> <li>60 Hours in-classroom work</li> <li>20 Hours exam preparation</li> </ul>		te studies sroom work preparation		
Contents of teaching: • • • • • • • • • • • •					
Qualification-goals/Competencies: • •	Qualification-goals/Competencies: • •				
Grading through: • written exam					
Responsible for this module: • Prof. Dr. rer. nat. Enno Hartmann Teacher: • Institute for Biology • Prof. Dr. rer. nat. Enno Hartmann • Prof. Dr. rer nat. Rainer Duden • PD Dr. rer. nat. Kai-Uwe Kalies • PD Dr. rer. nat. Bärbel Kunze					
Literature: • Campbell: Biology					
Language: • offered only in German					
Notes:         Prerequisites for the modul:         - nothing         Prerequisites for admission to the written examination:         - nothing         Modul exam:         - LS1000-L1: Biology, written exam, 90 min, 100% modul grade					



LS2000-KP06 - Biochemistry 1 (Bioche1_06)					
Duration:	Turnus of offer:		Credit points:		
1 Semester	each winter semeste	r	6		
Course of study, specific field a • Bachelor Biophysics 2024 • Bachelor Biophysics 2016	n <b>d term:</b> (compulsory), life sciences, 3rd se (compulsory), life sciences, 3rd se	emester emester			
Classes and lectures: • Biochemistry for Biophys	ysics (lecture, 4 SWS) • 90 Hours private studies • 60 Hours in-classroom work • 30 Hours exam preparation		e studies ssroom work preparation		
Contents of teaching: Characteristics of biosyster Proteins: structure and dy Enzymes: structure, funct Intermediary metabolism Biomembranes and cell r DNA Replication, transcri	ems, biomolecules /namics ion and regulation espiration ption, translation				
Qualification-goals/Competend • Understanding structures • Understanding biochemi • Knowledge of biochemic	<ul> <li>Qualification-goals/Competencies:</li> <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>				
Grading through: • written exam					
Responsible for this module: • Prof. Dr. Thomas Krey Teacher: • Institute of Biochemistry • Prof. Dr. Thomas Krey • Prof. Dr. Lars Redecke • PD Dr. rer. nat. Guido Har • Dr. rer. nat. Janna Bigalke • Dr. Mariana Grieben	ısen				
Literature: • Berg/Tymoczko/Stryer: Biochemistry 7th ed. • Voet/Voet: Biochemistry 4th ed. • Lehninger: Principles of Biochemistry 5th ed. • Alberts et al.: Molecular Biology of the Cell 5th ed.					
Language: • offered only in English					
Notes:					



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



LS2200-	KP04, LS2200 - Introdu	iction into Biophysics	(EinBiophy)	
Duration:	Turnus of offer:		Credit points:	
1 Semester	each winter semester		4	
Course of study, specific field and term: <ul> <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 MES 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 MES 2014 (optional subject), mathematics / natural sciences, 3rd or 5th semester</li> <li>Bachelor MES 2010 (optional subject), life sciences, 5th semester</li> <li>Bachelor MES 2010 (optional subject), life sciences, 5th semester</li> <li>Bachelor MLS 2009 (compulsory), life sciences, 5th semester</li> <li>Bachelor MES 2010 (optional subject), life sciences, 5th semester</li> <li>Bachelor MES 2011 (compulsory), medical engineering science, 5th semester</li> </ul>				
Classes and lectures:       Workload:         • Introduction into Biophysics (lecture, 2 SWS)       • 50 Hours private studies         • Biophysics (Excercise or practical course, 1 SWS)       • 45 Hours in-classroom work         • 15 Hours written report       • 10 Hours exam preparation		studies sroom work report preparation		
Contents of teaching: <ul> <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>				
Qualification-goals/Competencies: • You can assign forces in biologica • You become familiar with the bas • You gain the expertise to simplify • You can choose and apply approp	Il systems ic aspects of living matter complex living systems priate experimental methods	for the study of living matt	er	
Grading through: • written exam				
Responsible for this module: • Dr. Young-Hwa Song Teacher: • Institute of Physics • Dr. Young-Hwa Song • Prof. Dr. rer. nat. Christian Hübner				
Literature: <ul> <li>Volker Schünemann: Biophysik: Eine Einführung</li> <li>Werner Mäntele: Biophysik</li> </ul>				
Language: • offered only in German				
Notes:				



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:	Turnus of offer:		Credit points:	
1 Semester	each winter semester		5	
Course of study, specific field a Bachelor CLS 2023 (comp Bachelor Biophysics 2024 Bachelor Computer Science Bachelor Computer Science Bachelor Medical Informat Master MLS 2018 (optionat Bachelor Computer Science Bachelor Computer Science Master MLS 2016 (optionat Bachelor CLS 2016 (comp Bachelor Biophysics 2016	nd term: ulsory), mathematics, 3rd semester (compulsory), mathematics, 3rd seme ce 2019 (optional subject), Extended ce 2019 (compulsory), Canonical Spec tics 2019 (optional subject), medical o al subject), interdisciplinary competer ce 2016 (optional subject), advanced ce 2016 (compulsory), Canonical Spec al subject), mathematics / computer s ulsory), mathematics, 3rd semester (compulsory), mathematics, 3rd seme	ester optional subjects, Arbitrary cialization Bioinformatics a computer science, 4th to 6 nce, 1st semester curriculum, Arbitrary seme cialization Bioinformatics, 5 cience, 1st semester	y semester Ind Systems Biology, 5th semester ith semester ester 5th semester	
Classes and lectures:		Workload:		
<ul> <li>Biomathematics (lecture,</li> <li>Biomathematics (exercise)</li> </ul>	2 SWS) , 2 SWS)	<ul> <li>70 Hours private</li> <li>60 Hours in-clas</li> <li>20 Hours exam</li> </ul>	e studies and exercises ssroom work preparation	
<ul> <li>Dependence of solutions</li> <li>Linear systems (in particu</li> <li>Higher-Order linear differ</li> <li>Qualitative theory of nonl</li> <li>Qualification-goals/Competence</li> <li>Students are able to explain bad</li> <li>Students can explain bad</li> <li>Students can specify concordinary differential equa</li> <li>Students are able to find</li> <li>Students are able to explain</li> <li>Students are able to explain</li> </ul>	on initial conditions lar with constant coefficients) ential equations linear systems <b>:ies:</b> ain basic notions from the theory of o phenomena of solutions of differenti ditions under which good phenomen- tions. explicit solutions of simple differentia ain how solutions of differential equa- ent important models of the natural s	rdinarydifferential equatic al equations using examp a of solutions are guarante Il equations. tions can beanalysed quali ciences which canbe analy	ons. les. eed by applying theorems from the theory of itatively. ysed by differential equations.	
Grading through: • written exam Requires: • Linear Algebra and Discre • Linear Algebra and Discre • Analysis 2 (MA2500-KP04, • Analysis 1 (MA2000-KP08,	te Structures 2 (MA1500-KP08, MA15 te Structures 1 (MA1000-KP08, MA10 MA2500) MA2000)	00) 00)		
Responsible for this module: • PD Dr. rer. nat. Christian E Teacher: • Institute for Mathematics • PD Dr. rer. nat. Christian E	3ey 3ey			
Literature: • G. Birkhoff, GC. Rota: Ord	dinary 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

### Notes:

Admission requirememnts for taking the module:

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

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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



ME2	053-KP04, ME2053 - Ph	nysics Lab Course (PhysPrakt)	
Duration:	Turnus of offer:	Credit points:	
1 Semester	each winter semester	4	
Course of study, specific field and term Bachelor Biophysics 2024 (compul Bachelor Molecular Life Science 20 Bachelor MES 2020 (compulsory), Bachelor MLS 2018 (compulsory), Bachelor Biophysics 2016 (compul Bachelor MES 2014 (compulsory), Bachelor MLS 2009 (compulsory), Bachelor MES 2011 (compulsory),	sory), physics, 3rd semester 24 (compulsory), physics, 3rd physics, 3rd semester life sciences, 3rd semester sory), physics, 3rd semester physics, 3rd semester life sciences, 3rd semester physics, 3rd semester	d semester	
Classes and lectures:		Workload:	
Physics Lab Course (practical course, 3 SWS)		<ul> <li>55 Hours written report</li> <li>45 Hours in-classroom work</li> <li>20 Hours exam preparation</li> </ul>	
<ul> <li>Experiment 2: heat</li> <li>Experiment 3: non stationary current</li> <li>Experiment 4: stationary current</li> <li>Experiment 5: spectrometer</li> <li>Experiment 6: diffusion</li> <li>Experiment 7: wave optics</li> <li>Experiment 8: geometrical optics</li> <li>Experiment 9: radio activity</li> <li>Experiment 10: sound and ultraso</li> </ul>	ent und		
<ul> <li>Qualification-goals/Competencies:</li> <li>The students can practically work roles of GSP of the University of Lie They can use measuring instrume</li> <li>They can display measurement re</li> <li>They can analyze collected data q</li> <li>They can estimate and evaluate th</li> <li>They can document measuremen</li> <li>They can draw meaningful conclution of the can name the principles of or the can analyze of the can analyze of the can analyze of the can analyze of the can be ca</li></ul>	out the physical connections ibeck and of the DFG-guidel nts correctly. sults graphically. uantitatively. ne accuracy of the measurem t results correctly. sions from measurement dat ccupational health and safet	s to the mentioned contents of the practical course with regard to the ines eent data and the results of the analysis. ta. y 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 Dr. rer. nat. Norbert Linz 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:	Turnus of offer:	Credit points:		
1 Semester	each summer semester	5		
Course of study, specific field • Bachelor Biophysics 2024 • Bachelor Biophysics 2010	<b>and term:</b> 4 (compulsory), physics, 4th semester 6 (compulsory), physics, 4th semester			
Classes and lectures:		Workload:		
<ul> <li>Atom and Molecule Physics (lecture, 2 SWS)</li> <li>Atom and Molecule Physics (exercise, 2 SWS)</li> </ul>		<ul> <li>60 Hours in-classroom work</li> <li>60 Hours private studies and exercises</li> <li>30 Hours exam preparation</li> </ul>		
Contents of teaching:				
<ul> <li>Mass, size, and structure</li> <li>Bohr's hydrogen model</li> <li>Orbital and spin magnet</li> <li>The atom in electric and</li> <li>Many-electron atoms</li> <li>X-ray spectra, nuclear sp</li> <li>Mass, size, and structure</li> <li>Theory of the chemical b</li> <li>Molecular spectroscopy</li> <li>Nuclear and electron spi</li> <li>Guideline for GSP of the</li> </ul>	of atoms and the electron ism, fine structure magnetic field in, hyperfine structure of molecules bond (IR, Raman, etc) n resonance University at Lübeck and correspondir	ng DFG guidelines		
<ul> <li>They can explain the for</li> <li>They can apply their known</li> <li>They can explain the structure</li> <li>You know the rules of going</li> </ul>	mation and shape of atomic and molec wledge of the structure of atoms and ucture of molecules bod scientific practice	:ular spectra. molecules in the biophysical context.		
Grading through: • written exam				
Requires: • Physics 2 (ME1020-KP08, • Physics 1 (ME1010-KP08,	ME1020) ME1010)			
Responsible for this module: • Prof. Dr. rer. nat. Christia	n Hübner			
Teacher: • Institute of Physics				
<ul><li> Prof. Dr. rer. nat. Christia</li><li> MitarbeiterInnen des In</li></ul>	n Hübner stituts			
Literature: • Wolfgang Demtröder: At • :	oms, Molecules and Photons: An Intro	duction 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 - Bi	iophysical Chemistry	(BPCKP08)
Duration:	Turnus of offer:		Credit points:
1 Semester	each summer semeste	er	8
Course of study, specific field Master CLS 2023 (comp Bachelor Biophysics 20 Bachelor Molecular Life Bachelor MLS 2018 (com Bachelor MLS 2016 (com Master CLS 2016 (comp Bachelor Biophysics 20 Master CLS 2010 (option Bachelor MLS 2009 (com	<b>J and term:</b> bulsory), MML with specialization in L 24 (compulsory), biophysics, 4th sem Science 2024 (compulsory), Chemist mpulsory), Chemistry, 4th semester mpulsory), Chemistry, 4th semester bulsory), MML with specialization in L 16 (compulsory), biophysics, 4th sem mal subject), computational life scien mpulsory), life sciences, 4th semester	ife Science, 2nd semester lester try, 4th semester life Science, 2nd semester lester lice / life sciences, 2nd seme	ester
Classes and lectures:		Workload:	
<ul><li>Biophysical Chemistry</li><li>Biophysical Chemistry</li><li>Biophysical Chemistry</li></ul>	<ul> <li>Biophysical Chemistry (lecture, 3 SWS)</li> <li>Biophysical Chemistry (exercise, 1 SWS)</li> <li>Biophysical Chemistry (practical course, 3 SWS)</li> <li>160 Hours private studies</li> <li>80 Hours in-classroom work</li> </ul>		ivate studies :lassroom work
<ul> <li>Basics of chemical ther</li> <li>Thermodynamics of lig</li> <li>Basics of chemical kine</li> <li>Basics of enzyme kinet</li> <li>Molecular Mechanics</li> <li>Practical works:</li> <li>NMR, Molecular Model</li> </ul>	modynamics and binding tics ics ing, experiments with a focus on the proces:	rmodynamics and kinetics	
<ul> <li>Acquire basic knowled</li> <li>Insight into properties basic knowledge to co</li> <li>Application of laws of the recognition reactions in</li> <li>Acquire basic knowled</li> <li>Acquisition of skills to the Lübeck and of the DFG</li> </ul>	ge on spectroscopic techniques to ar (e.g. structure, dynamics, spectroscop mpute molecules hermodynamics to describe chemica n biological systems ge to analyze time courses of chemic work independently and self-determi -guidelines.	nalyze (bio)molecules. Focu pic properties) of molecule al reactions and biological p al reactions and biological ined in the laboratory with	us is on NMR and mass spectrometry techniques es employing theoretical models. Acquisition of processes with a focus on binding and processes regard to the roles of GSP of the University of
Grading through: • written exam			
Requires: • Organic Chemistry (LS1	600-KP10, LS1600-MLS)		
Responsible for this module: • Prof. Dr. rer. nat. Ulrich Teacher: • Institute of Chemistry a • Prof. Dr. rer. nat. Ulrich	Günther Ind Metabolomics		



### • 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%.)



LS2700-KP04 - Cell Biology (ZellbioKP4)					
Duration:	Turnus of offer:		Credit points:		
1 Semester	each summer semester		4		
Course of study, specific field and term: • Bachelor Biophysics 2024 (compulsory), Elective Chemistry/Biology, 4th semester • Bachelor Biophysics 2016 (compulsory), Elective Chemistry/Biology, 4th semester					
Classes and lectures: • Cell Biology (lecture, 3 SWS)		<ul> <li>Workload:</li> <li>75 Hours private studies</li> <li>45 Hours in-classroom work</li> </ul>			
Contents of teaching: <ul> <li>Special structure of cells</li> <li>Cell cycle and apoptosis</li> <li>Introduction into developmental biology</li> </ul>					
<ul> <li>Qualification-goals/Competencies:</li> <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>					
Grading through: • written exam					
Responsible for this module: • Prof. Dr. rer. nat. Enno Hartmann Teacher: • Institute of Medical and Marine Biotechnology • Institute for Biology • Prof. Dr. rer. nat. Enno Hartmann • PD Dr. rer. nat. Kai-Uwe Kalies • Prof. Dr. rer. nat. Charli Kruse					
Literature: • Lodish: Molecular Cell Biology • Pollard: Cell Biology • Wolpert: Principles of Development • Alberts: Molecular Biology of the Cell					
Language: • offered only in German					
Notes: Prerequisites for the modul: - nothing Prerequisites for admission to the writt - nothing Modul exam: - LS2700-L1: Cellbiology, written exam,	en examination: , 90 min, 100 % module gra	de			



MA1600-KP04, MA1600, MA1600-MML - Biostatistics 1 (BioStat1)			
Duration:	Turnus of offer:	Credit points:	
1 Semester	each summer semester	4	
Course of study, specific field and term: Bachelor CLS 2023 (compulsory), mai Bachelor Biophysics 2024 (compulso Bachelor Nutritional Medicine 2024 ( Bachelor MES 2014 (optional subject Bachelor Computer Science 2019 (co Bachelor Computer Science 2019 (co Bachelor Medical Informatics 2019 (co Bachelor MLS 2018 (compulsory), life Bachelor Nutritional Medicine 2018 ( Bachelor CLS 2018 (compulsory), mai Bachelor CLS 2016 (compulsory), mai Bachelor CLS 2010 (compulsory), mai Bachelor COmputer Science 2016 (co Bachelor Computer Science 2016 (co Bachelor MLS 2016 (compulsory), life Bachelor Nutritional Medicine 2016 (co Master MES 2011 (advanced curriculus Bachelor Computer Science 2014 (co Master MES 2011 (advanced curriculus Bachelor Medical Informatics 2011 (co Master Computer Science 2012 (com Bachelor MLS 2009 (compulsory), life Bachelor MLS 2011 (optional subject Bachelor Melcular Life Science 2024	:hematics, 2nd semester y), Elective Computer Science, 4th compulsory), mathematics / natura ), mathematics / natural sciences, 3 itional subject), Extended optional seme mpulsory), Canonical Specialization ompulsory), medical computer scie sciences, 6th semester compulsory), mathematics / computer thematics, 2nd semester itional subject), advanced curriculur mpulsory), Canonical Specialization sciences, 6th semester thematics, 2nd semester itional subject), advanced curriculur mpulsory), Canonical Specialization sciences, 6th semester ry), Elective Computer Science, 4th compulsory), medical computer scie mpulsory), medical computer scie onpulsory), medical computer scie onal subject), specialization field bioir um), biophysics and biomedical opt ompulsory), advanced curriculur stoc stoinal subject), specialization field bio pulsory), advanced curriculur stoc stoinal subject), specialization field bio pulsory), advanced curriculur stoc stoinal subject), specialization field bio pulsory), medical computer scie onal subject), specialization field bio pulsory), medical computer scie (tional subject), specialization field bio pulsory), mathematics / computer sciences, 6th semester ), medical engineering science, 6th (compulsory), mathematics / computer sciences (th semester ), medical semester )	semester al sciences, 4th semester 3rd semester at the earliest subjects, Arbitrary semester n Bioinformatics and Systems Biology, 6th semester ence, 6th semester uter science, 6th semester m, Arbitrary semester n Bioinformatics, 4th semester ence, 4th semester uter science, 6th semester ence, 4th semester ence, 4th semester ence, 4th semester ence, 4th semester ence, 4th semester ence, 4th semester ioinformatics, 2nd or 3rd semester chastics, 2nd semester bioinformatics, 6th semester	
Classes and lectures:	Work	kload	
<ul> <li>Biostatistics 1 (lecture, 2 SWS)</li> <li>Biostatistics 1 (exercise, 1 SWS)</li> </ul>	•	<ul> <li>66 Hours private studies</li> <li>39 Hours in-classroom work</li> <li>15 Hours exam preparation</li> </ul>	
Contents of teaching:			
<ul> <li>Descriptive statistics</li> <li>Probability theory, including random</li> <li>Normal distribution, other distributio</li> <li>Diagnostic tests, reference range, no</li> <li>Statistical testing</li> <li>Sample size calculations</li> <li>Confidence intervals</li> <li>Selected statistical tests I</li> <li>Selected statistical tests II</li> <li>Linear simple regression</li> <li>Analysis of variance (one-way-classif</li> <li>Clinical trials</li> <li>Multiple Testing: Bonferroni, Bonferr</li> </ul>	variables, density, and cumulative ns rmal range, coefficient of variation ication) oni-Holm, Bonferroni-Holm-Shaffer	e distribution function	
Qualification-goals/Competencies:			
<ul> <li>With regard to the roles of GSP of th statistical methods:The students are</li> <li>They are able to calculate quantiles a</li> <li>They are able to explain terms of dia</li> </ul>	<ul> <li>University of Lübeck and of the D able to calculate descriptive statisti and surfaces of the normal distribut gnostic testing, such as sensitivity of</li> </ul>	>FG-guidelines the student were able to work with the following :ics. tion. or specificity.	

• They are able to list the basic principles of statistical testing, sample size calculation and confidence interval construction.


the results.	
<ul> <li>They are able to explain the basic principles of linear regression.</li> </ul>	
<ul> <li>They are able to apply the linear simple regression.</li> </ul>	
• 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.	
Ihey know the basic principles of clinical therapeutic studies.	
<ul> <li>They know the assumptions that need to be fulfilled for the application of specific statistical tests.</li> <li>They are able to calculate simple adjustments for multiple comparisons.</li> </ul>	
Grading through:	
written exam	
s 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	
Geacher.	
Institute of Modical Piemetry and Statistics	
Institute of Medical Biometry and Statistics	
Prof. Dr. rer. biol. hum. Inke König	
MitarbeiterInnen des Instituts	
itoraturo	
Menthies Dudelf William d Kuhlisch, Disstatistik Firs Finführung für Dissuissenschaftlag, 1. Auflagt Dessen Deutschland	
<ul> <li>Matthias Rudolf, Wiltrud Ruhlisch: Biostatistik: Eine Einfuhrung für Biowissenschaftler - T. Auflage, Pearson: Deutschland</li> <li>Lothar Sachs, Jürgen Hedderich: Angewandte Statistik: Methodensammlung mit R - 15. Auflage, Springer: Heidelberg</li> </ul>	
-anguage.	
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	

• They are able to carry out a set of elementary statistical tests, such as t-test, test of proportions, X2 independence test, and to interpret





M	E2060-KP05 - Fields a	nd Quanta (FQ_BioPhy)
Duration:	Turnus of offer:	Credit points:
1 Semester	each summer semester	5
Course of study, specific field and term: • Bachelor Biophysics 2024 (compulso • Bachelor Biophysics 2016 (compulso	ory), physics, 4th semester ory), physics, 4th semester	
Classes and lectures:		Workload:
<ul> <li>Fields and Quanta (lecture, 2 SWS)</li> <li>Fields and Quanta (exercise, 2 SWS)</li> </ul>		<ul> <li>60 Hours in-classroom work</li> <li>60 Hours private studies</li> <li>30 Hours exam preparation</li> </ul>
Contents of teaching:		
<ul> <li>Scalar and vector fields</li> <li>electric charge, electr. Potential, electric charge, electr. Potential, electromagnetic field</li> <li>electromagnetic induction</li> <li>Maxwell equations</li> <li>Wave-particle duality</li> <li>Uncertainty</li> <li>Wave functions, operators and mea</li> <li>Schrödinger equation</li> </ul>	ctr. field ) surement	
Qualification-goals/Competencies:		
<ul> <li>Students are able to calculate the p</li> <li>They can enumerate the main axion</li> <li>They can explain the terms operato</li> <li>They can calculate the eigenstates of</li> <li>They can describe the stationary state</li> <li>They are using the terms and concert</li> </ul>	ropagation of electromagne ns of quantum mechanics. r, wave function, quantum n of simple quantum mechani tes of the hydrogen atom a pts of theoretical physics su	etic waves in homogeneous media. numbers and measurements, and the relationships between them. cal systems. nd calculate the associated energy values. Ich an extent that you can acquire further representations on their own.
Grading through: • written exam		
Requires: • Linear Algebra and Discrete Structur • Linear Algebra and Discrete Structur • Analysis 2 (MA2500-KP08) • Analysis 1 (MA2000-KP08, MA2000) • Physics 2 (ME1020-KP08, ME1020) • Physics 1 (ME1010-KP08, ME1010)	res 2 (MA1500-KP08, MA150 res 1 (MA1000-KP08, MA100	)0) )0)
Responsible for this module:		
<ul> <li>Prof. Dr. rer. nat. Magdalena Rafecas</li> <li>Teacher: <ul> <li>Institute of Medical Engineering</li> <li>Prof. Dr. rer. nat. Magdalena Rafecas</li> <li>Prof. Dr. rer. nat. Martin Koch</li> </ul> </li> </ul>		
Literature:		
<ul> <li>D. J. Griffiths: Elektrodynamik: Eine E</li> <li>D. J. Griffiths: Quantenmechanik: Le</li> </ul>	Einführung - Pearson, Hallbe hr- und Übungsbuch - Pear	ergmoos 2011 son, Hallbergmoos 2012
Language:		



### • 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.

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Format of the module exam:

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



nus of offer:	Credit points:
h summer semester	4
a compulsory module), physics pulsory module), medical engir a compulsory module), physics pulsory module), medical engir	;, 4th semester neering science, 4th semester ;, 4th semester neering science, 4th semester
Workic Ire, 2 SWS) • SWS) •	<b>Dad:</b> 55 Hours private studies and exercises 45 Hours in-classroom work 20 Hours exam preparation
cal tissues (Mie, Rayleigh) s,Mathematical description of lig ow cytometryof photophysics otobiology ue, photocoagulation ed dissection of transparent tiss osy, refractive surgery, and cell s laser scanning microscopy be the fundamental physical ph and tissue and describe it mathe d therapeutic techniques in the uments for biomedical application to practical applications.	ght propagation sues surgery nenomena and laws regarding light propagation and ematically. field of biomedical optics and can list, describe and compare ons and are able to explain their function.
e examiner	· · · · · · · · · · · · · · · · · · ·
<sup>.</sup> Medicine - Springer 2003 Edition, Springer 2007	
	<b>us of offer:</b> a summer semester         a compulsory module), medical engines         a compulsory module), medical engines         a compulsory module), medical engines         pulsory module), medical engines         sws)         sws)         •         cal tissues (Mie, Rayleigh)         s,Mathematical description of lis         pw cytometryof photophysics         potocoagulation         ed dissection of transparent tiss         psy, refractive surgery, and cells         laser scanning microscopy         be the fundamental physical pl         nd tissue and describe it mathed         therapeutic techniques in the         uments for biomedical applicati         d limits of microscopic imaging         to practical application skills to d         e examiner         Medicine - Springer 2003



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.





N	1E2102 T - Module pa	rt: Photonics (Photon	iik)
Duration:	ation: Turnus of offer: Credit points:		
1 Semester	1 Semester each summer semester		4
Course of study, specific field and term: Bachelor MES 2020 (Module part of a Bachelor Biophysics 2016 (Module p Bachelor MES 2014 (Module part of a Bachelor Biophysics 2024 (Module p	a compulsory module), mea art of a compulsory module a compulsory module), mea art of a compulsory module	dical engineering science, 4 e), physics, 4th semester dical engineering science, 4 e), physics, 4th semester	4th semester 4th semester
Classes and lectures: • Photonics (lecture, 2 SWS)	Classes and lectures: • Photonics (lecture, 2 SWS) • 45 Hours in-classroom work		
Photonics (exercise, 1 SWS)		<ul><li> 35 Hours private</li><li> 20 Hours exam p</li></ul>	studies and exercises preparation
Contents of teaching: • Historical introduction • Light as EM wave, physical parameter • Detection and detection of light • Geometric optics, raytracing • Optical Instruments • Optics of the eye • Polarization • Diffraction • Optical fibres • Integrated optics • Optoelectronics • Laser • Nonlinear Optics	ers of the light wave field		
<ul> <li>Qualification-goals/Competencies:</li> <li>The students can name the essentia each other.</li> <li>The students can name and explain</li> <li>The students can explain the function</li> </ul>	l concepts of optics (geome the essential optical phenc on and application of the m	etric optics, wave optics, qu omena. lost important photonic co	uantum optics) and distinguish them from mponents.
Grading through: • Written or oral exam as announced	by the examiner		
Responsible for this module: <ul> <li>Siehe Hauptmodul</li> </ul> Teacher: <ul> <li>Institute of Biomedical Optics</li> <li>Prof. Dr. rer. nat. Gereon Hüttmann</li> </ul>			
Literature: • E. Hecht: Optics - Addison-Wesley, ( • Frank L. Pedrotti, Leno S. Pedrotti: Ir • Frank Pedrotti: Optik eine Einführun • B.E.A. Saleh, M.C. Teich: Fundamenta • Matt Young: Optics and Lasers : Inclu	dt: Optik, Oldenbourg) htroduction to optics - Pren g - Prentice Hall als of Photonics - Wiley 200 uding Fibers and Optical W	tice-Hall 7 (dt.: Grundlagen der Pho aveguides - Springer 2000	tonik, Wiley-VCH)
Language: • English, except in case of only Germ	an-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.



600 - Introduction to Bio	omedical Optics and	Photonics (EinfBMOPho)	)
Turnus of offer:		Credit points:	
each summer semester		8	
<b>m:</b> ulsory), physics, 4th semester ), medical engineering science, ulsory), physics, 4th semester ), medical engineering science,	4th semester 4th semester		
	Workload:		
ction to Biomedical Optics (4 ics (4 ECTS) (course, 3 SWS)	<ul><li>110 Hours priv</li><li>90 Hours in-cla</li><li>40 Hours exam</li></ul>	ate studies ssroom work preparation	
ts			
ts			
nn			
photonics - Wiley 2003 ons - 3rd Edition, Springer 2007 Light Microscopy and Electronic 16, Pearson ti: Introduction to optics - Prent ik: für Wissenschaftler und Inge	: Imaging - Wiley-Liss 200 tice Hall enieure (Teil 5: Optik) - Sp	)1 vringer 2000	
dule: edical Optics and Photonics, W	ritten exam, 90 min, 100	% Module note	
	Turnus of offer: each summer semester m: pulsory), physics, 4th semester ), medical engineering science, pulsory), physics, 4th semester ), medical engineering science, ction to Biomedical Optics (4 ics (4 ECTS) (course, 3 SWS) ts ts ts ts nnn photonics - Wiley 2003 ons - 3rd Edition, Springer 2007 Light Microscopy and Electronic 16, Pearson ti: Introduction to optics - Prent ik: für Wissenschaftler und Inger edical Optics and Photonics, W	Turnus of offer:         each summer semester         m:         ulsory), physics, 4th semester         ), medical engineering science, 4th semester         ), medical engineering science, 4th semester         ), medical engineering science, 4th semester         (ction to Biomedical Optics (4         icts (4 ECTS) (course, 3 SWS)         ts         ts         onn         ontices - Wiley 2003         ons- 3rd Edition, Springer 2007         ongint Hitrobuction to optics - Prentice Hall         ik: für Wissenschaftler und Ingenieure (Teil 5: Optik) - Sp         odule: </td <td>BOD - Introduction to broniecucal optics and Protonics (Encoded optics (Protonics (Protonics))))))))))))))))))))))))))))))))))))</td>	BOD - Introduction to broniecucal optics and Protonics (Encoded optics (Protonics (Protonics))))))))))))))))))))))))))))))))))))



BP3100-KP07 - Seminar and Practical Course Biophysics (SemBiophys)				
Duration:	Turnus of offer:		Credit points:	
2 Semester	each winter semester		7 (Тур В)	
Course of study, specific field ar • Bachelor Biophysics 2024 ( • Bachelor Biophysics 2016 (	nd term: compulsory), biophysics, 5th and 6th compulsory), biophysics, 5th and 6th	semester semester		
Classes and lectures:		Workload:		
<ul><li>Bachelor Seminar Biophysi</li><li>Advanced Practical Course</li></ul>	ics (seminar, 2 SWS) Biophysics (practical course, 3 SWS)	• 200 Hours (see m	nodule parts)	
Contents of teaching: •				
Qualification-goals/Competenci •	es:			
Grading through:				
• continuous, successful par	ticipation in practical course			
Responsible for this module:				
Prof. Dr. rer. nat. Christian	Hübner			
Teacher:				
<ul> <li>Institutes of the Departme</li> <li>Institutes of natural science</li> <li>Institute of Physics</li> </ul>	nt of Computer Science/ Engineering e			
Language:				
German and English skills	required			



	BP3102 T - Bachelor	Seminar Biophysics (SemBP)		
Duration:	Turnus of offer:	Turnus of offer:		
1 Semester	each winter semester			
Course of study, specific field an • Bachelor Biophysics 2024 (I • Bachelor Biophysics 2016 (I	<b>d term:</b> Module part of a compulsory mo Module part of a compulsory mo	odule), biophysics, 5th semester odule), biophysics, 5th semester		
Classes and lectures: • Bachelor Seminar (seminar	. 2 SWS)	<ul> <li>Workload:</li> <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>		
Contents of teaching: • •				
Qualification-goals/Competencie • Students can apply for a sc • They can present the result • They can present and discu	es: ientific degree. Thoroughly work is in a written elaboration and in iss a scientific question in Englisl	s through the topic. an oral presentation in an understandable way. h.		
Grading through: • Oral presentation and writt	en report			
Responsible for this module: • Prof. Dr. rer. nat. Christian H Teacher: • Institutes of natural science • Institutes of the Departmer	lübner nt of Computer Science/ Enginee	ring		
Language: • German and English skills r	equired			



CS1500-KP04, CS1500 - Introduction to Robotics and Automation (ERA)				
Duration:	Turnus of offer:		Credit points:	
1 Semester	each winter semester		4	
Course of study, specific field and term: Bachelor IT-Security 2016 (optional s Bachelor Biophysics 2024 (compulso Bachelor Computer Science 2019 (op Bachelor Robotics and Autonomous Bachelor Medical Informatics 2019 (op Bachelor Computer Science 2016 (op Bachelor Biophysics 2016 (compulso Bachelor Robotics and Autonomous Bachelor Robotics and Autonomous Bachelor Medical Informatics 2014 (co Bachelor CLS 2010 (optional subject) Bachelor MES 2011 (optional subject) Bachelor Computer Science 2012 (co	ubject), interdisciplinary, A ry), Elective Computer Scien stional subject), Introductor Systems 2020 (compulsory optional subject), medical co trional subject), Introductor ry), Elective Computer Scien Systems 2016 (compulsory optional subject), medical co mpulsory), specialization fi , computer science, 5th or ), medical engineering scie mpulsory), specialization fi	bitrary semester nce, 5th semester y Module Computer Science ), Robotics and Autonomo omputer science, 4th to 6th y Module Computer Science nce, 5th semester ), Robotics and Autonomou omputer science, 5th or 6th eld robotics and automatio 6th semester nce, 5th semester eld robotics and automatio	ce, 1st semester us Systems, 1st semester n semester ce, 1st semester us Systems, 1st semester n semester on, 1st semester	
Classes and lectures:		Workload:		
<ul><li>Introduction to Robotics and Autom</li><li>Introduction to Robotics and Autom</li></ul>	Introduction to Robotics and Automation (lecture, 2 SWS)     Introduction to Robotics and Automation (exercise, 1 SWS)     Introduction to Robotics and Automation (exercise, 1 SWS)			
<ul> <li>Introduction</li> <li>Control systems</li> <li>Programmable Logic Controller (PLC</li> <li>Combinatorial control</li> <li>Sequential control</li> <li>Feedback control systems</li> <li>Plants</li> <li>PID controller</li> <li>Controller parameterization</li> <li>Autonomous mobile robots</li> <li>Al-paradigms</li> <li>Elementary and emergent behaviors</li> <li>Signal acquisition and processing</li> <li>Actuators</li> <li>According to the rules of GSP of the</li> </ul>	) ; UzL			
<ul> <li>Qualification-goals/Competencies:</li> <li>The students are able to explain the principles of control systems.</li> <li>The students are able to design combinatorial and sequential control systems.</li> <li>The students are able to program simple application problems as PLC-program in the IEC-languages.</li> <li>The students are able to analyze closed-loop controlled systems (plants) and to select and parameterize a suitable feedback PID controller.</li> <li>The students are able to present the principal structure and functionality of autonomous wheel-driven robots.</li> <li>The students are able to program simple autonomous robots in a behavior-based way</li> </ul>				
Grading through: • written exam				
Responsible for this module: <ul> <li>Prof. DrIng. Mladen Berekovic</li> </ul> Teacher: <ul> <li>Institute of Computer Engineering</li> </ul>				



# Module Guide

DrIng. Kristian Ehlers	
Literature:	
<ul> <li>J. L. Jones, D. Roth: Robot Programming - A Practical Guide to Behavior-Based Robotics - New York: Mc Graw Hill 2004</li> <li>J. Knespl: Automatisierungstechnik 1 - Regelungstechnik - Köln: Stam-Verlag 1999</li> <li>R. R. Murphy: Introduction to Al Robotics - Cambridge, MA: The MIT Press 2000</li> <li>G. Wellenreuther, D. Zastrow: Automatisieren mit SPS - Theorie und Praxis - Braunschweig: Vieweg 2008</li> </ul>	
Language:	
offered only in German	
Notes:	
-Computer Science students are issued a B certificate, after having finished entire assignments including the tests and havir written exam at the end of the term.	ng passed the
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-KI	904, CS1601 - Basics of	Multimedia Systems	(MMTechnik)
Duration:	Turnus of offer:		Credit points:
1 Semester	each winter semester		4
Course of study, specific field and term Bachelor Biophysics 2016 (optional Bachelor Computer Science 2019) Bachelor Media Informatics 2020 ( Bachelor Robotics and Autonomou Bachelor Computer Science 2016 ( Bachelor Robotics and Autonomou Bachelor Robotics and Autonomou Bachelor IT-Security 2016 (optional Bachelor Media Informatics 2014 ( Bachelor Computer Science 2012 ( Bachelor CLS 2010 (optional subjet Bachelor Computer Science 2012 ( Bachelor Computer Science 2012 ( Bachelor Computer Science 2012 ( Bachelor Computer Science 2012 ( Bachelor Biophysics 2024 (optional subjet))	I subject), computer science, optional subject), major subj compulsory), media informat us Systems 2020 (optional su optional subject), major subj us Systems 2016 (optional su l subject), computer science, compulsory), media informat optional subject), central top optional subject), central top coptional subject), central top coptional subject), central top coptional subject), central top optional subject), central top coptional subject), central top coptional subject), central top compulsory), specialization f l subject), computer science,	5th semester fect informatics, Arbitrary se ics, 3rd semester ibject), media informatics, 5 fect informatics, Arbitrary se bject), computer science, 4 Arbitrary semester cics, 3rd semester bics of computer science, 5t bics of computer science, 6t mester ield media informatics, 2nd 5th semester	emester Sth or 6th semester emester th or 6th semester h semester h semester semester
Classes and lectures: • Basics of Multimedia Systems (lect • Basics of Multimedia Systems (exe	ure, 2 SWS) rcise, 1 SWS)	Workload: • 55 Hours private • 45 Hours in-class • 20 Hours exam p	studies room work reparation
Contents of teaching: • Sensation and Perception • Analog Media Technology • Digitalisation • Digital Audio, Image and Video Te • Media storage (compression / forr • Media Transmission (Broadcast / S Qualification-goals/Competencies: • Students are able to present to es • They are able to judge possibilitie • They are able to classify the condi	chnology nats) treaming) sential functions and principl s and limitations of human p tions and technologies for ca	es of multimedia systems. erception. pturing, processing, storing	g, transmitting and perception of multimedia.
<ul> <li>They can balance the specific advalation</li> <li>They are able to apply appropriate</li> </ul>	antages and disadvantages o e technical components and	f analog and digital media processes for the design of	technology. multimedia systems.
Grading through: • Written or oral exam as announce	d by the examiner		
Responsible for this module: • Prof. DrIng. Andreas Schrader Teacher: • Institute of Telematics • Prof. DrIng. Andreas Schrader			
Literature: • Thomas Görne: Tontechnik - 4. Au • Ulrich Schmidt: Professionelle Vide	flage, Hanser 2014 eotechnik - 6. Auflage, Spring	jer 2013	
Language: • English, except in case of only Ger	man-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:	Turnus of offer:	Credit points:	Max. group size:	
1 Semester	each winter semester	6	12	
Course of study, specific field • Bachelor Biophysics 20	d and term: 24 (optional subject), computer science,	5th semester		
<ul> <li>Bachelor Media informa</li> <li>Bachelor Computer Sci</li> <li>Bachelor Robotics and</li> <li>Bachelor Medical Informa</li> </ul>	ence 2019 (compulsory), computer science ence 2019 (compulsory), foundations of o Autonomous Systems 2020 (compulsory matics 2019 (compulsory), computer scie	computer science, 3rd seme computer science, 3rd seme ), computer science, 3rd sei nce, 3rd semester	ster nester	
<ul> <li>Bachelor Robotics and</li> <li>Bachelor IT-Security 20</li> <li>Bachelor Biophysics 20</li> </ul>	16 (compulsory), computer science, 3rd s 16 (optional subject), computer science,	, computer science, ard sen emester 5th semester	hester	
<ul> <li>Bachelor Computer Sci</li> <li>Bachelor Media Inform</li> <li>Bachelor Medical Inform</li> <li>Bachelor Computer Sci</li> </ul>	ence 2016 (compulsory), foundations of a atics 2014 (compulsory), foundations of c matics 2014 (compulsory), computer scie ence 2014 (compulsory), foundations of a	computer science, 3rd seme omputer science, 3rd seme nce, 3rd semester computer science, 3rd seme	ster ster	
Classes and lectures:		Workload:		
<ul> <li>Software Engineering (</li> <li>Software Engineering (</li> </ul>	(lecture, 3 SWS) (exercise, 1 SWS)	<ul> <li>100 Hours private</li> <li>60 Hours in-classre</li> <li>20 Hours exam pressure</li> </ul>	studies and exercises oom work eparation	
Contents of teaching:				
<ul> <li>overview on major field</li> <li>Software development</li> <li>Project plan and workle</li> <li>Software management</li> <li>System Analysis and re</li> <li>Basics of UML</li> <li>Software architectures</li> <li>Validation and verificat</li> </ul>	ds of software engineering t, software process models oad estimation t and quality assurance equirements analysis and design patterns tion at standards liability licenses			
	•			
Qualification-goals/Compete The students understant They can argue about in They can explain impo They can describe and They are able to model They can apply the bass They are able to apply They can discuss about	encies: nd software design as an engineering pro major software process models. rtant techniques and factors of software evaluate measures for quality ensurance I software systemson different levels of a sic concepts of object-oriented modelling design patterns in a useful way. t legal aspects of software development.	ocess. management. btraction. and design.		
Grading through:				
Written or oral exam as	s announced by the examiner			
Is requisite for:				
<ul><li>Safe Software (CS3250-</li><li>Lab Course Software Er</li></ul>	-KP08) ngineering (CS2301-KP06, CS2301)			
Requires:				
<ul> <li>Algorithms and Data St</li> <li>Introduction to Program</li> </ul>	tructures (CS1001-KP08, CS1001) mming (CS1000-KP10, CS1000SJ14)			
Responsible for this modules • Prof. Dr. Martin Leucker	r			



#### 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.



Duration:	Turnus of offer:	Credit points:
Semester	each winter semester	8
<ul> <li>Course of study, specific field and term:</li> <li>Master CLS 2023 (compulsory), ma</li> <li>Bachelor Biophysics 2024 (compulse</li> <li>Bachelor Robotics and Autonomou</li> <li>Bachelor Computer Science 2019 (computer Science 2019)</li> <li>Bachelor Computer Science 2019 (compulsory), computer Science 2019)</li> <li>Bachelor Metical Informatics 2020 (compulsory), computer Science 2014)</li> <li>Bachelor Medical Informatics 2019</li> <li>Bachelor Computer Science 2014 (computer Science 2014)</li> <li>Bachelor Computer Science 2016 (computer Science 2016)</li> <li>Bachelor Robotics and Autonomou</li> <li>Bachelor Biophysics 2016 (compulse)</li> <li>Bachelor Metical Informatics 2014</li> <li>Bachelor Metical Informatics 2014</li> </ul>	thematics, 1st semester ory), computer science, 5th semester s Systems 2020 (compulsory), Robot optional subject), major subject inforr compulsory), Canonical Specialization omputer science, 5th semester optional subject), computer science, 5 (optional subject), computer science, 5 (optional subject), computer science, compulsory), specialization field bioin compulsory), specialization field bioin compulsory), Canonical Specialization optional subject), major subject inforr compulsory), Canonical Specialization thematics, 1st semester s Systems 2016 (compulsory), Roboti subject), computer science, Arbitrary ory), computer science, 5th semester (compulsory), computer science, 5th omputer science, 5th semester	cs and Autonomous Systems, 5th semester natics, Arbitrary semester Bioinformatics and Systems Biology, 5th semester th or 6th semester 4th to 6th semester tics and automation, 5th semester formatics, 5th semester Bioinformatics, 5th semester natics, Arbitrary semester Web and Data Science, 5th semester semester to and Autonomous Systems, 5th semester semester
Classes and lectures: • Signal Processing (lecture, 2 SWS) • Signal Processing (exercise, 1 SWS) • Image Processing (lecture, 2 SWS) • Image Processing (exercise, 1 SWS)	Work • •	oad: 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 a Sampling Discrete-time signals and systems Discrete-time Fourier transform FIR and IIR filters Block diagrams FIR filter design Discrete Fourier transform (DFT) Fast Fourier transform (DFT) Fast Fourier transform (FFT) Characterization and processing of Introduction, interest of visual info 2D Sampling Image enhancement Edge detection Multiresolution concepts: Gaussiar Principles of image processing	deterministic signals Trandom signals rmation	



• Students work self-actingly and independently with regard to the roles of GSP of the University of Lübeck.
Qualification-goals/Competencies:
<ul> <li>Students are able to explain the fundamentals of linear system theory.</li> <li>They are able to define and competently explain the essential elements of signal processing mathematically.</li> <li>They will have a command of mathematical methods for the description and analysis of continuous-time and discrete-time signals and systems.</li> <li>They are able to design digital filters and know various structures for their implementation.</li> <li>They are able to explain the basic techniques for describing and processing of random signals.</li> <li>They will have basic knowledge of two-dimensional system theory.</li> <li>They are able to describe the main techniques for image analysis and image enhancement.</li> <li>They are able to apply the learned principles in practice.</li> </ul>
Grading through:
written exam
Responsible for this module:
Prof. DrIng. Alfred Mertins
Teacher:
Institute for Signal Processing
Prof. DrIng. Alfred Mertins
Literature:
<ul> <li>A. Mertins: Signaltheorie: Grundlagen der Signalbeschreibung, Filterbänke, Wavelets, Zeit-Frequenz-Analyse, Parameter- und Signalschätzung - Springer-Vieweg, 3. Auflage, 2013</li> <li>A. K. Jain: Fundamentals of Digital Image Processing - Prentice Hall, 1989</li> <li>Rafael C. Gonzalez, Richard E. Woods: Digital Image Processing - Prentice Hall 2003</li> </ul>
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





L	LS3150-KP04 - Molecular Biology (MolBioKP04)				
Duration:	Turnus of offer:		Credit points:		
1 Semester	each winter semester		4		
Course of study, specific field and term: • Bachelor Biophysics 2024 (compuls • Bachelor Biophysics 2016 (compuls	sory), Elective Chemistry/Biolo sory), Elective Chemistry/Biolo	ogy, 5th semester ogy, 5th semester			
Classes and lectures: • Molecular Biology (lecture, 2SWS) • Molecular Biology (seminar, 2 SWS)	(lecture, 2 SWS) ) (seminar, 2 SWS)	Workload: • 75 Hours private • 45 Hours in-class	studies room work		
<ul> <li>Contents of teaching:</li> <li>Lectures:Typically, 5 coherent bloc</li> <li>Basics: genetic engineering and ge</li> <li>Growth and aging: molecular procorganisms</li> <li>Nucleic-acids: molecular basis, poly</li> <li>Molecular biology of plants: molece</li> <li>Gene-therapeutic approaches and</li> <li>Conceptual design of publications</li> <li>English as lingua franca in science</li> </ul>	ks will be lectured. ene regulation esses during ontogenetic diff ymorphism, RNA-regulation. I cular basis as well as economi recombinant vaccines	erentiation, maintenance a Diagnostic and possible the c and ecological aspects of	and loss of function during aging of cells and erapeutic aspects f transgenic plants and herbicide resistance		
<ul> <li>Qualification-goals/Competencies:</li> <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>					
Responsible for this module:					
Teacher:         • Institute of Virology and Cell Biology         • Department of Neurosurgery         • Institute of Medical and Marine Biotechnology         • Dr. rer. nat. Olaf Isken         • Prof. Dr. rer. nat. Norbert Tautz         • PD Dr. rer. nat. Christina Zechel					
Literature: • Alberts et al.: Molecular Biology of Cells - Garland Science • Lodish et al.: Molecular Cell Biology - Freeman • Buchanan et al.: Biochemistry and Molecular Biology of Plants - Wiley Verlag • : Versuchsanleitungen • : Course script					
<ul><li>Language:</li><li>• offered only in German</li></ul>					
Notes:					



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 E	ngineering (TissueEng)
Duration:	Turnus of offer:	Credit points:
1 Semester	each winter semester	5
Course of study, specific field an <ul> <li>Bachelor Molecular Life Scie</li> <li>Bachelor Biophysics 2016 (a</li> </ul> Classes and lectures: <ul> <li>Tissue Engineering (seminering)</li> </ul>	d term: ence 2024 (optional subject), life scie optional subject), life sciences, 5th se	ences, 5th semester emester Workload:
<ul><li>Tissue Engineering (seminal</li><li>Tissue Engineering (lecture)</li></ul>	, 2 SWS)	<ul><li>90 Hours private studies</li><li>60 Hours in-classroom work</li></ul>
Contents of teaching: Lectures:Mamalia cells in th Aging of cells in vitro Established cell lines Diverse in vitro culturing co Proliferation and differentia Stem cell biology Materials for medical applie Fermentors, bioreactors an Home work e. g. Tissue tra Practical course (in groups autoclaves Preparation of sterile media Slicing of tissue samples, tr Microscopy and document Cell count, passaging by try Viability test, freezing of ce Adherence of cells to vario	neir natural environment and under in ponditions ation under in vitro conditions cations an biotechnology d protein purification ansplantation and rejection of 2):Principles of aseptic manipulati a, additives and other reagents ansfer into tissue culture flasks for ex ation of growing cells /psinisation lls and reseeding after thawing us matrices ntracellular and extracellular protein	in vitro culture as an example of industrial application. ions, working in sterile containments, object and selfprotection, use of xplant cultures
Qualification-goals/Competencie Students are able to explain They are able to explain ba They are able to explain ba They can reproduce the as They acquire the ability to They improve their competent Grading through:	es: n principles of cell- and tissue culture sic principles of pro- and eukaryotic sic principles of organoid biology pects of stem cell biology assess ethical aspects of tissue engin tence for correct documentation and	e to generate biocomposites from differentiated and pluripotent cells gene expression systems neering d team working skills
• written exam		
Responsible for this module: • Prof. Dr. rer. nat. Charli Krus Teacher: • Institute of Medical and Ma • • Department of Dermatolog • Institute of Virology and Ce • Prof. Dr. rer. nat. Charli Krus	e rine Biotechnology y, Allergology and Venerology Il Biology	



Dr. rer. nat. Philipp Ciba
Prof. Dr. med. vet. Jennifer Hundt
Prof. Dr. med. Ralf Ludwig
• Dr. rer. nat. Olaf Isken
Dr. med. Dipl. Biol. Judith Sewing
terature:
Lanza, Langer, Vacanti: Principles of Tissue Engineering
inguage:
offered only in German
otes:
Knowledge in Cell biology is a prerequisite for this course. Entrance requirement for the practical course: certificate of the course Biochemistry 1 or 2.





	LS3252-KP05 - Metaboli	LS3252-KP05 - Metabolic Medicine (MetabolMed)				
Duration:	Turnus of offer:		Credit points:			
1 Semester	each winter semester		5			
Course of study, specific field and to • Bachelor Molecular Life Scienc • Bachelor Biophysics 2024 (opt • Bachelor Biophysics 2016 (opt	<b>erm:</b> e 2024 (optional subject), life scie ional subject), life sciences, 5th se ional subject), life sciences, 5th se	ences, 5th semester emester emester				
Classes and lectures: • Metabolic Medicine (lecture, 2 • Tissue Engineering (seminar w	lasses and lectures:Workload:• Metabolic Medicine (lecture, 2 SWS)• 90 Hours private studies• Tissue Engineering (seminar with practical exercises, 2 SWS)• 60 Hours in-classroom work					
Contents of teaching: Metabolic physiology glucose metabolism & diabete lipid metabolism & obesity, ad gastroenterology thyroid central appetite regulation circadian clocks & metabolism sleep & metabolism	es lipokines					
Qualification-goals/Competencies: • Understanding the principles • Understanding physiological i • Students know the symptoms	of energy homeostasis nteractions of different compartn of major metabolic disorders and	nents in the context of ene I their pathophysiological c	rgy metabolism causes			
Grading through: • written exam						
Requires: • Biochemistry 1 (LS2000-KP06) • Physiology (MZ2200-KP06)						
Responsible for this module: Prof. Dr. rer. nat. Henrik Oster Teacher: Institute of Neurobiology Institute for Experimental Ender Prof. Dr. rer. nat. Henrik Oster Dr. rer. nat. Violetta Pilorz Dr. rer. nat. Isabel Heyde Dr. rer. nat. Rebecca Ölkrug Dr. rer. nat. Carla Schulz Prof. Dr. rer. nat. Jens Mittag PD Dr. Britta Wilms	ocrinology					
Literature: • Keith N. Frayn: Metabolic Regu	ılation: A Human Perspective - W	iley & Blackwell, 2010				
Language: • German and English skills requ Notes:	iired					
Notes:						



Principle knowldege 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 - Biop	hysics of lonizing Rac	liation and Radiation	n Safety (StrahlenSk)		
Duration:	Turnus of offer:		Credit points:		
1 Semester	each semester		5		
<ul> <li>Course of study, specific field and term:</li> <li>Bachelor Biophysics 2024 (compulsory), life sciences, 5th semester</li> <li>Master Molecular Life Science 2023 (optional subject), interdisciplinary competence, 2nd semester</li> <li>Master MLS 2018 (optional subject), interdisciplinary competence, 2nd semester</li> <li>Bachelor Biophysics 2016 (compulsory), life sciences, 5th semester</li> <li>Master MLS 2016 (optional subject), interdisciplinary competence, 1st or 2nd semester</li> </ul>					
Classes and lectures:       Workload:         • Biophysics of Ionizing Radiation and Radiation Safety (lecture, 2 SWS)       • 60 Hours private studies         • Biophysics of Ionizing Radiation and Radiation Safety (practical course, 2 SWS)       • 60 Hours in-classroom work         • 30 Hours exam preparation			studies room work reparation		
<ul> <li>Contents of teaching:</li> <li>Physics of ionizing radiation</li> <li>Basic principles of dosimetry</li> <li>Introduction to methods of radiation measurement</li> <li>Radiation biology: principles of radiation damage, deterministic and stochastic effects, health risks caused by ionizing radiation</li> <li>Radiation chemistry, handling of open and enclosed radioactive materials</li> <li>Safety requirements in radionuclide laboratories</li> <li>Application of radionuclides in research and medicine</li> <li>German and international laws and regulations dealing with radiation safety</li> </ul>					
<ul> <li>Qualification-goals/Competencies:</li> <li>The students will have acquired in de able to implement these regulations decontamination</li> <li>They are able to safely handle open a</li> <li>They are able to work in radiation preserved and the students will acquire the requisite (upon fulfillment of other regulatory)</li> </ul>	epth knowledge of the lega in all relevant situations: Pu and enclosed radioactive co otection areas in complianc ty, calculate radiation doses ing radioactive materials, id re qualification (Fachkunde) requirements) to perform a	l regulations concerning the irchase, transport, storage mpounds e with legal regulations and evaluate the results v entify and meet the neces according to German law s a radiation safety officer	he work with radioactive materials and are , experimental use, disposal and with respect to legal thresholds and biological ssary safety precautions and establish a r (RöV and StrlSchV). This will qualify them according to German law.		
Grading through: <ul> <li>written exam</li> </ul>					
Responsible for this module: • Prof. Dr. rer. nat. Christian Schmidt Teacher: • Institute of Medical Engineering • Institute of Biochemistry • Institute for Biology • Institute of Physics • Isotopes laboratory • Prof. Dr. rer. nat. Christian Schmidt • Prof. Dr. rer. nat. Christian Hübner					

• Prof. Dr. rer. nat. Magdalena Rafecas



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

#### Literature:

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

#### Language:

• offered only in German

#### Notes:

Admission requirements for taking the module:

- Participation in the radiation protection instruction

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

Module examination(s):

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

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

Only by passing the German examination is it possible to obtain the certificate of professional competence!

Prerequisite for the award of the certificate of proficiency: Attendance during the entire course (In justified exceptional cases, a maximum absence of 10% of the lecture time is permitted) and at least 70% of the points in the written examination.

If less than 70% but more than 50% of the points are achieved, a written or oral re-examination will be offered promptly at the discretion of the module coordinator. If the re-examination is passed, the certificate of specialist knowledge will be awarded. In this case, only the result of the first examination is decisive for the grade on the certificate of achievement.

The Guideline on the technical knowledge required in radiation protection (technical knowledge guideline according to the Radiation Protection Ordinance) in the currently valid version is decisive for the implementation of the course and the issuing of the certificates of technical knowledge.



MZ2200-KP06 - Physiology (PhysioKP06)				
Duration:	Turnus of offer:		Credit points:	
1 Semester	each winter semester		6	
Course of study, specific field and term: Bachelor Biophysics 2024 (compulso Bachelor Nutritional Medicine 2024 Bachelor Molecular Life Science 202 Bachelor MLS 2018 (compulsory), lift Bachelor Nutritional Medicine 2018 Bachelor MLS 2016 (compulsory), lift Bachelor Nutritional Medicine 2016 Bachelor Biophysics 2016 (compulsor)	ory), life sciences, 5th semest (compulsory), life sciences, 3 4 (compulsory), life sciences e sciences, 3rd semester (compulsory), life sciences, 3 e sciences, 3rd semester (compulsory), life sciences, 5 bry), life sciences, 5th semest	ter Brd semester , 3rd semester Brd semester Brd semester ter		
Classes and lectures:		Workload:		
<ul> <li>Physiology (lecture, 4 SWS)</li> <li>Physiology (seminar, 1 SWS)</li> </ul>		<ul><li>120 Hours private</li><li>60 Hours in-class</li></ul>	≥ studies room work	
<ul> <li>Contents of teaching:</li> <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 sleen</li> </ul>				
<ul> <li>Qualification-goals/Competencies:</li> <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 interprete the physiological functions in a scientific way.</li> </ul>				
Grading through: • written exam				
Responsible for this module:         • Prof. Dr. rer. nat. Henrik Oster         • Institute of Neurobiology         • Prof. Dr. rer. nat. Henrik Oster         • Dr. rer. nat. Violetta Pilorz				
Literature: • Schmidt et al.: Physiolologie des Menschen - Springer, Heidelberg • Rhoades et al.: Medical Physiology - Lippincott Raven, Philadelphia • Speckmann et al.: Physiologie - Elsevier, Amsterdam				
Language: • offered only in German				
Notes:				



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





F	Y1200-KP04, PY1200-MIW -	General Psycholog	у 1 (АРКР04)
Duration:	Turnus of offer:		Credit points:
1 Semester	each winter semester		4
Course of study, specific field at Bachelor MES 2014 (option Master MES 2014 (option Master MES 2020 (option Bachelor MES 2020 (option Bachelor Biophysics 2016	n <b>d term:</b> nal subject), no specific field, Arbitra I subject), no specific field, 1st or 2n I subject), interdisciplinary, Arbitrary nal subject), interdisciplinary, Arbitra (optional subject), no specific field, 5	ry semester d semester / semester ary semester 5th semester	
Classes and lectures:		Workload:	
General Psychology 1 (lect	ture, 2 SWS)	<ul><li>90 Hours private studies and exercises</li><li>30 Hours in-classroom work</li></ul>	
Contents of teaching:			
<ul> <li>Acquisition of basic know</li> <li>Teaching of basic ideas, co</li> <li>Learning basic principles of</li> <li>Understanding and judgm</li> </ul>	edge in the topics perception, actio oncepts and theories of perception a of experimental psychology work for nent of basic ideas, theories and met	n, cognition and langua and cognitive psycholog r planning and conducti thods of perception, cog	ge y ng experiments nition and language
Qualification-goals/Competence • Students can explain and • They can translate psycho • They can use their knowle • They have acquired social • They have acquired self-co scientific literature. • They can structure newly	ies: apply psychological concepts in the logical research questions into empi dge in basic psychological research competence through discussion ski ompetence in the areas of concentra acquired knowledge themself.	areas of perception, act irical research. to scientifically reason, t ills and knowledge trans ated absorption of know	ion, cognition and language. hink and discuss. fer. ledge, critical reflection and dealing with
Grading through: • written exam			
Responsible for this module: • Prof. Dr. rer. nat. Ulrike Krä Teacher: • Institute of Medical Psycho • Prof. Dr. rer. nat. Ulrike Krä • Dr. rer. nat. DiplPsych. Fro	imer ology imer ederike Beyer		
Goldstein: Wahrnehmung     Müsseler (Hrsg.): Allgemei     Anderson: Kognitive Psych	spsychologie - Spektrum, 2007 ne Psychologie - Spektrum, 2007 nologie (7. Auflage) - Springer, 2013		
Language: • offered only in German			
Notes:			
Prerequisites for attending t - None	he module:		
Prerequisites for the exam: - Preliminary examinations c completed and positively as	an be determined at the beginning sessed before the initial examinatior	of the semester. If prelin n.	ninary work has been defined, it must have been



BP3900 T - Advanced Practical Course Biophysics (FortPrakBP)			
Duration:	Turnus of offer:		
1 Semester	each summer semester		
Course of study, specific field and terms • Bachelor Biophysics 2024 (Module • Bachelor Biophysics 2016 (Module	: part of a compulsory module part of a compulsory module	), physics, 6th semester ), biophysics, 6th semester	
Classes and lectures: • Advanced Practical Course Biophy	sics (practical course, 3 SWS)	Workload: • 120 Hours work on project	
<ul> <li>Contents of teaching:</li> <li>Familiarization with a scientific top</li> <li>Collaboration in current research p</li> <li>Evaluation and analysis of measure</li> <li>Documentation and presentation</li> </ul>	bic projects of the supervising ins ement data of research results, according	titute to the guidelines of good scientific practice of the UZL.	
Qualification-goals/Competencies: <ul> <li>The students master the handling</li> <li>They are able to correctly assess w</li> <li>They can correctly evaluate, analyz</li> <li>They can document and present re</li> <li>They know the rules of good scient</li> </ul>	of laboratory equipment ork allocation and requireme ze, and interpret research resu esearch results itific practice	nts Ilts/data.	
Grading through: • continuous, successful participatio	n in practical course		
Responsible for this module: • Prof. Dr. rer. nat. Christian Hübner Teacher: • Institute of Physics • MitarbeiterInnen des Instituts			
Literature: • : Scientific publications - Scientific	publications		
Language: • offered only in German			





BP3990-KP12 - Bachelorarbeit Biophysik (BABP)				
Duration:	Turnus of offer:		Credit points:	
1 Semester	each semester		12	
Course of study, specific field and term: • Bachelor Biophysics 2024 (compulso • Bachelor Biophysics 2016 (compulso	ry), biophysics, 6th semeste ry), biophysics, 6th semeste	ır ır		
Classes and lectures: <ul> <li>Bachelor Thesis (supervised self studies, 1 SWS)</li> <li>Colloquium (presentation (incl. preparation), 1 SWS)</li> </ul>		Workload: • 360 Hours private studies		
Contents of teaching: •				
<ul> <li>Qualification-goals/Competencies:</li> <li>Ability to solve a preformulated simple defende the experimental results wit DFG-guidelines.</li> <li>They can answer expert questions of They can present complex content in</li> </ul>	pel scientific problem mostl h regardto the roles of Goo n their subject understand. n written and oral presenta	y independent in a defined d Scientific Practice (GSP) d tions.	d period of time and to present and of the University of Lübeck and of the	
Grading through: • Written report				
Responsible for this module:         • Studiengangsleitung         Teacher:         • Institutes of natural science         • Alle prüfungsberechtigten Dozentinnen/Dozenten des Studienganges				
Literature: • Topical literature about the subject:				
Language: • thesis can be written in German or E	nglish			
Notes: Prerequisites for the module: - Minimum of 120 ECTS Prerequisites for admission to the writt	ten examination:			
- successful work of a topic of MLS Module exam: - BP3990-L1: Bachelor Thesis MLS, writt grade	ten documentation of a pra	ctical work of an MLS topic	c and colloquium, 60 min, 100 % module	
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.				
Thesis must be written in German. Except: if the examinator is an English nativ speaker				



Γ

С\$1020-КР05 - Іі	ntroduction Into Data	bases and Systems Bi	iology (EinfDBSB)	
Duration:	Turnus of offer:		Credit points:	
1 Semester	each summer semester		5	
Course of study, specific field and term: Bachelor Biophysics 2024 (compulse Bachelor Nutritional Medicine 2024 Bachelor Molecular Life Science 2022 Bachelor MLS 2018 (compulsory), co Bachelor Nutritional Medicine 2018 Bachelor MLS 2016 (compulsory), co Bachelor Biophysics 2016 (compulsor Bachelor Nutritional Medicine 2016	ory), bioinformatics, 6th sem (compulsory), life sciences, 6 4 (compulsory), life sciences mputer science, 6th semest (compulsory), computer scie mputer science, 6th semest ory), bioinformatics, 6th sem (compulsory), computer scie	ester oth semester , 6th semester er er er ester ence, 6th semester		
Classes and lectures: • Introduction into databases and sys	tem biology (lecture, 2	Workload: • 75 Hours private	studies	
<ul> <li>SWS)</li> <li>Introduction into databases and sys SWS)</li> <li>Introduction into databases and sys course, 1 SWS)</li> </ul>	tem biology (exercise, 1 tem biology (practical	<ul><li>45 Hours in-classi</li><li>30 Hours exam pi</li></ul>	room work reparation	
Contents of teaching: • Entity-Relationship-Models • Relation algebras • Database systems • Structured query language • bio-databases • Basic terms of system biology • Cellular networks				
<ul> <li>Qualification-goals/Competencies:</li> <li>Students can create databases, manage them and create complex database queries.</li> <li>They can explain the basic terms of system biology and classify them correctly.</li> <li>Students know different bio-databases and can use and access them to solve problems from bioinformatics and system biology.</li> </ul>				
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. Hauke Busch				
<ul> <li>Literature:</li> <li>Edda Klipp et al.: Systems Biology - A Textbook - Weinheim Wiley-VCH Verlag GmbH &amp; Co. KGaA [2016]</li> <li>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.</li> <li>Gumm, Sommer: Einführung in die Informatik - 2012, De Gruyter Studium Kemper</li> <li>Kemper, Eickler: Datenbanksysteme: Eine Einführung - 2015, De Gruyter Studium</li> </ul>				
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



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		intais of Computer Er	
Juration:	i urnus of offer:		
1 Semester	each summer semester		6
Course of study, specific field and term: Bachelor MES 2020 (compulsory), com Bachelor Media Informatics 2020 (com Bachelor Computer Science 2019 (cor Bachelor Robotics and Autonomous S Bachelor Medical Informatics 2019 (op Bachelor Computer Science 2016 (cor Bachelor Computer Science 2016 (cor Bachelor Robotics and Autonomous S Bachelor IT-Security 2016 (compulsor Bachelor Biophysics 2016 (optional su Bachelor Medical Informatics 2014 (cor Bachelor Media Informatics 2014 (cor Bachelor MES 2014 (compulsory), four Bachelor Computer Science 2014 (cor Bachelor Biophysics 2024 (optional su	nputer science, 4th semes npulsory), computer scien npulsory), foundations of ystems 2020 (compulsor potional subject), computer npulsory), foundations of ystems 2016 (compulsory y), computer science, 2nd bject), computer science, npulsory), computer scien ndations of computer scien npulsory), foundations of bject), computer science,	ter ce, 2nd semester computer science, 2nd ser y: aptitude test), computer r science, 4th to 6th semes computer science, 2nd ser r: aptitude test), computer semester 6th semester ence, 2nd semester ce, 2nd semester cence, 4th semester computer science, 2nd ser 6th semester	nester science, 2nd semester ter nester science, 2nd semester nester
Classes and lectures:		Workload:	
<ul> <li>Fundamentals of Computer Engineer</li> <li>Fundamentals of Computer Engineer</li> </ul>	ng 1 (lecture, 2 SWS) ng 1 (exercise, 2 SWS)	<ul> <li>100 Hours privat</li> <li>60 Hours in-class</li> <li>20 Hours exam p</li> </ul>	te studies sroom work preparation
<ul> <li>Switching algebra and switching func</li> <li>Technological realization</li> <li>Combinatorial and sequential circuits</li> <li>Memories</li> <li>Microprocessors</li> <li>Assembler programming</li> <li>Microcontrollers</li> <li>Input/Output programming</li> <li>Basic processor architectures</li> </ul>	Tions		
Qualification-goals/Competencies:			
<ul> <li>The students can explain the principal principle.</li> <li>They can elucidate the principal funct algebra.</li> <li>They can demonstrate the basic circu</li> <li>They can explain the structure and op</li> <li>They can elucidate the instruction set</li> <li>Sie können die Ein/Ausgabe-Schnittst bzw. Interrupt).</li> <li>They can program microcontrollers for</li> <li>They can discuss and compare basic part</li> </ul>	l organization of a compu- cioning of combinatorial a its for the technological re- peration of registers and n of a microprocessor exer ellen eines Mikrocontrolle or simple applications in a processor architectures an	iter and the execution of a nd sequential circuits and ealization of logic gates wi nemories. nplarily and to be able to u ers beschreiben und in Ass ssembly language. id their instruction sets.	program according to the Von-Neumann describe them formally using switching th bipolar and MOS transistors. use it for assembly programming. emblersprache programmieren (mit Polling
Grading through: • written exam			
Is requisite for:			
<ul> <li>Embedded Systems (CS2101-KP04, CS</li> <li>Computer Architecture (CS2100-KP04</li> <li>Fundamentals of Computer Engineeri</li> </ul>	2101) , CS2100SJ14) ng 2 (CS1202-KP06, CS12	02)	



Responsible for this module:
Prof. DrIng. Mladen Berekovic
Teacher:
Institute of Computer Engineering
DrIng. Kristian Ehlers
Literature:
• C. Hamacher, Z. Vranesic, S. Zaky, N. Manjikian: Computer Organisation and Embedded Systems - McGraw-Hill 2012
<ul> <li>M. M. Mano, C. K. Kime: Logic and Computer Design Fundamentals - Pearson 2007</li> <li>D. A. Batterran, J. L. Hannessin Computer Organization &amp; Design The Hardware (Software Interface). Margan Keyfmann 2011</li> </ul>
<ul> <li>T. Ungerer, U. Brinkschulte: Mikrocontroller und Mikroprozessoren - Springer 2010</li> </ul>
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:	Turnus of offer:	Credit points:			
1 Semester	each summer semester	4			
Course of study, specific field and term:					
<ul> <li>Bachelor Robotics and Autonomous Systems 2020 (optional subject), Additionally recognized elective module, Arbitrary semester</li> <li>Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester</li> <li>Bachelor MES 2020 (optional subject), computer science / electrical engineering, 3rd semester at the earliest</li> <li>Bachelor Computer Science 2016 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Computer Science 2016 (optional subject), canonical Specialization SSE, 6th semester</li> <li>Bachelor Computer Science 2016 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Computer Science 2016 (optional subject), Canonical Specialization SSE, 6th semester</li> <li>Bachelor Computer Science 2016 (optional subject), Canonical Specialization SSE, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor IT-Security 2016 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), computer science, 6th semester</li> <li>Bachelor Computer Science 2014 (optional subject), central topics of computer science, 6th semester</li> <li>Bachelor Computer Science 2014 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2011 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2011 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2011 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2011 (optional subject), compu</li></ul>					
		·····			
Classes and lectures:       Workload:         • Embedded Systems (lecture, 2 SWS)       • 60 Hours private studies and exercises         • Embedded Systems (exercise, 1 SWS)       • 45 Hours in-classroom work         • 15 Hours exam preparation					
<ul> <li>Target architectures (microcontrollers, FPGAs etc.)</li> <li>Conceptional models</li> <li>Peripheral buses</li> <li>Scheduling algorithms and real-time operating systems</li> <li>Specification languages</li> <li>Transformation from specification to implementation</li> <li>Development tools</li> </ul>					
<ul> <li>Qualification-goals/Competencies:</li> <li>Students are able to explain the differences between desktop systems and embedded systems.</li> <li>They are able to select an appropriate hardware architecture for an embedded system.</li> <li>They are able to select appropriate communication protocols for interfacing peripheral components.</li> <li>They are able to control peripheral components with a microcontroller.</li> <li>They are able to model embedded systems conceptually and to specify them formally.</li> <li>They are well acquainted with the model-based design and tool-based implementation and of simple embedded systems.</li> <li>They can independently implement the specifications of the embedded system through C programming</li> <li>They can use real-time operating systems to implement embedded systems with real-time capability and deterministic time behavior</li> </ul>					
Grading through:					
• written exam					
Requires: • Introduction to Programming (CS1000-KP10, CS1000SJ14) • Fundamentals of Computer Engineering 1 (CS1200-KP06, CS1200SJ14)					
Responsible for this module: • Prof. DrIng. Mladen Berekovic	Responsible for this module:         • Prof. DrIng. 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: Turnus of offer: Credit points:				
1 Semester	each winter semester 4			
Course of study, specific field and term: Bachelor Biophysics 2024 (optional subject), computer science, 6th semester Bachelor MES 2020 (optional subject), computer science, 5th semester 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 Computer Science 2019 (compulsory), foundations of computer science, 5th or 6th semester Bachelor Robotics and Autonomous Systems 2020 (optional subject), computer science, 5th or 6th 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 Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester Bachelor Robotics and Autonomous Systems 2016 (optional subject), computer science, 5th or 6th semester Bachelor Rescurity 2016 (compulsory), computer science, 3rd semester Bachelor Res 2011 (optional subject), computer science, 6th semester Bachelor Metical Informatics 2014 (compulsory), computer science, 4th semester Bachelor Metical Informatics 2014 (compulsory), computer science, 4th semester Bachelor Metical Informatics 2014 (compulsory), foundations of computer science, 4th semester Bachelor Metical Informatics 2014 (compulsory), computer science, 4th semester Bachelor Metical Informatics 2014 (compulsory), foundations of computer science, 4th semester Bachelor Metical Informatics 2014 (compulsory), foundations of computer science, 4th semester Bachelor Metical Informatics 2014 (compulsory), computer science, 4th semester Bachelor Medical Informatics 2014 (compulsory), computer science, 2nd semester Bachelor Medical Informatics 2011 (compulsory), computer science, 2nd semester Bachelor Metical Informatics 2011 (compulsory), computer science, 2nd semester Bachelor				
Classes and lectures:		Workload:		
<ul> <li>Databases (lecture, 2 SWS)</li> <li>Databases (exercise, 1 SWS)</li> </ul>	e, 2 SWS) • 55 Hours private studies se, 1 SWS) • 45 Hours in-classroom work • 20 Hours exam preparation			
Contents of teaching:				
<ul> <li>Introduction, conceptual vie</li> <li>The relational data model* and relationships into the re Database normalization, clo decomposition of relation s</li> <li>Practical query language: Se management* Integrity cor</li> <li>Storage structures and data manager, buffer manager, f</li> <li>Query processing* Indexing selection trees, query execu- partition-based join with ha</li> <li>Datalog* Syntax, semantics</li> </ul>	ew of database systems, conceptua Referential integrity, keys, foreign k elational data model* Update, inser isure w.r.t. FD set, canonical cover of chemata, multi-value dependencie QL* Selection, projection, join, aggr istraints base architecture* Characteristics of iles and access methods, record allo techniques, ISAM index, B+-tree in tion plans, join operator: nested lo ishing* Addition operators: groupin treatment of negation (stratification patrics).	al data modeling with the Entity-Relationship (ER) modeling language keys, functional dependencies (FDs)* Canonical mapping of entity types ertions, and deletion anomalies* Relational algebra as a query language* of FD sets, normal forms, correct and dependency preserving es, inclusion dependencies regation, grouping, sorting, difference, relational algebra in SQL* Data of storage media, I/O complexity* DBMS architecture: disk space location strategies (row-wise, column-wise, mixed) index, hash index* Sorting: Two-way merge sort, blockwise processing, pops join, blockwise nested loops join, index-based joins, sort-merge join, ing and duplicate elimination, selection, projection, pipeline principle ion)* Evaluation strategies (naive, semi naive, magic set transformation) diate tables selectivity* loin optimization, physical plan properties		

- 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.

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### Grading through:

### • written exam

### Is requisite for:

• Nonstandard Databases and Data Mining (CS3130-KP08)



Nonstandard Database Systems (CS3202-KP04, CS3202)
Requires:
<ul> <li>Algorithms and Data Structures (CS1001-KP08, CS1001)</li> <li>Introduction to Programming (CS1000-KP08, CS1000SJ14-MML/MI, CS1000SJ14-MIW)</li> <li>Introduction to Programming (CS1000-KP10, CS1000SJ14)</li> </ul>
Responsible for this module:
Prof. Dr. Sven Groppe
Teacher:
Institute of Information Systems
Prof. Dr. Sven Groppe
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 (KI1)					
Duration:	Turnus of offer:		Credit points:		
1 Semester	each summer semester		4		
Course of study, specific	Course of study, specific field and term:				
<ul> <li>Course of study, specific field and term:</li> <li>Bachelor Biophysics 2024 (optional subject), computer science, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2020 (compulsory), Robotics and Autonomous Systems, 6th semester</li> <li>Bachelor Computer Science 2019 (optional subject), major subject informatics, Arbitrary semester</li> <li>Bachelor Media Informatics 2020 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Medical Informatics 2019 (optional subject), computer science, 4th to 6th semester</li> <li>Bachelor Computer Science 2016 (optional subject), major subject informatics, Arbitrary semester</li> <li>Bachelor Computer Science 2016 (compulsory), Canonical Specialization Web and Data Science, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 6th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), Robotics and Autonomous Systems, 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Computer Science 2014 (optional subject), computer science, 5th or 6th semester</li> <li>Bachelor Computer Science 2014 (optional subject), central topics of computer science, 6th semester</li> <li>Bachelor Computer Science 2014 (optional subject), central topics of compu</li></ul>					
Bachelor Compute	r Science 2012 (optional subject), central to	pics of computer science, 5	ith or 6th semester		
<b>Classes and lectures:</b>		Workload:			
<ul><li>Artificial Intelligence</li><li>Artificial Intelligence</li></ul>	ce (lecture, 2 SWS) ce (exercise, 2 SWS)	<ul><li>55 Hours private</li><li>45 Hours in-clas</li><li>20 Hours exam (</li></ul>	e studies sroom work preparation		
Contents of teaching:					
<ul> <li>Part 1: Search strat introduced and exp concept of agents</li> <li>Part 2: Learning an (supervised and ur</li> <li>Part 3: Applications processing are identified</li> </ul>	egiesAs an introduction and a prerequisite olained. We will introduce uninformed, info will be presented. d reasoningRevision of the foundations of r supervised) are introduced. An introduction s of artificial intelligenceTypical applications ntified. Ethical issues and risks of the develo	for most of the principles o rmed, local search, adversia nathematical logic and pro n to fuzzy logic is also inclu s in the fields or robotics, m pment of artificial intellige	f artificial intelligence search strategies are al search as well as heuristic search. The obability. Principles of machine learning ded. nachine vision, and industrial image and data nce are discussed.		
Oualification-goals/Com	petencies:				
<ul> <li>The students are able to handle scope-oriented tutorials with a mathematical background in a team, and timely.</li> <li>They have developed an understanding for the benefits and disadvantages of the different search and problem solving techniques.</li> <li>The students are in a position to choose and apply independently appropriate algorithms for search and learning issues.</li> <li>They have gained an insight into the complex development of systems with artificial intelligence and the distinction of its various forms.</li> <li>The students have an understanding of the risks and possible technological consequences of the development of systems with strong Al.</li> </ul>					
Grading through:					
• portfolio exam					
Requires:					
<ul> <li>Analysis 2 (MA250)</li> <li>Algorithms and Da</li> </ul>	)-KP04, MA2500) ta Structures (CS1001-KP08, CS1001)				



Responsible for this module:
Prof. Dr. rer. nat. Floris Ernst
Teacher:
Institute for Robotics and Cognitive Systems
<ul> <li>MitarbeiterInnen des Instituts</li> <li>Prof. Dr. rer. nat. Floris Ernst</li> </ul>
Literature:
<ul> <li>G. Görz (Hrsg.): Handbuch der Künstlichen Intelligenz - München: Oldenbourg Wissenschaftsverlag, 2003</li> <li>C-M. Bishop: Pattern Recognition and Machine Learning - Springer Verlag, 2007</li> <li>Russell/Norvig: Artificial Intelligence: a modern approach - (3rd Ed.), Prentice Hall, 2009</li> <li>Mitchell: Machine Learning - McGraw-Hill, 1997</li> <li>Luger: Artificial Intelligence: Structures and Strategies for Complex Problem Solving - (6th Ed.), Addison-Wesley, 2008</li> </ul>
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.
Moduel Exam(s): - CS3204-L1: Artificial Intelligence, Portfolio examination, 100% of the module grade
Note: The portfolio examination consists of: 70 points in the form of a written examination at the end of the semester, 15 points in the form of semester-accompanying programming tasks (group and individual performance), 15 points in the form of semester-accompanying e-tests (individual performance)



CS4340-KP04, CS4340SJ14 - Health Economy (GOEK14)			
Duration:	Turnus of offer:	Credit points:	
1 Semester	every summer semester	4	
Course of study, specific field Bachelor MES 2020 (op Master Medical Informa Bachelor Biophysics 20 Bachelor MES 2014 (op	<b>J and term:</b> tional subject), medical engineering scier atics 2019 (advanced module), medical co 16 (optional subject), no specific field, 6th tional subject), medical engineering scier	nce, 3rd semester at the earliest omputer science, 1st or 2nd semester n semester nce, 4th or 6th semester	
Master Medical Information	atics 2014 (compulsory), medical computer	er science, 1st or 2nd semester	
Classes and lectures:Workload:• CS4340-V: Health Economy (lecture, 2 SWS)• 55 Hour• CS4340-Ü: Health Economy (exercise, 1 SWS)• 45 Hour• 20 Hour		<ul> <li>Workload:</li> <li>55 Hours private studies and exercises</li> <li>45 Hours in-classroom work</li> <li>20 Hours exam preparation</li> </ul>	
Contents of teaching:			
course, the basics of di are programmed in sui Microsoft EXCEL as we planned. The use of ot practical examples will PART 1: BASICS OF HEA Relevance and objectiv Forms of study Cost types Effectiveness measures Decision analyses Sensitivity analyses Evaluation of digital he PART 2: DECISION ANA Decision trees Markov cohort models Microsimulations Mathematical models (	fferent types of modeling for conducting table software using practical examples. I as the programming of microsimulation ner software products or programming la be worked on, dealing in particular with NLTH ECONOMIC EVALUATIONS res of economic evaluation in the context sealth applications LYTICAL MODELING	health economic evaluations are explained and corresponding models The programming of decision trees and Markov cohort models in is and epidemiological models (based on differential equations) in R is nguages can be discussed during the course. In addition, exercises with modeling. to of healthcare	
Qualification-goals/Compete PART 1: FUNDAMENTA They know the different They can explain types They know different m They know how to com They know the steps o They can assess the su analyses by changing a They can apply the know products and procedur PART 2: DECISION ANA	encies: LS OF HEALTH ECONOMIC EVALUATIONS at forms of health economics studies and of costs and measurement approaches for easures of effectiveness and discuss the r duct cost-effectiveness analyses for medi f decision analysis and can carry out corre- itability of data sources for health econor assumptions and data sources. weldge they have acquired to analyze ar res. LLYTICAL MODELING	can differentiate between them. or determining them in health economic studies. espective advantages and disadvantages. cal interventions / health programs. esponding analyses on the basis of evaluation results. nic studies, reflect on parameter assumptions and carry out sensitivity nd critically assess specific studies on the cost-effectiveness of medical	
<ul> <li>They know the strengt application examples.</li> <li>They can develop deci- specific application examples.</li> <li>They can use the abov.</li> <li>They can program algo software and carry out</li> </ul>	sion trees, Markov models, microsimulation amples and program them in suitable soft e-mentioned model types to carry out he prithms for univariate, multivariate and pr corresponding analyses.	es and are able to make an appropriate model selection for specific ons and epidemiological models (based on differential equations) for tware. alth economic evaluations. obabilistic sensitivity analyses (Monte Carlo simulations) in suitable	

They can calibrate epidemiological models using epidemiological data.



Grading through:
written exam
Responsible for this module:
Prof. Dr. Alexander Kuhlmann
Teacher:
Institute for Social Medicine and Epidemiology
Prof. Dr. Katrin Balzer
Prof. Dr. Alexander Kuhlmann
Literature:
<ul> <li>Fleßa S, Greiner W: Grundlagen der Gesundheitsökonomie - Eine Einführung in das wirtschaftliche Denken im Gesundheitswesen - 4. aktualisierte Auflage. Berlin: Springer Gabler 2020 (978-3-662-62115-8)</li> </ul>
<ul> <li>Schöffski O, Graf von der Schulenburg JM (Hrsg.): Gesundheitsökonomische Evaluationen - 4. aktualisierte Auflage. Springer Berlin Heidelberg 2012 (ISBN: 978-3-642-21699-2)</li> </ul>
Briggs A, Claxton K, Sculpher M: Decision Modelling For Health Economic Evaluation - Oxford University Press 2006 (ISBN:
978-0198526629) A Municipal E White B: An Introduction to Infectious Disease Modelling Oxford University Press 2010 (ISBN: 078-0108565765)
Language:
offered only in German
Notes:
Admission requirements for taking the module: - None
Admission requirements for participation in module examination(s):
- 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
(Share of Institute of Social Medicine and Epidemiology in V is 100%)
(Share of Institute of Social Medicine and Epidemiology in Ü is 100%)



LS2803-KP04 - Model organisms in molecular biology research (BioModOrg)			
Duration:	Turnus of offer:	Credit points:	Max. group size:
1 Semester	each summer semester	4	16
Course of study, spe Bachelor Biop Bachelor Mole Bachelor MLS Bachelor MLS Bachelor Biop	ecific field and term: hysics 2024 (optional subject), life sciences, 6th ser ecular Life Science 2024 (optional subject), life scien 2018 (optional subject), life sciences, 4th semester 2016 (optional subject), life sciences, 4th semester hysics 2016 (optional subject), life sciences, 6th ser	nester nces, 4th or 6th semester 	
Classes and lectures	5:	Workload:	
<ul> <li>Model organisms in molecular biology research (lecture, 1 SWS)</li> <li>Model organisms in molecular biology research (exercise, 2 SWS)</li> </ul>		<ul> <li>70 Hours private studies</li> <li>45 Hours in-classroom work</li> </ul>	
Contents of teachin Microorganisi Green plants Invertebrates Invertebrates Vertebrates II Vertebrates II Phylogeny of	rg: ms Saccharomyces cerevisae Arabidopsis thaliana I Caenorhabditis elegans II Drosophila melanogaster Danio rerio Mus musculus model organisms		
Qualification-goals/	<b>/Competencies:</b> anding of the biology of the organisms presented anding of the advantages and disadvantages of the I abilities in self-acting handling these organisms	e different model organism	s for biological research
Grading through: • Active particip	pation in all course days		
Requires: • Biology 1 (LS1	1000-KP06)		
Responsible for this • Dr. rer. nat. Al Teacher: • Institute for B	s <b>module:</b> lexandra Schatt iology		
<ul> <li>Prof. Dr. rer. n</li> <li>Dr. rer. nat. Ni</li> <li>Prof. Dr. rer. n</li> <li>Dr. rer. nat. Ca</li> <li>Dr. rer. nat. Al</li> <li>PrivDoz. Dr.</li> </ul>	iat. Enno Hartmann icole Sommer iat. Christian Schmidt arla Schulz iexandra Schatt rer. nat. Aleksander Rakovic		
Literature: • : - zur Einführ	ung: Campbell Allgemeine Biologie die entsprec	henden Kapitel	
Language: • offered only in	n German		





LS3500-KP05, LS3500 - Introduction into Structural Analysis (EinStruA05)				
Duration:	Turnus of offer:	Credit points:		
1 Semester	each summer semester	r 5		
Course of study, specific field and term • Bachelor Biophysics 2024 (compul • Bachelor Molecular Life Science 20 • Bachelor MLS 2018 (compulsory), • Bachelor Biophysics 2016 (compul • Bachelor MLS 2016 (compulsory),	: sory), life sciences, 6th semes )24 (compulsory), life science: life sciences, 6th semester sory), life sciences, 6th semes life sciences, 6th semester	ter 5, 6th semester ter		
Classes and lectures:	Classes and lectures: Workload:			
<ul> <li>Introduction into Structural Analysis (lecture, 2 SWS)</li> <li>Introduction into Structural Analysis (seminar / exercises, 2</li> <li>SWS)</li> </ul>		<ul><li>90 Hours private stu</li><li>60 Hours in-classroo</li></ul>	<ul><li>90 Hours private studies</li><li>60 Hours in-classroom work</li></ul>	
Contents of teaching:				
<ul> <li>Part A: Protein structure analysis by crystal X-ray diffraction:</li> <li>Crystal growth: precipitant and phasediagram</li> <li>Crystal morphology: symmetry and space groups</li> <li>X-ray diffraction: Bragg's law, reciprocal lattice and the Ewald-sphere construction</li> <li>Phase determination: Patterson map and molecular replacement</li> <li>Part B: Basic NMR spectroscopy for the investigation of biomolecular structures: Basics of NMR spectroscopy: NMR experiments, Spin systems, the classical vector model</li> <li>The nuclear Overhauser effect</li> <li>Identification and characterisation of protein-ligand interactions: The transfer nOe, the STD-NMR-experiment, the HSQC experiment, the cross-saturation experiments</li> <li>Part C: Basics of mass spectrometry:Indroduction and basics</li> <li>Ion sources and their fields of application</li> <li>Mass analysers</li> <li>Structural applycing of the implecular</li> </ul>				
<ul> <li>Qualification-goals/Competencies:</li> <li>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.</li> <li>Furthermore, the students will learn how to elucidate the structure of small organic molecules</li> <li>•</li> </ul>				
Grading through: <ul> <li>written exam</li> </ul>				
Responsible for this module:				
Dr. Alvaro Mallagaray				
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         • Dr. Dominik Schwudke				
l iterature:				
<ul> <li>actual papers:</li> <li>Teil B: Horst Friebolin: Ein- und zweidimensionale NMR-Spektroskopie. Eine Einführung - Wiley-VCH</li> </ul>				



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

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Language:

### offered only in German

### 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: Turnus of offer: Credit points:				
1 Semester each summer semester	4			
<ul> <li>Course of study, specific field and term:</li> <li>Minor in Teaching Mathematics, Bachelor of Arts 2023 (compulsory), mathematics, 8th semester</li> <li>Bachelor CLS 2023 (compulsory), mathematics / natural sciences, 3rd semester at the earliest</li> <li>Bachelor MES 2020 (optional subject), mathematics, 6th semester</li> <li>Bachelor Computer Science 2019 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2020 (compulsory), mathematics, 4th semester</li> <li>Bachelor Computer Science 2019 (optional subject), mathematics, 4th to 6th semester</li> <li>Bachelor Computer Science 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Computer Science 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Computer Science 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics and Autonomous Systems 2016 (compulsory), mathematics, 4th semester</li> <li>Bachelor Robotics 2016 (optional subject), mathematics, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2014 (optional subject), mathematics, 5th or 6th semester</li> <li>Bachelor Medical Informatics 2014 (compulsory), mathematics, 4th semester</li> <li>Bachelor Medical Informatics 2014 (compulsory), mathematics, 4th semester</li> <li>Bachelor Computer Science 2014 (compulsory), mathematics, 4th semester</li> <li>Bachelor Computer Science 2014 (compulsory), mathematics, 4th semester</li> <li>Bachelor Computer Science 201</li></ul>				
Bachelor CLS 2010 (compulsory), mathematics, 2nd semester				
Classes and lectures: • Stochastics 1 (lecture, 2 SWS) • Stochastic 1 (exercise, 1 SWS)	<ul> <li>Workload:</li> <li>65 Hours private studies and exercises</li> <li>45 Hours in-classroom work</li> <li>10 Hours exam preparation</li> </ul>			
Contents of teaching: <ul> <li>probability spaces</li> <li>basics of combinatorics</li> <li>conditional probability and stochastic independency</li> <li>random variables</li> <li>important discrete and continuous one-dimensional probability distributions</li> <li>characteristics of distributions</li> <li>law of large numbers, central limit theorem</li> <li>modeling examples from the life sciences</li> </ul>				
<ul> <li>Qualification-goals/Competencies:</li> <li>Students are able to explain basic stochastic models formally correct and in the context of their application</li> <li>They are able to formalize stochastic problems</li> <li>They are able to identify basic combinatorial patterns and to use them for solving stochastic problems</li> <li>They understand central statements of elementary stochastics</li> </ul>				
Grading through: <ul> <li>written exam</li> </ul>				
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)
<ul> <li>Stochastics 2 (MA4020-KP04, MA4020)</li> </ul>
Responsible for this module:
Nachfolge von Prof. Dr. rer. nat. Karsten Keller
Teacher:
Institute for Mathematics
Nachfolge von Prof. Dr. rer. nat. Karsten Keller
Literature:
N. Henze: Stochastik für Einsteiger - Vieweg
U. Krengel: Einführung in die Wahrscheinlichkeitstheorie - Vieweg
Language:
offered only in German
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:	Turnus of offer:		Credit points:	
1 Semester	each summer semester		4	
<ul> <li>Course of study, specific field and term:</li> <li>Bachelor Molecular Life Science 2024 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Master MES 2020 (optional subject), interdisciplinary, Arbitrary semester</li> <li>Bachelor MES 2020 (optional subject), interdisciplinary, Arbitrary semester</li> <li>Bachelor MLS 2018 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2016 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2016 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor Biophysics 2016 (optional subject), no specific field, 6th semester</li> <li>Bachelor MES 2014 (optional subject), no specific field, 2nd semester</li> <li>Bachelor MLS 2009 (optional subject), no specific field, 4th or 6th semester</li> <li>Master MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2011 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2010 (optional subject), interdisciplinary competence, Arbitrary semester</li> <li>Bachelor MLS 2009 (optional subject), interdisciplinary competence, Arbitrary semester</li> </ul>				
Classes and lectures: • English for Bachelor and Master stud	Classes and lectures:       Workload:         • English for Bachelor and Master students MLS (exercise, 4 SWS)       • 60 Hours private studies         • 60 Hours in-classroom work			
Contents of teaching: • Exercise:The content follows a curric • Creating a CV in English	ulum, modified depending	on the given skills and the	e thematic interests of the participants.	
<ul> <li>Qualification-goals/Competencies:</li> <li>Students acquire basic knowledge of the English language in word and writing.</li> <li>They improve their communication in English.</li> <li>They improve their skills in reading and writing English texts, including specialist literature.</li> </ul>				
Grading through: • written exam				
Responsible for this module: • B. Sc. Sara Meitner Teacher: • • • 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)	
Duration:	ation: Turnus of offer:		Credit points:	
1 Semester	each summer semeste	each summer semester 4		
Course of study, specific fie Bachelor Psychology 2 Bachelor Media Inform Bachelor Psychology 2 Bachelor Biophysics 2 Bachelor Psychology 2 Bachelor Media Inform	<b>Id and term:</b> 2013 (optional subject), psychology, An natics 2020 (compulsory), psychology, 2016 (optional subject), psychology, A 016 (optional subject), no specific field 2020 (optional subject), psychology, A natics 2014 (compulsory), psychology,	rbitrary semester 4th semester rbitrary semester d, 6th semester rbitrary semester , 4th semester		
Classes and lectures:		Workload:		
<ul><li>Media Psychology (lea</li><li>Media Psychology (se</li></ul>	<ul> <li>Media Psychology (lecture, 2 SWS)</li> <li>Media Psychology (seminar, 1 SWS)</li> <li>75 Hours private studies and exercises</li> <li>45 Hours in-classroom work</li> </ul>			
<ul> <li>Media effects</li> <li>Media competency</li> <li>Persuasive technology</li> <li>Advertising, social net</li> <li>Public Relations</li> <li>Human-computer inte</li> </ul>	y, gamification tworks eraction, companion technologies			
Qualification-goals/Competent The students can exple They are able to drawn to judge media use arrown They are able to analy	tencies: licate theories and findings of media p r conclusions from media psychology nd media effects based on knowledge yse and to evaluate digital media with	osychology using digital s scientific contribution of media psychology. methods from media p	media as examples. s regarding multimedia and interactive media and sychology.	
Grading through: • portfolio exam - the c	oncrete examination elements and the	eir weights will be publi	shed in the course	
Responsible for this module • Prof. Dr. rer. nat. Thon Teacher: • Institute for Multimed • Prof. Dr. rer. nat. Thon • MitarbeiterInnen des	2: nas Franke lia and Interactive Systems nas Franke s Instituts			
Literature: • B. Batinic & M. Appel • S. Trepte & L. Reineck • :	(Hrsg.): Medienpsychologie - Heidelbe e: Medienpsychologie - Stuttgart: Koh	rg: Springer, 2008 lhammer, 2013		
Language: • offered only in Germa	.n			
Notes:				



Prerequisites for attending the module: - None

Prerequisites for the exam: - Successful completion of homework assignments during the semester.

Exam(s):

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