Hochschule
Bonn-Rhein-Sieg
University of Applied Sciences

Module Handbook
„Applied Biology“
Bachelor of Science (B.Sc.)

Department of Natural Sciences
University of Applied Sciences Bonn-Rhein-Sieg

28.05.2024

General Modules:

Elective Courses:

<table>
<tr><td>Module:</td><td colspan="3">General Chemistry</td></tr>
<tr><td>Semester:</td><td colspan="3">1</td></tr>
<tr><td>Course leader:</td><td colspan="3">Dr. Ulf Ritgen</td></tr>
<tr><td>Lecturer:</td><td colspan="3">Dr. Ulf Ritgen, Antje Thielen</td></tr>
<tr><td>Language:</td><td colspan="3">English</td></tr>
<tr><td>Assignment to Curriculum</td><td colspan="3">Pflichtfach, 1. Semester Applied Biology</td></tr>
<tr><td>Course units / credit hours per week (SWS):</td><td colspan="3">Lecture: 2 credit hours
Exercise: 2 credit hours
Practical Class: 2 credit hours</td></tr>
<tr><td rowspan="6">Students' workload:</td><td></td><td>Contact hours</td><td>Self Study</td></tr>
<tr><td>Lecture</td><td>30</td><td>30</td></tr>
<tr><td>Exercise</td><td>30</td><td>30</td></tr>
<tr><td>Practicals</td><td>30</td><td>60</td></tr>
<tr><td></td><td>90</td><td>120</td></tr>
<tr><td colspan="3">Total: 210 Hours</td></tr>
<tr><td>Credits:</td><td colspan="3">7 ECTS</td></tr>
<tr><td>Prerequisites according to examination regulations:</td><td colspan="3">None</td></tr>
<tr><td>Recommended prerequisites:</td><td colspan="3">None</td></tr>
<tr><td>Learning Outcome:</td><td colspan="3">The students are able to
compare the fundamental atom / matter models,
classify and safely handle substances,
classify chemical reactions with respect to their reaction type and explain the corresponding processes and observable phenomena,
recognise the effect of various parameters to the law of mass action, and
plan, conduct, and protocol basic chemical experiments, regarding material requirements, setup of apparatuses, and operation
by
applying the models according to the respective task/problem,
using their knowledge about the characteristic properties of various classes of materials,
setting up reaction equations (including substance balance and charge balance), based on predefined information regarding reactants and/or products,
applying Le Chatelier's principle to predict expectable outcomes/observations,
actively applying their knowledge about the theoretical background of the experiments performed, the lab-specific hazards when handling dangerous materials and laboratory apparatuses, and the general precations for laboratory safety, and
documenting both performing the experiment and any observations in a laboratory journal
in order to
explain chemical facts and concepts from both laboratory and "everyday life" systematically and using the proper terminology,
familiarise themselves autonomously with more complex facts and concepts of chemistry and related disciplines, based on the background knowledge gained within this module,
interpret, manipulate, and evaluate experimentally obtained data and present them both orally and in writing.</td></tr>
<tr><td>Content:</td><td colspan="3">Lecture:
atomic models (Bohr, Rutherford), atomic spectra</td></tr>
</table>

	the periodic table of the elements, orbitals, the Aufbau principle chemicals bonds (ionic, covalent, metallic, coordinative); intermolecular interactions chemical reactions and the dynamic equilibrium, the law of mass action, fundamentals / laws of thermodynamics acids and bases, the pH value (and corresponding calculations), buffer systems solubility and the solubility product redox reactions, electrochemical potentials, galvanic cells, the Nernst equation Laboratory course: Introduction to laboratory safety introductory experiments on the law of mass action, acid/base titrations, electrochemistry, coordination complexes
Assessment:	successful participation in the practical class final modular examination in writing – graded (120 min)
Teaching Style:	Lecture: presentation slides; blackboard/whiteboard (analogue or digital) Tutorial: exercise collections, blackboard/whiteboard (a/d) Laboratory course: written laboratory instructions and operating procedures, introductory videos, and presentations slides (a/d) seminar accompanying the laboratory course, especially covering interpretation, manipulation, and evaluating data.
Indicative Bibliography/Sourcese:	D.D. Ebbing, S.D. Gammon, "General Chemistry", 11th ed. Houghton Mifflin (in englischer Sprache) S. Ortanderl, U. Ritgen, "Chemie - das Lehrbuch für Dummies", 2. Aufl., Wiley-VCH

Module:	**Cell Biology**		
Semester:	1		
Course leader:	Prof. Dr. Annette Menke		
Lecturer:	Prof. Dr. Annette Menke		
Language:	English		
Assignment to curriculum:	Compulsory Course 1. Semester Applied Biology		
Course units / credit hours:	The module is consists of Lecture : 3 credit hours Exercise: 2 credit hours Practicals: 1 credit hour		
Workload:		Contact hours	Self study
	Lecture	45	45
	Exercise	30	30
	Practicals	15	45
	Sum	90	120
	Total	210 Hours	
Credits:	7 ECTS		
Prerequisites according to examination regulations:	None		
Recommended examination regulations:	None		
Learning outcome:	The students are able to Describe and explain the structure and function of prokaryotic and eukaryotic cells, name the types, structure and functions of cellular macromolecules and explain the process and regulation of their synthesis. Describe and explain the significance, process and regulation of the eukaryotic cell cycle. Mention, explain and distinguish between typical forms of energy metabolism in eukaryotic cells. Observe and describe preparations of eukaryotic cells with the light microscope, describe and explain the effect of osmosis on cells and extract DNA or proteins from animal or plant tissue using simple methods compile their own data in a laboratory report and interpret it critically. By referring to what they learned at school in order to gain further insights into the structure and function of the cell and to acquire the correct scientific terminology in English. deepening and applying knowledge learned in the exercises. getting familiar with different forms of scientific publications in addition to textbook study. having learned in the practical course how to set up, carry out and interpret simple experiments and how to use scientific Indicative Bibliography/Sourcese to evaluate and explain their own data in order to expand and deepen the acquired knowledge of the structure and function of the cell, initially in the courses of the second semester (Human Biology/Histology). learn how to work in a safety laboratory in a competent and safety-conscious manner, based on the basic skills acquired in the practical course in the coming semester. be able to use the acquired knowledge and skills in research and in routine laboratories.		

Content:	Lecture and Exercise Structure and morphology of the cell Macromolecules, structure and function Biological membranes; membrane transport Basics of gene expression and its regulation Molecular and cellular basics of cell reproduction and its regulation Germ cell formation Basics of energy metabolism Methods of cell biology Practical course: Light microscopy and representation in scientific drawing. DNA or protein extraction from plant or animal tissue Basic metabolism studies in yeast Osmo tolerance in erythrocytes
Assessment:	Successfull participation in the practical class Written exam (120 min)
Teaching Style:	Screencasts: Power Point-Presentations, Whiteboard, Textbooks, Digital Material (Videos, Screencasts)
Indicative Bibliography/Sourcese:	Bruce Alberts, Rebecca Heald, Alexander Johnson, David Morgan, Martin Raff, "Molecular Biology of the Cell" W.W. Norton & Co. Inc. 5. oder 6. Auflage Bruce Alberts, Karen Hopkin, Alexander Johnson, David Morgan, Martin Raff "Essential Cell Biology", W.W. Norton & Co. Inc. 5. Auflage.

Module:	**Mathematics**		
Semester:	1		
Course Leader:	Prof. Dr. Draber and Prof. Dr. Oligschleger		
Lecturers:	Prof. Dr. Draber, Prof. Dr. Oligschleger and external lecturers		
Language:	English		
Assignment to curriculum:	Compulsory courses Semester 1 Applied Biology		
Course units credit hours:	The module consists of a Lecture 4 credit hours Exercise 2 credit hours		
Students' workload:		Contact hours	Self Study
	Lecture	60	60
	Exercise	30	30
	Practicals	0	0
		90	90
	Total	180 hours	
Credits:	6 ECTS		
Prerequisites according to examination recommendation:	None		
Recommended prerequisites:	Preparatory course Mathematics		
Learning outcomes:	The students are able to solve given problems and tasks with basic methods from differential and integral calculus and apply analytical and numerical procedures in mathematics and related fields. recognise the methods, elementary functions, derivatives and integrals to be applied in practical problems and carry out basic calculations themselves by handling the presented functions, analytical methods and numerical procedures with confidence knowing, distinguishing and assessing the methods and procedures presented to be able to use suitable mathematical functions, analytical and numerical methods safely and independently in everyday laboratory and working life and to carry out corresponding calculations		
Content:	Lecture: Sets, real numbers and intervals, complex numbers, linear and quadratic equations, binomial theorem. Functions and curves: definition and representation, understanding as a mapping, general function properties, polar coordinates, sequences: Limit and continuity of a function, polynomials, fractional rational functions, power functions, trigonometric functions and arcsine functions, exponential functions and logarithmic functions, logarithmic representations (logarithmic paper). Differential calculus: derivative as tangent slope, derivative of elementary functions, derivative rules, higher derivatives, linearisation of a function, characteristic curve points and extreme value tasks, curve discussion, numerical zero search. Integral calculus: integration as inverse of the derivative, definite integral as surface, indefinite integral, fundamental theorem of differential and integral calculus, important integrals, calculation of definite integrals, integration rules and methods, substitution,		

	partial integration, numerical integration, some applications of integral calculus. Power series, Taylor series: infinite series, power series, Taylor series, limit rule of de L'Hospital. Exercise: Exercise sheets on the topics are worked on and discussed weekly.
Assessment:	Written exam (120 min), graded
Teaching style:	Blackboard, Overhead, Transparencies, Textbooks
Indicative Bibliography/Sourcese:	Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, vieweg Verlag, Braunschweig Wiesbaden. Band 1,2 und 3. Manfred Brill, Mathematik für Informatiker, Hanser Verag, München, Wien, 2. Auflage, 2005 K. Gieck, R. Gieck, Technische Formelsammlung, Gieck Verlag, Germering, 1995, 30. erweiterte Ausgabe. Alan J. Cann, Maths from Scratch for Biologists, John Wiley& Sons.

<table>
<tr><td>Module:</td><td colspan="3">Laboratory Skills / Computing Sciences</td></tr>
<tr><td>Semester:</td><td colspan="3">1</td></tr>
<tr><td>Course Leaders:</td><td colspan="3">Prof. Dr. A. Menke / Prof. Dr. U. Eßmann</td></tr>
<tr><td>Lecturers:</td><td colspan="3">Lecturers of the Department</td></tr>
<tr><td>Language:</td><td colspan="3">English</td></tr>
<tr><td>Assignment to curriculum:</td><td colspan="3">Compulsory course, 1. Semester Applied Biology</td></tr>
<tr><td>Course units/credit hours:</td><td colspan="3">Laboratory Skills:
Lecture: 1 credit hour
Exercises: 1 credit hour
Practicals: 0 credit hour

Computing Sciences:
Lecture: 2 credit hours
Exercises: 0 credit hours
Practicals: 2 credit hours</td></tr>
<tr><td rowspan="6">Students‘ workload:</td><td></td><td>Contact hours</td><td>Self Study</td></tr>
<tr><td>Lecture</td><td>45</td><td>40</td></tr>
<tr><td>Exercise</td><td>15</td><td>60</td></tr>
<tr><td>Practicals</td><td>30</td><td>20</td></tr>
<tr><td></td><td>90</td><td>120</td></tr>
<tr><td>Total</td><td colspan="2">210 hours</td></tr>
<tr><td>Credits:</td><td colspan="3">7 ECTS</td></tr>
<tr><td>Prerequisites according to examination regulations:</td><td colspan="3">None</td></tr>
<tr><td>Recommended prerequisites:</td><td colspan="3">None</td></tr>
<tr><td>Learning Outcomes:</td><td colspan="3">Laboratory Skills:
The students are able to
Present and explain basic steps in the design of an experiment.
Present experiments and data obtained in the form of laboratory reports ("protocols") and lectures.
Present selected scientific publications in the form of a lecture.
Safely use online Indicative Bibliography/Sourcese databases for research and critically evaluate other internet sources for their reliability.
By using
Independently work out biological correlations from publications or textbooks on a given topic, summarise them and present them in a short presentation.
In order to
Present In the further course of their studies scientific results to specific target groups in the form of lectures or written reports/discussions.

Computing Sciences:
The students are able to
analyse scientific data with the measures of exploratory data analysis and prepare present these data in professional tables and graphs
apply numerical algorithms to the analysis of data sets and implement these algorithms in a high-level programming language
by using
spreadsheet programs for the preparation of professional tables and graphs
functions of spread sheet programs for the calculation of the measures of descriptive statistics
Python for the analysis of scientific data and the implementation of algorithms with the data structures of Python
in order to
analyse scientific data and present them visually and characterise the data with the measures of descriptive statistics</td></tr>
</table>

Content:	Laboratory Skills: Lecture : Experimental design in biology Structure and preparation of laboratory reports Different forms of scientific presentations, use of PowerPoint to prepare scientific presentations Forms of scientific publications, use of online Indicative Bibliography/Sourcese databases; reliability of other internet sources Exercises: Practical application of the skills acquired in the lecture Preparation of a short presentation on selected biological topics Development of a plan for an experiment on a given question. Computing Sciences: Structure and mechanisms of spreadsheet programs Calculations and functions in spreadsheet programs Statistical measures for the characterisation of experimental distributions numerical mathematics with spreadsheet programs Basic concepts and structure of Python programs Data structures and control structures in Python
Assessment:	The Laboratory Skills part is non-graded. Assessment via short presentation that has to be delivered at the end of the exercise session. For the Computing Sciences part successful participation is demonstrated by working out the weekly lab exercises and (optional) a written examination at the end of the semester.
Teaching style:	V: Presentation, blackboard E: Blackboard, work sheet P: Practical computer exercises
Indicative Bibliography/Sources:	Script Microsoft Excel Joseph E. Billo, Excel for chemists, Wiley, New York 2001 (has a lot of tips and tricks relevant for scientists) Python https://www.python-kurs.eu/kurs.php (Deutsch und Englisch) Martin Jones, Python for Biologists, CreateSpace Independent Publishing Platform, 2015 https://www.tutorialspoint.com/python/index.htm https://www.w3schools.com/python/

Module:	**English for Biology 1 & 2**
Semester:	1. and 2. Semester
Course Leader:	Peter Kapec
Lecturer:	Peter Kapec et al.
Language:	English
Assignment in Curriculum:	Elective Course in 1st and 2nd Sem. Applied Biology
Course Units/Credit hours:	Exercise: 6 credit hours; max. group size: 20
Students workload:	Contact hours Private study Exercise:: 90 90 Total Sum: 180 hours
Credits	6 ECTS
Prerequisites according to examination regulations:	English for Biology 1: None English for Biology 2: Attendance of "English for Biology 1"
Recommendations:	The course assumes that students have achieved a minimum CEF B1 level.
Learning outcomes:	The students will be able to discuss, describe and give presentations about Biology and other natural sciences, in English by using grammatically correct language, accurate pronunciation and relevant technical vocabulary, and by conducting research, accessing information from English-language scientific journals and other sources in order to be able to use English as a means of communication in their future projects and academic careers.
Summary indicative content:	The Periodic Table Describing Systems Genetics Mathematics Describing Procedures Acids and Bases Human Biology The Influence of Substances on the Human Body Review of the Main Tenses Biology Vocabulary Pronunciation Practice
Assessment:	Passing of module – graded Attendance requirement of at least 75% Type portfolio: written final examination (weighting 50%), 60 min scientific presentation (weighting 50%), 10 min
Teaching style:	Script, Videos
Indicative Bibliography/Sources:	Script: English for Biology

Module:	**Language 1 & 2**
Semester:	1. and 2. Semester
Course Leader:	Language Centre: Stephanie Cramer (Coordinator of the German courses), Albina Rogozhnikova (Coordinator of courses in other languages) and Claudia Ruiz Vega (Coordinator of the Spanish courses)
Lecturer:	Faculty and casual staff from the Language Centre (see course description in LEA)
Language:	German as a Foreign Language / Spanish / Norwegian / Dutch
Assignment in Curriculum:	Elective course in 1st and 2nd Sem. Applied Biology Elective course in 1st and 2nd Sem. Chemistry
Course Units/Credit hours:	Exercise: 6 credit hours; max. group size: 20
Students workload:	Contact hours Private study Exercise: 90 90 Total Sum: 180 hours
Credits	6 ECTS
Prerequisites according to examination regulations:	Proof of a B2 level in English in a placement test conducted before the 1st semester; otherwise English must be taken as Language 1 and 2 (for details, see orientation lecture before the 1st semester) Completion of Language 1 is a prerequisite for attending Language 2. It is not possible to change the language, i.e. the courses chosen as Language 1 and Language 2 must be for the same language.
Recommendations:	Language skills according to the required entry level (depending on the course)
Learning outcomes:	The students will be able to acquire and extend language competencies in speaking, writing, listening and/or reading (depending on their language level) by practising communicative language activities such as reception, production, interaction and mediation in oral and/or written form in an interactive course setting with different forms such as group, pair or individual work and an e-learning component expanding their vocabulary, acquiring functional grammatical knowledge and getting to know types of verbal interaction and language registers being introduced to the regional and cultural studies as well as to the mentality of the cultural area of the target language in order to deal with situations in everyday life, studies and/or work in written and oral form in a communicative way appropriate to the level reach the target level in the respective foreign language.
Summary indicative content:	The exact course content depends on the respective level of the course according to the Common European Framework of Reference for Languages (CEFR); information on the levels and corresponding skills of the Common European Framework of Reference for Languages can be found at https://www.h-brs.de/files/ger.pdf. Further information on the respective course content will be made available on LEA at the beginning of the course.
Assessment:	Prerequisites for the awarding of credit points Active participation in at least 75% of the course. Possible forms of assessment Portfolio: The exact requirements for the portfolio will be announced at the beginning of the semester for the respective courses. Written or oral final examination Overall grade for Language 1+2 Language 1 and Language 2 must be passed independently of each other. The final grade for Language 1 and Language 2 is submitted to the Examination Office after the end of each course.

	The module grade (= overall grade) is calculated from the average of the final grades for Language 1 and Language 2.
Teaching style:	Textbooks according to CEFR, audio-visual materials, scripts developed by teachers, LEA
Indicative Bibliography/Sources:	-

Module:	**Physics/Statistics**
Semester:	2. Semester
Course Leader:	Prof. Dr. Ulrich Essmann
Lecturer:	Prof. Dr. Ulrich Essmann
Language:	English
Assignment in Curriculum:	Compulsory Course in the 3rd Semester BSc Applied Biology
Course Units/Credit hours:	Lecture: 2 credit hours Physics + 1 credit hour Statistics Exercise: 1 credit hour Physics + 1 credit hour Statistics Lab work: 1 credit hour Physics (up to 12 groups with 2 students per group)
Students' workload:	Contact hours / Private study Lecture: 45 / 30 Exercise: 30 / 30 Lab work: 15 / 30 Sum: 90 / 90 Total Sum: 180 hours
Credits:	6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the module Mathematics
Learning outcomes:	**Physics:** The students are able to explain the fundamental phenomena and principles of classical mechanics, mechanics of fluids and thermodynamics and describe them by mathematical equations describe the results of scientific experiments quantitatively and recognize the limitations of the experiments based on the inherent experimental uncertainties by developing solutions for simple problems in the aforementioned fields and discussing physical problems applying the concepts of mechanics and thermodynamics to the analysis and understanding of experiments and apparatuses performing experiments in a team and analyse these experiments with statistical tools and error analysis in order to work independently in a scientific laboratory and plan and perform scientific experiments develop new concepts in a laboratory and work environment to overcome experimental difficulties work in a scientific environment based on a solid basis be able to develop and critically assess scientific reasoning use the physical knowledge to acquire new scientific fields **Statistics:** The students are able to describe and analyse experimental data with statistical parameters and apply selected distribution functions formalise and analyse biomedical questions by utilising probabilistic concepts by using data from biomedical research for a statistical analysis concepts of probability theory, in particular the concept of conditional probability in the analysis of biomedical problems the parameters of the normal distribution as a basis for statistical tests in order to analyse and describe data with statistical parameters

	analyse biomedical questions by utilising probability theory apply simple statistical tests to biomedical questions
Summary indicative content:	**Physics:** Lecture: Mechanics (kinematics and dynamics, forces, work and energy, momentum, mechanics of fluids and gases); Thermodynamics (temperature, physical changes of solids and fluids due to temperature changes, ideal gas law, kinetic theory of gases, first and second law of thermodynamics, equation of state for real gases, conduction of heat, transport phenomena) Exercise**:** Applications of the concepts presented in the lecture to real problems to enhance the understanding of the physical principles. Practical course**:** Experiments in the different fields of the module are performed in small groups (usually 2 students per group). The subject areas comprise mechanics (air track experiment and density determination with different methods) and thermodynamics (e.g. temperature measurement, determination of heat capacities and enthalpies) and the statistical analysis of data including error discussion (random vs. systematic errors) and error propagation. The topics of the lecture are considered from a more practical standpoint of view. **Statistics:** Lecture: Samples; parameters of samples; error propagation: random and systematic errors, regression und correlation; linear regression; fitting of parametric functions; least square minimization. Probability: combinatorics; probability experiments; calculation of probabilities; conditional probability; probability density; definition of probability density functions; distribution functions; parameters of probability distributions; normal distribution Exercise**:** Applications of the concepts presented in the lecture to real problems to enhance the understanding of the physical principles.
Assessment:	Written exam (120 min) – graded The successful passing of the laboratory course is a prerequisite for the completion of the module.
Teaching style:	Lecture: Blackboard, demonstration experiments, computer experiments (Applets) Exercises: Written exercises, blackboard Practical course: Manuscript for the practical course
Indicative Bibliography/Sources:	**Physics**: Fundamentals of Physics, Halliday, Resnick, Walker, Wiley, 2001 Physics in Biology and Medicine, Davidovits, Harcourt Academic Press Physics for Pre-Med, Biology, and Allied Health Students, Hademenos, McGraw-Hill Physics with illustrative examples from Medicine an Biology, Biological Physics Series College physics, Urone, Brooks/Cole, Pacific Grove, CA **Statistics:** An Introduction to Error Analysis, Taylor, University Sci. Books, 1982 Fundamentals of Biostatistics, Rosner, Duxbury, 2000

Module:	**Human Biology/Histology**
Semester:	2. Semester
Course Leader:	Prof. Dr. Christopher Volk
Lecturer:	Prof. Dr. Christopher Volk
Language:	English
Assignment to curriculum:	Compulsory course, Semester 2, BSc Applied Biology
Course units/credit hours:	This module is made up by lectures, exercises and a practical course. Lecture: 3 credit hours Exercises: 1 credit hour Practical course: 2 credit hours
Students' workload:	Contact hours Self Study L: 45 90 E: 15 0 P: 30 30 90 120 Total: 210 Stunden
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommended prerequisites:	Successful participation in the module Cell biology
Learning Outcomes:	The students are able to Prepare under supervision microscopic tissue thin section preparations Interpret microscopic preparations of the various tissues and organs under the microscope and identify the basic tissue structures Understand the functions of the different tissues and organs and relate them to the morphological structures. by first learning the basic characteristics of the different tissues and the cellular structures associated with them. then looking at the structure of the individual organs and organ systems from the different basic tissues and understanding how these tissue-typical structures are responsible for the functions of the organs further deepening and applying this learned knowledge in the exercises learning and carrying out the manual basics for making microscopic preparations (cutting, staining) and to independently analyse and document preparations of various organs under the microscope. In order to gain a deeper understanding of the different organ systems of the body, their structural characteristics and functions be able to use the acquired knowledge and skills in research and in routine laboratories, e.g. in clinical diagnostics.
Content:	Discussion of common histological methods: Fixation and embedding of tissue samples; preparation of thin sections using microtome and cryotome; presentation of the most important staining methods; artefacts; explanation of various light and electron microscopic techniques. General cell biology: explanation of the different compartments of the cell with regard to structure and function, building on the foundations laid in the module "Cell Biology".

	General histology: Presentation of the different basic tissues of the body: epithelial tissue, connective and supporting tissue, muscle tissue, nervous tissue. Discussion of the tissue types belonging to the respective basic tissue types, taking into account functional and cell biological aspects. Special organ theory: Explanation of the most important organs and organ systems of the human body, taking into account macroscopic and microscopic anatomy and physiology. The following are covered in detail: Digestive tract: oral cavity incl. all structures associated there, pharynx, oesophagus, stomach, small and large intestine, liver, pancreas; Cardiovascular system: heart as central pump, organisation of the vascular system, components of the blood; Defence system: primary and secondary lymphatic organs, organisation of the lymphatic system, mode of action of the various lymphatic cells; Respiratory tract: nasal cavity, trachea, lungs, physiology of gas exchange, respiratory mechanics; Urinary tract: kidney including the physiological processes involved in urine formation, urinary tract, control of micturition; Reproductive tract: female and male sex organs, oogenesis and spermatogenesis, hormonal control of the cycle; Endocrine system: general mode of action of hormones, more detailed examination of hypothalamus and pituitary gland, adrenal gland, thyroid gland and parathyroid glands; Skin: structure and functions of epidermis and dermis; Nervous system: structure and function of central and peripheral nervous system, meninges, cerebrospinal fluid spaces, organisation of the spinal cord, discussion of the different parts of the brain with special emphasis on functional aspects; Sensory organs: structure and function of the eye and ear.
Assessment :	Successful participation in the practical course (lab report, short presentation), written exam 90 min (100%), graded
Teaching style:	Lecture/Exercises: Power Point-presentation, black board, white board, digital content: Videos, Screencasts, Kahoot Quizes, Textbooks Practcial Course. Script, Power Point presentation, videos
Indicative Bibliography/Sources:	W. Pawlina, M.H. Ross, Histology: A Text and Atlas. Wolters Kluwer, 8. Auflage 2019 A.L.Mescher, Junqueira´s Basic Histology: Text and Atlas. McGraw-Hill, 16. Auflage 2021 R. Lüllmann-Rauch, E. Asan, Taschenlehrbuch Histologie. Thieme, 6. Auflage 2019. U. Welsch, W. Kummer, T. Deller, Histologie - Das Lehrbuch. Elsevier, 5. Auflage 2018 U. Welsch, Sobotta Atlas Histologie. Elsevier, 7. Auflage 2005

Module:	**Microbiology**		
Semester:	2		
Course leader:	Prof. Dr. Annette Menke		
Lecturer:	Prof. Dr. Annette Menke		
Language:	Englisch		
Assignment to curriculum:	Compulsary course, 2. Semester Applied Biology		
Course Units/Credit hours:	Lecture: 2 credit hours Eercises: 2 credit hours Practicals: 2 credit hours		
Students' workload:		Contact hours	Self study
	Lecture	30	30
	Exercises	30	60
	Practicals	30	30
	Sum	90	120
	Sum total	210 Hours	
Credits:	7 ECTS		
Prerequisites according to examination regulations:	None		
Recommended prerequisites:	Successful participation in the module Cell Biology		
Learning outcome:	Students are able to Differentiate between different microorganisms, describe their cellular structure in comparison to animal or plant cells, mention general and specialised structures of the microbial cell and characterise their function. Describe physical and chemical factors that influence the growth of microorganisms in their natural environment and explain the influence of such factors on growth and metabolism. Distinguish between different cultivation methods and media types for microorganisms and identify suitable cultivation procedures. Mention, describe, explain and critically evaluate methods for controlling microbial growth. Describe and explain the role of microorganisms in daily life (health and disease, food, biotechnology, etc). By Using subject specific terminology correctly Combining the content acquired in the lecture with their knowledge from the Cell Biology module and applying it in the practical course on non-pathogenic microorganisms that can be easily cultivated. In order to Work in a safety-conscious manner in the follow-up practical course Medical Microbiology in the L2 laboratory identify, culture and examine microorganisms in research or diagnostic laboratories. safely apply sterile working techniques to non-microbiological laboratory activities.		
Content:	Lecture Introduction to microbiology, importance of microorganisms for humans. Structure and composition of prokaryotic cells; specific structures of the prokaryotic cell and their function. Microbial growth in nature and in the laboratory: physical and chemical factors influencing microbial growth, culture media and culture techniques; growth parameters; direct and indirect methods for measuring microbial growth. Control of microbial growth: physical and chemical methods		

	Specific microbial metabolic pathways: selected fermentations, anaerobic respiration, lithotrophy and anaerobic photosynthesis. Characteristic representatives of individual bacterial families: morphological and metabolic diversity of selected groups. Aspects of applied microbiology Introduction to virology Practical course: Light microscopic observation of stained and unstained pro- and eukaryotic cells. Identification of bacteria based on their morphological and biochemical characteristics Determination of the number of coliform bacteria from water samples Determination of the effect of antibacterial agents on selected bacterial strains Investigation of gene regulation mechanisms in E.coli using the example of the lac-operon
Assessment	Successful participation in practical course, written exam 120 min., graded
Teaching Style	Textbooks, Powerpoint Presentations, digigital content: videos, screencasts, whiteboard
Indicative Bibliography/Sources	Michael Madigan, Kelly Bender, Daniel Buckley, W. Sattley, David Stahl "Brock Biology of Microorganisms." Pearson Education Limited, 15. oder16. Auflage Joanne Willey, Linda Sherwood, Christopher J. Woolverton "Prescott's Microbiology." McGraw Hill. 10. oder 11. Auflage.

Module:	**Organic Chemistry**
Semester:	2nd semester
Course Leader:	Prof. Dr. Margit Schulze
Lecturer:	Dr. Kai Jakoby, Prof. Dr. Margit Schulze
Language:	English
Assignment to curriculum:	Compulsory Course 2nd semester B.Sc. Applied Biology
Course units/ Lesson hours per week (SWS)	Lecture: 3 SWS Exercises: 2 SWS Laboratory Course: 1 SWS (max. group size: 16)
Students' workload:	Contact hours / Private study Lecture: 45 / 45 Exercises: 30 / 50 Laboratory Course: 15 / 25 Total: 90 / 120 Total (contact hours + private study): 210 hours
Credits	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	General Chemistry (1st sem.)
Learning Outcomes:	The students are able to identify and name the most common families of organic compounds and describe their physical porperties and their chemical reactivity, present and predict typical organic reaction pathways including all the steps of the reaction mechanism and all the relevant stereochemical aspects, explain relevant properties of important classes of bio-molecules, such as amino acids, carbohydrates, proteins. by exemplifying important relationships between chemical structure and properties based upon functional groups, applying the concept of nucleophile and electrophile, explaining the influence of resonance on the stability, reactivity, acidity and basicity of organic molecules, performing fundamental laboratory techniques for the synthesis, purification and analysis of organic substances, in order to describe and interpret the physical and chemical properties of organic molecules based upon their structure as a prerequisite for the compulsory course "Instrumental Analysis" in the 3rd semester, explain the meaning of stereochemical aspects for the structure and the properties of natural biomolecules, predict relevant chemical conversions of typical organic biomolecules as a prerequisite for the compulsory course "Biochemistry" in the 4th semester.
Summary indicative content:	Lectures and Exercises: Fundamental principles of organic chemistry (such as theory of chemical bonds and molecular structure), Introduction into important classes of organic substances (including essential classes of biomolecules) with a special focus on their physical and chemical properties (such as volatility, polarity, solubility, acidity / basicity, nucleophilicity) and on stereochemical aspects (chirality). Presentation of typical chemical reactions of organic compounds including reaction mechanisms, with a focus on electrophilic / nucleophilic substitution reactions, addition and elimination reactions, oxidation and hydrolysis. Laboratory Work:

	Basic techniques of organic synthesis (such as heating under reflux, recrystallization, liquid-liquid extraction), Basic techniques of analytical organic chemistry (such as determination of melting points and optical purities)
Assessment:	Successful participation in the laboratory course, documented by a laboratory report. Written Examination 120 min. – graded
Teaching style:	Lectures: Power Point Presentation, Document Visualizer, Whiteboard or Blackboard Exercises: Written Compilation of Exercise Problems, Whiteboard or Blackboard, Document Visualizer Lab Course: Written Experimental Instructions, Tablet PCs, Interactive Smartboard
Indicative Bibliography / Sources	Paula Y. Bruice, Organic Chemistry, Pearson Prentice Hall, 8th edition, 2017. John McMurry, Fundamentals of Organic Chemistry, Brooks / Cole Cengage Learning, 7th edition, 2011. R.G. Engel et al., Introduction to Organic Laboratory Techniques, Brooks / Cole Cengage Learning, 3rd ed., 2011.

Module:	**Molecular Genetics**
Semester:	3rd semester
Course Leader:	Professor Dr. Edda Tobiasch
Lecturer:	Professor Dr. Edda Tobiasch
Language:	English
Assignment in Curriculum	Compulsory Course in the 3rd Semester Applied Biology
Course Units/Credit hours	Lecture: 4 credit hours Seminar: 0 credit hours Lab work: 2 credit hours; max. group size: 24
Students workload:	Contact hours / Private study Lecture: 60 / 90 Seminar:: 0 / 0 Lab work: 30 / 30 Sum: 90 / 120 Total Sum: 210 hours
Credits	7 ECTS
Prerequisites according to examination regulations:	General Safety Instruction, S1 Safety Instruction
Recommendations:	Passing of the modules of the 1st and 2nd semester
Learning outcomes:	The students are able: to isolate, characterise and analyse genomic and plasmid DNA. to perform bacterial gene transfer and bacteriophage titration. by knowing the most important molecular genetic processes in the cell, such as replication, regulation, variation, transcription, translation and expression, cell cycle and repair mechanisms. knowing the most important molecular genetic events in gene technology. Judging basic ethical aspects of molecular genetics. to use and judge the learned skills in professional, scientifically and economically settings
Summary indicative content:	<u>Content of the Lecture</u> Molecular structure and function of DNA and RNA Replication, transcription and translation: Mechanisms and enzymes involved Comparison of replication and gene expression in prokaryotes, eukaryotes and viruses: Similarities and differences Regulation of gene expression in prokaryotes, viruses and eukaryotes Variation and mutation Repair mechanisms The eukaryotic chromosome The eukaryotic cell cycle Mitosis and meiosis Transposable elements Profiling and polymorphisms Gene technology as applied molecular genetic: Techniques, enzymes, application Ethical aspects of molecular genetics Composition, structure and reproduction of the most important virus families <u>Content of the lab work</u> 1. Bacterial Conjugation 2. Bacteriophage Titering 3. Isolation of Plasmid DNA by HiSpeed Plasmid Mini-Preparation 4. Determination and Characterisation of Plasmid DNA

	5. Isolation of Human Genomic DNA from Buccal Swabs 6. Typing of Human Genomic DNA
Assessment	Successful participation the practical course . Marked written exam (120 min.)
Teaching style:	L: Powerpoint presentation, black board, videos, text books P: Written manuscript, videos, text books
Indicative Bibliography/Sources:	Lewin Genes XII, Pearson Verlag Griffiths, Gelbart, Miller, Lewontin; Modern Genetic Analysis; Freeman and Company D. M. Knipe and P. M. Howley; Fields Virology; Lippincott Williams & Wilkins Birge; Bacterial and Bacteriophage Genetics; Springer Verlag Alberts, Bray, Lewis, Raff, Roberts, Watson, Molekularbiologie der Zelle, VHC Verlagsgesellschaft Clark, Molecular Biology, Understanding the Genetic Revolution Kippers, Molekulare Genetik, Thieme Verlag Nicholl; Gentechnische Methoden; Spektrum Verlag (German) Henning; Genetik, Springer Verlag (German) Lewin; Molekularbiologie der Gene; Spektrum Verlag (German)

Module:	**Instrumental Analysis**
Semester:	3rd Semester
Course coordinator:	Prof. Angelika Muscate-Magnussen
Lecturer:	Prof. Angelika Muscate-Magnussen
Language:	English
Assignment in Curriculum:	Compulsory Course in the 3rd Semester Applied Biology
Course units/Credit hours:	L: 2 SWS E: 3 SWS, max. group size: 60 Lab work: 1 SWS; group size: max. 16
Student workload:	Contact hours Self study L: 30 30 E: 45 60 P: 15 30 Sum: 90 120 Sum total: 210 hours
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendation:	Mathematics (1st Sem.), General Chemistry (1st Sem.), Physics/Statistics (2nd Sem.)
Learning outcomes:	Students are able to explain the basic principles of electrophoretic and chromatotographic separation methods and current detection methods select a suitable detector for a particular analyte class design reasonable workflows for the qualitative and quantitative analyses of small organic compounds, proteins and carbohydrates adjust the workflow to different sample matrixes deduce and assess basic analytical parameter from chromatograms, mass spectra and electropherograms for method development conduct basic hands-on experiments in UVVIS spectroscopy, SDS-PAGE and sample preparation for HPLC by means of understanding the principles of analyte separation and detetction the strategies of qualitative and quantitative analysis the physiochemical properties of the major analyte classes in the biomedical field the relationship of structure and function in proteins, lipids, carbohydrates and small molecules in order to develop and optimize sample purification and quantification workflows on an introductionary level evaluate chromatograms and mass spectra for further development
Content:	Lecture: Classes of analytes: Proteins, peptides, carbohydrates, lipids, nucleic acids and small organic molecules; physicochemical properties and structure-function relationships Fundamentals and major applications of chromatographic and electrophoretic separation and detection methods: RP-HPLC, IEC, SEC, HILIC, CE, GC, SDS-PAGE, IEF, TLC, UVVIS, LC-MS, MALDI-MS, TOF, ion trap and quadrupole, LSD and fluorescence detection Sample preparation: SPE, dialysis, ultrafiltration, extraction, precipitation

	Exercise: Biochemical calculations, data analysis and evaluation based on problem sets and case studies of the primary literature Lab course: SDS-PAGE, UVVIS spectroscopy, RP HPLC, sample preparation
Assessment:	Written exam, 120 min. – 100% of overall grade. Successful participation in the practical class
Teaching style:	L/E: Power Point Presentation, self assessment tools like Kahoot, Quizacademy, LEA quizzes, eboards like padlet, video animations, video lectures, textbooks P: Script, textbook, lab videos
Textbooks:	Westermeier, R. (2016) Electrophoresis in practice : A guide to methods and applications of DNA and protein separations, Wiley-VCH Lottspeich, F. & Engels, J. (2018) Bioanalytics: Analytical Methods and concepts in biochemistry and molecular biology, 1st. ed., Wiley-VCH Snyder, Kirkland, J.J. and Dolan, J.W. (2010) Practical HPLC method development, 3rd. ed., New York, John Wiley & Sons John Greaves und John Roboz (2014) Mass spectrometry for the novice, CRC Press

Module:	**Physiology**
Semester	3rd Semester
Course Leader:	Prof. Dr. Mike Althaus
Lecturer:	Prof. Dr. Mike Althaus
Language:	English
Assignment in Curriculum:	Compulsory Course in the 3rd Semester B.Sc Applied Biology
Course Units/Credit hours:	The module consists of Lectures with integrated Exercises, and Practical Classes. Lectures: 3 credit hours Exercises: 1 credit hour Practical classes: 2 credit hours; max. group size 15
Student workload:	Contact hours / Private study time (hours) Lectures: 45 / 90 Exercises: 15 / 15 Practical classes: 30 / 15 Sum: 90 / 120 Total sum: 210
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful participation in "Human Biology/Histology"
Learning outcomes:	Student are able to describe and explain physiological processes with correct terminology, explain simple pathophysiological observations, perform, obtain, analyse, interpret and communicate data derived from simple physiological experiments, by learning basic physiological concepts in lectures and by applying their knowledge to answer physiological questions in exercises and practical classes, applying basic physiological concepts to answer questions related to pathophysiological mechanisms in lectures and exercises, performing physiological experiments (supervised in small groups) and delivering adequate experimental analyses, interpretation and documentation, in order to apply their knowledge in physiological concepts to understand and interpret specialist literature in Physiology. apply their knowlede in physiological concepts to understand and interpret specialist literature in Pathophysiology and Biomedicine. apply their skills to interprete and document experimental data derived from physiological/pathophyssiological experiments.
Summary of indicative content:	Lectures/Exercises: The module teaches basic concepts in Physiology as well as simple pathophysiological mechanisms: Concepts of membrane physiology and membrane transport Structure and function of neurons (CNS and periphery) Physiological techniques Functional organisation of nervous systems Physiology of the senses: visual system, mechanical senses, chemical senses, temperature sensation Structure and function of muscles Blood Physiology of the cardiovascular system Respiration Renal Physiology

	Digestion Practical classes: Students will perform physiological experiments, analyse, interpret and document experimental data. Practical classes include experiments in the laboratory as well as simulations of physiological experiments (virtual Physiology): Recording of action potentials with extracellular electrodes Determination of nerve conduction velocity Physiology of the human senses: visual system and mechanical senses Physiology of skeletal muscles (virtual Physiology) Recording of ECGs Regulation of heart activity by the autonomic nervous system (virtual Physiology)
Assessment	Successful participation in the practical class. Written Exam 90 min.
Teaching style:	Lectures/Exercises: PowerPoint, Blackboard/Whiteboard, digital content (e.g. Videos), written Exercises, Textbooks Practical classes: written instructions incl. theoretical background, digital teaching formats (virtual Physiology), Other
Literature:	Silverthorn: Human Physiology - An Integrated Approach, 8th ed., Pearson Tortora & Derrickson, Principles of Anatomy and Physiology, 11th ed., Wiley

Module:	**Measuring Techniques**
Semester:	3. Semester
Course Leader:	Prof. Dr. Ulrich Essmann / Prof. Dr. Peter Kaul
Lecturer:	Prof. Dr. Ulrich Essmann
Language:	English
Assignment in Curriculum:	Compulsory Course in the 3rd Semester Applied Biology
Course Units/Credit hours:	Lecture: 1 credit hour Exercise: 1 credit hour Lab work: 1 credit hour
Workload:	Contact hours / Private study Lecture: 15 / 15 Exercise: 15 / 15 Lab work: 15 / 15 Sum: 45 / 45 Total Sum: 90 hours
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules Mathematics and Physics/Statistics
Learning outcomes:	The students are able to: explain the fundamental phenomena and principles of electricity, magnetism, oscillations and waves and optics and describe them by mathematical equations describe the results of scientific experiments quantitatively and recognize the limitations of the experiments based on the inherent experimental uncertainties by developing solutions for simple problems in the aforementioned fields and discussing physical problems applying the concepts of mechanics and thermodynamics to the analysis and understanding of experiments and apparatuses performing experiments in a team and analyse these experiments with statistical tools and error analysis in order to work independently in a scientific laboratory and plan and perform scientific experiments develop new concepts in a laboratory and work environment to overcome experimental difficulties work in a scientific environment based on a solid basis be able to develop and critically assess scientific reasoning use the physical knowledge to acquire new scientific fields
Summary indicative content:	Lecture: Oscillations and waves (mathematical description, superposition of oscillations and waves, interference); Optics (Hygens' principle, geometrical optics, physicsl optics, refraction, interference, diffraction gratings, dispersion, polarisation); Elektricity (charges, elektric field, elektrostatics, elektric potential, elektric current, Ohm's law, direct current circuits); Magnetism (moving cahrges, electromagnetic induction, magnetism in matter, alternatinc current circuits); Applications in measuring instruments Exercise: Applications of the concepts presented in the lecture to real problems to enhance the understanding of the physical principles. Practical course:

	Experiments in the different fields of the module are performed in small groups (usually 2 students per group). The subject areas comprise oscillation and waves (including the parameters to describe waves), optics, physical optics, electricity and the statistical analysis of data including error discussion (random vs. systematic errors) and error propagation. The topics of the lecture are considered from a more practical standpoint of view.
Assessment	Written exam 120 min. – graded The successful passing of the laboratory course is a prerequisite for the completion of the module.
Teaching style	Lecture: Blackboard, demonstration experiments, computer experiments (Applets), video clips and lectures Exercises: Written exercises, blackboard Practical course: Manuscript for the practical course
Indicative Bibliography/Sources	Physics: Fundamentals of Physics, Halliday, Resnick, Walker, Wiley, 2001 Physics in Biology and Medicine, Davidovits, Harcourt Academic Press Physics for Pre-Med, Biology, and Allied Health Students, Hademenos, McGraw-Hill Physics with illustrative examples from Medicine and Biology, Biological Physics Series Gerthsen; Physik, Springer-Verlag, Berlin J. Rybach, Physik für Bachelors, 2. Aufl., Leipzig 2010 J. Orear, Physik, dt. Ausgabe, München 1982 Measuring techniques: H.-R. Tränkler, Taschenbuch der Messtechnik, Verlag R. Oldenbourg, München J. Niebuhr, G. Lindner: Physikalische Messtechnik mit Sensoren, Oldenbourg Verlag J. Hoffmann, Taschenbuch der Messtechnik, Fachbuchverlag Leipzig

Module:	**Medical Microbiology**
Semester:	3rd Semester
Course Leader:	Prof. Dr. Dieter Reinscheid
Lecturer:	Prof. Dr. Dieter Reinscheid
Language:	English
Assignment in Curriculum	Compulsory Course in 3rd Semester Applied Biology
Course Units/Credit hours:	The teaching unit consists of lectures, accompanying exercises and experiments. L: 2 SWS E: 2 SWS; group size: max. 60 P: 2 SWS; group size: max. 16
Students' workload:	Contact hours / Private study Lecture: 30 / 30 Exercise: 30 / 40 Lab work: 30 / 20 Sum: 90 / 90 Total Sum: 180 hours
Credits:	6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	For safety reasons, a successful participation in the laboratory course of the module ´Microbiology´ is mandatory for the attendance of the laboratory course in the module ´Medical Microbiology´.
Learning outcomes:	The students can allocate different antibiotics to their respective areas of application distinguish pathogenic organisms, recognise their clinical pictures and take protective measures against infectious diseases isolate pathogenic microorganisms from clinical specimens and identify them on the basis of physiological characteristics. by learning the defence mechanisms of the human body, the mode of action of antibiotics and the pathogenicity mechanisms of different pathogens in the lecture reflecting on the knowledge gained in the exercises and applying it to diagnostic or infectious examples cultivate pathogenic organism in the laboratory under L2 safety conditions, perform physiological and serological tests with pathogens and interpret the results obtained to perform and evaluate microbiological tests in the diagnostic work environment carry out research in the field of infection biology to characterise pathogenic mechanisms of pathogens or the mode of action of antimicrobial substances.
Summary indicative content:	The module teaches the basics of the interaction between microorganisms and humans regarding the microbiome as well as infections by pathogenic organisms: Definitions and subject-specific terms of medical microbiology Normal flora of humans: Tissue tropism, microbial metabolic functions, health-promoting/harmful effects on the host Infection steps: Transmission, attachment to and invasion of the host, damage to the host, bacterial strategies to protect themselves against the immune system Toxins: Classification, mode of action Antibiotics: Classes of substances, mode of action, areas of application Infectious diseases of the skin, gastrointestinal and genital tract, cardiovascular system, respiratory tract and central nervous system:

	pathogens, infection routes, symptoms and course of disease, virulence factors and therapy Isolation and characterisation of pathogenic organisms in the laboratory Carrying out an epidemiological study on the distribution and antibiotic resistance of Staphylococcus aureus Carrying out a serological diagnosis of different streptococcal species
Study Assessment	Successful participation in the laboratory course
Examination Assessment:	Module examination - graded 100% written final exam (120 min)
Teaching style:	L/E: Powerpoint presentation, blackboard/whiteboard, digital content for post-processing (e.g. teaching videos, screenshots), textbooks P: written instructions for experiments
Indicative Bibliography/Sources:	1. Tortora, Funke & Case: Microbiology - An introduction, 13. Edition, Benjamin-Cummings, San Francisco, 2018. 2. Black: Microbiology: Principles and Explorations, 9. Edition, John Wiley & Sons, Hoboken, 2015. 3. Salyers & Whitt: Bacterial Pathogenesis. A molecular approach, 4. Edition, ASM Press, Washington, 2019. 4. Madigan, Martinko & Parker. Brock Biology of Microorganisms, 15. Edition, Benjamin Cummings, San Francisco, 2018.

Module:	**Immunology**
Semester:	4 th Semester
Course leader	Prof. Harald Illges
Lecturer	Prof. Harald Illges
Langage	English
Assignment to Curriculum	Compulsory Course in Semester 4, Applied Biolgoy
Course units/credit hours	This module consists of lectures, exercises and a practical course. Lecture: 2 credit hours Exercises 2 credit hours Practical course: 2 credit hours
Students' workload	Contact hours Self study L: 30 30 E: 30 30 P: 30 60 Sum 90 150 Sum Total 210 h
Credits	7 ECTS
Prerequisites according to examination regulations	None
Recommended prerequisites	Successful participation in Cell Biology and Molecular Genetics
Learning Outcomes	Students will be able to understand basic immunological mechanisms apply their knowledge to answer basic questions apply their knowledge to theoretically design basic experiments apply basic immunological techniques by understanding the basic properties of important immune cells understanding the basic principles of B-cell and T-cell interactions within the immune system. Performing cell-based analyses understandng basic principles in the design of cellular immunological experiments to Understand basic experimental protocols for simple and applied experiments. Use basic knowledge to understand publications and experimental protocols. Be able to classify basic questions in the literature and experimental approaches.
Content	Lecture Basics FACS and MACS technologies, applications of the techniques. B Cell biology. Differentiation, activation, germinal centre reaction Production of recombinant antibodies, hybridoma technology. Vaccines, vaccines. Antibody structure, somatic hypermutation, epitopes, affinity, avidity. T cell immunology, development, cytotoxic, helper, regulatory T cells. Activation, MHC restriction, culture T cells. Complement system, complement receptors, immune complexes, immune complex disease. Exercise: Questions related to lecture, discussion of thematically related experiments.

	Practical course: Blood group test. Isolation of lymphocytes and FACS analysis. Magnetic sorting with MACS.
Assessment:	Successful participation in the practical class. Written exam 120 min., graded
Teaching Style	Powerpoint Presentations, Videos, Textbook, Blackbard, Wihteboard
Indicative Bibliography/Sources:	Janeway Immunobiology, Garland, aktuelle Edition.

Module	**Bioinformatics and Data Analysis**
Semester	4. Semester
Course leader	Prof. Dr. Matthias Preller
Lecturer	Kurt Stüber, Prof. Dr. Matthias Preller
Language	English
Assignment to Curriculum	Compulsory course Semester 4 Applied Biology
Course untis/credits hourse	The module consists of a a lecture and exercises Lecture: 3 credit hours Exercise 3 credit hours
Students' workload	Contact hours Self Study L: 45 60 E: 45 60 P: 0 0 90 120 Total: 210 hours
Kreditpunkte:	7 ECTS
Prerequisites acoording to examination regulations	None
Recommended prerequisites	Successful participation in the modules Computing Science, General Chemistry, Physics/Statistics and Instrumental Analysis
Learning Outcome	The students are able to name and explain different bioinformatic methods for comparative sequence analysis Use the Python programming language to find, analyse and visualise scientific data and to automate iterative tasks. Use biological databases to find, compare and analyse primary sequences with bioinformatic programs and to interpret the results. Assess and apply the possibilities and limitations of protein structure prediction and modelling approaches Describe basic approaches to computer-aided drug discovery and evaluate resulting results by Learning the concepts and algorithms of bioinformatics methods in the lecture and using them in practical, application-oriented exercises to find DNA sequences in databases, compare them with unknown sequences, and construct phylogenetic trees, as well as perform protein structure and function predictions Learn the basics of programming and perform script-based, exemplary bioinformatics tasks to organise, analyse and visualise data. to apply the learned, theoretical basics directly in practical exercises in smaller groups on the computer and to reflect and discuss the results and approaches in order to Build core competencies in the context of the digitisation of the life sciences and be able to use them to analyse different amounts of data from various sources, such as genomics, transcriptomics, proteomics and metabolomics. To gain practical knowledge of programming for biological questions. To achieve a basic understanding of the advantages and disadvantages of bioinformatics methods and the connection between gene sequences, protein structure and function
Content	The module provides general knowledge of modern methods of bioinformatics and data science, as well as the underlying algorithms. In addition to the basics of programming, bioinformatics techniques

	are used in application-oriented exercises for data evaluation of different data volumes and for data visualisation: Basics of programming with Python (data management, databases, automation, controlling external prorgams, data visualisation). Overview of biological databases (e.g. NCBI, EBI) Genome and sequence comparisons (genome organisation, dotplots, scoring matrices, pairwise and multiple alignment (e.g. BLAST, FASTA)) Homology, similarity and evolution (phylogenetic trees) Proteome and protein structure function (structure elucidation and protein structure database (e.g. PDB), visualisation of 3D structures, physicochemical properties of proteins) Classification of protein structures (e.g. DALI, SCOP, CATH) Protein structure prediction, (homology modelling, AI-based prediction) Molecular modelling and drug design
Assessment	Successful participation in the exercise sessions. Graded written exam 120 min. (100%)
Teaching Style	Powerpoint, Blackboard/Whiteboard, Transparencies, Computer software (while working at PC), Textbooks, exercise sheets
Indicative Bibliography/Sources:	S. Choudhuri, Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools, Academic Press, 2014 A.M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2019 A.D. Baxevanis, B.F.F. Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley, 2004 P.M. Selzer, R. Marhöfer, A. Rohwer, Applied Bioinformatics, Springer, 2008 R. Merkl, S. Waack, Bioinformatik interaktiv: Grundlagen, Algorithmen, Anwendungen, Wiley-VCH, 2009 M.J. Zvelebil, J.O. Baum, Understanding Bioinformatics, Garland Science, 2008 R. Durbin, S.R. Eddy, A. Krogh, G. Mitchison, Biological Sequence Analysis, Cambridge University Press, 1998

Module:	**Cell Culture**
Semester:	4th semester
Course Leader:	Professor Dr. Edda Tobiasch
Lecturer:	Professor Dr. Edda Tobiasch
Language:	English
Assignment in Curriculum:	Compulsory Course in the 4th Semester BSc Applied Biology
Course Units/Credit hours:	Lecture: 1 credit hour Lab work: 2 credit hours; max. group size: 24
Students workload:	Contact hours / Private study Lecture: 15 / 30 Lab work: 30 / 15 Sum: 45 / 45 Total Sum: 90 hours
Credits:	3 ECTS
Prerequisites according to examination regulations:	General Safety Instruction, S1 Safety Instruction
Recommendations:	Passing the modules of the 1st, 2nd and 3rd semester
Learning outcomes:	The students are able: to use the cell culture equipment correctly. to work sterile in cell culture. to in vitro cultivate and sub cultivate monolayer and suspension cells. to recognize and test for contaminations. to perform in vitro gene transfer into eukaryotic cells. by knowing the cell culture equipment. knowing how to get information about cell lines and order them. discriminating cell lines from primary cells and lab scale from technical scale. recognizing chromosome banding patterns. discriminating contaminations and their sources. knowing the basic of apoptosis. to use and judge the learned skills in professional, scientifically and economically settings
Summary indicative content:	Lecture: Basics of cell- and tissue culture; appropriate handling of cell culture equipment Sterile techniques and sterile working Biology of cultivated cells; cultivation of primary cells; cloning and characterization of cell lines; cultivation and sub cultivation of cell lines; techniques of quantification of eukaryotic cells "Scale-Up" of cell cultures Contaminations in cell culture: Detection, control and prophylaxis Transformation of cells and tumour cells Stem cells and differentiation Karyotyping Cell death: apoptosis and necrosis Lab work: Permanent cell culture of monolayer and suspension cells with splitting, freezing and thawing of the cells RT-PCR and nested PCR for detection of mycoplasma infection Gene transfer into eukaryotic cells and use of reporter genes
Academic Achievement	Successful participation the practical course
Assessment	Marked written exam (120 min)
Teaching style:	L: Powerpoint presentation, black board, videos, text books P: Written manuscript, videos, text books

Indicative Bibliography/Sources:	Freshney's Culture of Animal Cells: a Manual of Basic Technique and specialized Applications (8th Edition), A. Capes-Davies, R.I. Freshney, Wilhey-Liss, ISBN: 978-1-119-51304-9 Zell-und Gewebekultur: allgemeine Grundlangen und spezielle Anwendungen (7. Auflage), G. Gstraunthaler, T. Lindl, Spektrum Verlag ISBN: 978-3-642-35997-2

<table>
<tr><td>Module</td><td colspan="3">Biochemistry</td></tr>
<tr><td>Semster</td><td colspan="3">4. Semester</td></tr>
<tr><td>Course Leader</td><td colspan="3">Prof. Dr. Jörn Oliver Sass</td></tr>
<tr><td>Lecturer</td><td colspan="3">Prof. Dr. Jörn Oliver Sass</td></tr>
<tr><td>Language</td><td colspan="3">Englisch</td></tr>
<tr><td>Assignment to Curriculum</td><td colspan="3">Pflichtfach 4. Sem. B.Sc. Applied Biology</td></tr>
<tr><td>Course units/credit hours</td><td colspan="3">The module consists of lectures, exercises and a practical class.

Lecture: 4 credit hours
Exercises : 1 credit hour
Practical class 2 credit hours</td></tr>
<tr><td rowspan="6">Students' workload</td><td></td><td>Contact hours</td><td>Self Study</td></tr>
<tr><td>Lecture</td><td>60</td><td>60</td></tr>
<tr><td>Exercise</td><td>15</td><td>15</td></tr>
<tr><td>Practical Class</td><td>30</td><td>30</td></tr>
<tr><td>Sum</td><td>105</td><td>105</td></tr>
<tr><td>Total</td><td colspan="2">210 Hours</td></tr>
<tr><td>Credits</td><td colspan="3">7 ECTS</td></tr>
<tr><td>Prerequisites according to examination regulations</td><td colspan="3">None</td></tr>
<tr><td>Recommended prequisites</td><td colspan="3">Successful participation of the Organic Chemistry and Instrumental Analysis modules wiil be essential for completion of the Biochemistry module.</td></tr>
<tr><td>Learning objectives</td><td colspan="3">Students will be able to
comprehend, understand and explain the basics of biochemistry
Understand experimental descriptions and perform calculations required for laboratory work.
carry out and evaluate biochemistry experiments and critically interpret results with the aid of specialist literature
by
being guided in the lecture to understand principles of biochemistry and learning the basics
prepare experiments based on the lecture and script and learn to perform calculations in the exercises
to link theoretical knowledge with practice in the laboratory

in order to
further qualify in further studies, in final thesis and professional practice, based on the contents of this module, and be able to work scientifically, theoretically and experimentally
be able to build on a solid foundation (including practical skills) in the field of biochemistry in other fields of work</td></tr>
<tr><td>Content</td><td colspan="3">Lecture:

General Introduction, Safety Instruction, Introduction into the Practical Course)
Foundations of Biochemistry
Amino Acids and Peptides
The Three-Dimensional Structure of Proteins
Protein Purification and Characterization
Enzymes
Lipids: Membranes, Vitamin A and Vision
Photosynthesis
Carbohydrates (including Glycolysis and Glycogen storage, Pentose Phosphate Pathway)
The Citric Acid Cycle
Fatty Acid Oxidation</td></tr>
</table>

	Electron Transfer and Oxidative Phosphorylation Nitrogen Metabolism (including Metabolism of Purines & Pyrimidines and amino acids, Urea Cycle) Signaling and Regulation In the exercise, contents of the lecture are deepened as well as - if required - aspects of the practical course/the protocol as part of assessment of the practical course. In addition, the performance of calculations is practised/repeated (e.g. buffer, photometry, enzyme kinetics), which are important for biochemistry. In the practical course, experiments are carried out which serve to acquire basic skills or to introduce/ make areas of biochemistry comprehensible in other ways/ for other types of learners (e.g. protein quantification, enzyme kinetics, energy metabolism).
Assessment	Regular and active participation in the practical class and the exercise sessions. Successful preparation of a lab report. Written exam 120 min. (100%), graded
Teaching Style	Lecture/Exercises: Power- Point-Presentation, Black board, White board, textbooks, essays, exercise sheets, digital content Practical classes:, Script, literature, digital content
Indicative Bibliography/Sources	u.a. -Campbell & Farell, Biochemistry, Cengage Learning , 8th ed., 2015 -Berg/Tymoczko/Stryer, Biochemistry, Freeman, 7th ed., 2012 -Nelson/Cox, Lehninger Principles of Biochemistry, Freeman, 6th ed., 2013 -Devlin, Textbook of Biochemistry, Wiley , 7th ed., 2011 -Hames & Hooper, Biochemistry, Garland Science, 4th ed., 2011 -Garrett & Grisham, Biochemistry, Cengage , 5th ed., 2013 -Voet/Voet/Pratt, Principles of Biochemistry, Wiley , 3rd ed., 2008 -Michal & Schomburg, Biochemical Pathways, Wiley , 2nd ed., 2012 -Lottspeich & Engels (eds). Bioanalytics, Wiley-VCH, 2018 (bzw. Folgeauflagen) -Fachaufsätze -Diverse Online-Ressourcen

Module	**Elective A-1/A-2**
Semester	4. Semester
Course Leader	Professors of the Department
Lecturer	Members of the Department
Languange	English
Assignment to Curriculum	Elective Course Semester 4 Applied Biology
Course units/credit hours	Module may consist of lectures, exercises, practical classes or a combination of those
Students' workkload	90 hours in a combination of contact hours and self study
Credits	3 ECTS
Prerequisites according to examination regulations	None
Recommended prerequisites	None
Learnng Outcome	The students are able Correctly describe, interpret, explain and evaluate the content taught in the elective subject from the field of biology. By Having chosen the elective subject according to their interests. Having articipated in the lectures, exercises or seminars and actively contributed to them Relating the concepts taught to content from previous semester modules. In order to further educate and pursue their own academic interest, and to develop a better idea of possible further specialisations in fifth semester electives or selection of a place for the thesis.
Content	Students choose two courses from the course catalogue in the Elective A category. These catalogue comprises exclusively English-language courses, which are offered by lecturers from the department. Students can combine two elective A on the same topic to form a 6 ECTS module or combine elective A with different content. Further information on the content and intended learning outcomes of individual Elective A courses can be found in the elective catalogue of this module handbook.
Assessment	Will be determined by the course leader and will be communicated to students in the corressponding module description as well as during the first session of the course. All forms of examination which are defined in the examination regulations might be used.
Teaching style	Will be determined by the course leader.
Indicative Bibliography/Sources:	Will be determined by the course leader.

Module	**Developmental Biology**		
Semester	5. Semester		
Course Leader	Prof. Dr. Christopher Volk		
Lecturer	Prof. Dr. Christopher Volk		
Language	English		
Assignment to Curriculum	Compulsory Course in semester 5 of study programm Applied Biology		
Course units/Contact hours	This course consists of lectures, exercises and a practcal class Lecture: 2 contact hours Exercises: 2 contact hours Practical classes: 2 contact hours		
Students' workload		Contact hours	Self Study
	Lecture	30	70
	EExercises	30	20
	Practical Class	30	30
	Sum total	90	120
	Total	210 Hours	
Kreditpunkte	7 ECTS		
Prerequisites according to examination regulations	None		
Recommended prerequisites	Successful participation in the modules Human Biology/Histology and Molecular Genetics		
Learning Objectives	The students are able to demonstrate an in-depth understanding of the basic mechanisms of the regulation of individual development. Show a detailed knowledge of human embryology in particular by Learning the basic mechanisms of the regulation of developmental processes in the lecture, In the following, getting to know the most important model organisms used to study developmental processes, and finally studying the more detailed processes, in particular of human embryology. further deepen and apply this learned knowledge in the exercises. study the embryonic development of two model organisms (Xenopus & C. elegans) in the practical course and detect the different expression of various developmental genes occurring during this development by molecular biology (using qPCR). In order to be able to use the acquired knowledge and skills in research, clinic and industry.		
Content	Genetic basis of developmental biology, control of differential gene expression at transcriptional, translational and post-translational levels, building on the foundations laid in Molecular Genetics. Mechanisms of cell migration and communication important for understanding embryonic development, mode of action of signalling molecules. Presentation of the most important model organisms for the study of developmental processes, including their early embryonic development: sea urchins, C. elegans, Drosophila, Xenopus laevis. Gametogenesis and fertilisation: development of egg and sperm cells, fertilisation, first developmental steps of the zygote. Gastrulation: development and differentiation of the three germ layers endoderm, ectoderm and mesoderm. Early human embryology: Implantation of the germ in the uterus, formation and function of the placenta. Organogenesis: detailed examination of the further development of selected human organs: Cardiovascular system, CNS, digestive tract, lungs, limbs.		

	Sex differentiation: regulation of the formation of a female or male phenotype by genes and hormones. Postembryonic development: Metamorphosis in amphibians and insects. Postembryonic development: ageing processes at the cellular and organismal level.
Assessment	Successful participation in the practical class as proven by lab reprts and presentation of a scientific report during the exercises. Written Exam 90 min. (100%), graded
Teaching Style	Lecture/Exercises: Power-Point Presentations, Black board, White board, digital content (screencasts, videos, Kahoot Quizzes) Practical class: script including background information on the experiments, Powerpoint Presentations, digital content.
Indicative Bibliography/Sources:	M.J. Barresi, S.F. Gilbert: Developmental Biology. Sinauer Oxford, 12. Auflage 2020. L. Wolpert, C. Tickle, A.M. Arias: Principles of Development. Oxford University Press, 6. Auflage 2019. K.L. Moore, T.V.N. Persaud, M.G. Torchia: The Developing Human. Elsevier, 11. Auflage 2019. W. Müller, M. Hassel: Entwicklungs- und Reproduktionsbiologie. Springer, 6. Auflage 2018. B. Christ, F. Wachler: Medizinische Embryologie. Ullstein Medical, 1998.

Module	**Genetic Engineering**		
Semester	5. Semester Bsc Applied Biology		
Course Leader	N.N (Succession Prof Weiher)		
Lecturer	Dr. Alexander Glassmann/ Dr. Barbara Roitzheim)		
Language	English		
Assignement to curriculum	Compulsory course in semester 5 of the study program Applied Biology		
Course units/Contact hours	This course consists of lectures, exercises and a practical class. Lecture: 2 contact hours Exercises: 2 contact hours Practical class: 2 contact hours		
Students' Workload		Contact hours	Self Study
	Lecture	30	60
	Exercises	30	30
	Practical class	30	30
		90	120
	total	210 Hours	
Credits	7 ECTS		
Prerequisites according to examination regulations	None		
Recommended prerequisites	Successful participation in the modules Molecular Genetics and Biochemistry		
Learning outcomes	The students are able to understand molecular biological basics of genetic engineering applications explain procedures, methods and techniques required for cloning processes and their molecular or biochemical basis use different vector systems and can evaluate them with regard to their usability for different applications. Establish and analyse recombinant DNA molecules and understand the latest genetic engineering methods. assess the importance of gene libraries and know their production methods Evaluate the production and use of plant and animal transgenic organisms. interpret, understand and evaluate current scientific results in the field of genetic engineering. by learning the theoretical basis for genetic engineering getting to know molecular biological methods and their application in order to carry out and analyse genetic engineering experiments as well as to establish their correct detection discussing practical methods in the exercises and perform bioinformatic techniques "hands-on" to plan in-silico cloning and diagnose by PCR and use sequencing for validation. generating in vitro recombinant nucleic acid by PCR and cloning it molecularly, identifying recombinant clones and detect ingthe expression of the cloned gene in the practical course in order to use the learned genetic engineering principles and analyses for the interpretation of molecular genetic processes and reactions as well as their analysis in scientific and/or commercial laboratory practice have developed a deeper understanding of the isolation and analysis of nucleic acids and their molecular-biological reactions on the basis of the basic gene-technological methods learned.		
Content:	During this module students get familiar with the basics and strategies of genetic engineering work with vector systems for the identification and characterisation of genes and their usefulness for biotechnological applications.		

	Basics of recombinant DNA technologies with the handling of plasmids (episomes, vectors) and their structural components. Use of nucleic acid modifying enzymes for genetic engineering and construction of synthetic vectors. Bacteriophages (viruses of bacteria) as useful vehicles for generating gene libraries to identify new genes. Nucleic acid transfer into living cells and the use of vectors outside of bacterial cells. Polymerase chain reaction (PCR) in diagnostics and its potential in recombinant gene technology Sequencing strategies for the structural validation of genes and the analysis of recombinant clones. New cloning strategies using recombination technologies Vector systems for mammalian cells also using viral vectors Gene editing technologies for modulating genetic structures (CRISPR/Cas9) and influencing gene expression (miRNA, siRNA, shRNA)
Assessment	Succesfull participation in the practical class. Written exam 120min. (100%), graded
Teaching style	Lecture: Powerpoint-Presentations, Blackboard, Whiteboard, textbooks, Exercises: web-pages which allow for bioinformatic exercises; "in silico" cloning tools (Serialcloner, SnapGene Viewer, BioEdit) Practical Class: script including introduction to the experiments, digital content
Indicative Bibliography/Sources:	Gene Cloning and DNA Analysis T. A. Brown; Wiley Blackwell, 2016 ISBN: 978-1-119-07256-0 Genetics: Analysis of Genes and Genomes D. Hartl & B.J. Cochrane; Jones & Bartlett Learning, 2018; ISBN-13: 978-1284122930 Molecular Biology of the Gene 7th ed. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick; Benjamin Cummings, 2013; ISBN: 978-0321762436 Molecular cloning: a laboratory Manual., Vol. 1,2 and 3, 4th Ed, Sambrook, Fritsch., Maniatis, Cold Spring Harbor Laboratory Press, ISBN 978-1-936113-41-5 Current Protocols in Molecular Biology https://currentprotocols.onlinelibrary.wiley.com/journal/19343647?tabActivePane=undefinedh

<table>
<tr><td>Module</td><td colspan="3">Structural Biology</td></tr>
<tr><td>Semester</td><td colspan="3">5. Semester</td></tr>
<tr><td>Course Leader</td><td colspan="3">Prof. Dr. Matthias Preller</td></tr>
<tr><td>Lecturer</td><td colspan="3">Prof. Dr. Matthias Preller</td></tr>
<tr><td>Language</td><td colspan="3">English</td></tr>
<tr><td>Assignment to curriculum</td><td colspan="3">Compulsary course, Semester 5 in the Applied Biology program</td></tr>
<tr><td>Course units/Credit hours</td><td colspan="3">This module comproses lectures and exercises as well as a practical class.
Lecture: 2 contact hours
Exercises 2 contact hours
Practical class: 2 contact hours</td></tr>
<tr><td rowspan="6"></td><td></td><td>Contact hours</td><td>Self Study</td></tr>
<tr><td>Lecture</td><td>30</td><td>60</td></tr>
<tr><td>Exercise</td><td>30</td><td>30</td></tr>
<tr><td>Practical Class</td><td>30</td><td>30</td></tr>
<tr><td></td><td>90</td><td>120</td></tr>
<tr><td>Total</td><td colspan="2">210 Hours</td></tr>
<tr><td>Credits</td><td colspan="3">7 ECTS</td></tr>
<tr><td>Prerequisites according to examination regulations</td><td colspan="3">None</td></tr>
<tr><td>Empfohlene Voraussetzungen</td><td colspan="3">Successful participation in modules General Chemistry and Biochemistry</td></tr>
<tr><td>Learning Outcomes</td><td colspan="3">The students are ablte to
Name different methods suitable for the structural elucidation of biological macromolecules and explain the basic principles.
Make full use of the Protein Data Bank (PDB) and determine and interpret the quality of structural data provided.
Use and evaluate complementary computer-assisted methods for the analysis of ligand binding and structural dynamics
Build practical experience of crystallisation and solving three-dimensional protein structures using X-ray crystallography
by
Learning in the lecture the theoretical basis and concepts of different techniques for the structural elucidation of biological macromolecules, in particular macromolecular X-ray crystallography and cryo-electron microscopy, including the necessary preparatory steps
Applyin this theoretical knowledge directly to practical examples in the accompanying exercises and thus deepen the understanding of structures and the quality of structural data, be able to assess and discuss results
Gaining initial practical experience in the structural elucidation of proteins: Plan and carry out crystallisation approaches, record and process diffraction data, use approaches to structure elucidation from X-ray diffraction data, calculate electron density maps and refine structural models.

In order to
Build a deeper understanding of structure-function relationships of biological macromolecules, understand changes in structure (misfolding) in the context of disease and molecular recognition processes.
be able to assess the possibilities and limitations of different structural biology techniques and available structural data.
be able to analyse and visualise structural data specifically with regard to scientific questions, and to understand and interpret structural biological
Indicative Bibliography/Sources</td></tr>
<tr><td>Content</td><td colspan="3">This module deals with different imaging techniques for the structural elucidation of biological macromolecules, which enable a fundamental understanding of the architecture and function of macromolecules and cellular processes:</td></tr>
</table>

	- Fundamentals of structural biology - Protein structure and architecture - Protein Data Bank (PDB) - X-ray diffraction - Protein crystallisation - Cryo-Electron Microscopy - Negative Stain Analysis - X-ray free electron laser - Structure-based drug discovery - Molecular Docking - Structural dynamics and simulations
Assessment	Successful participation in the practical class Written exam 120 min. (100%), graded
Teaching Style	Lecture/Exercises: Powerpoint, Blackboard or Whiteboard, Software for structural anlaysis, digital content, exercise sheets Practical Class: script, digital content for preparation
Indicative Bibliography/Sources:	B. Rupp, Biomolecular Crystallography, Garland Science, 2009 G. Rhodes, Crystallography Made Crystal Clear: A Guide for Users of Macromolecular Models, Academic Press, 2006 J. Frank, Three-Dimensional Electron Microscopy of Macromolecular Assemblies, Oxford University Press, 2006 F. Lottspeich, Bioanalytics: Analytical Methods and Concepts in Biochemistry and Molecular Biology, Wiley, 2018 D. Klostermeier, Biophysical Chemistry, CRC Press, 2017

Module	**Elective B**
Semester	5. Semester
Course leaders	Members of the Departement of Natural Sciences
Lecturer	Lecturers of the Department of Natural Sciences as well as external lecturers
Language	English or German
Assignment to Curriculum	Elective Course in Semester 5 of the Applied Biology program
Course units/Credit hours	This module might consist of lectures, exercises, practical classes or a combination of those
Students' workload	The workload of this module made up by contact hours and self study equals to 90 hours
Credits	3 ECTS
Prerequisites according to examination regulations	None
Recommended prerequisites	None
Learnng Outcome	Students are able to Describe, explain, interpret and evaluate the content and concepts with scientific content taught in the elective subject. By Having chosen the elective subject according to their interests Attendeding and actively participating in the lectures, tutorials or seminars. Relating the content and concepts taught in this module to content already known in biology. In order to further pursue and deepen their own academic interests and, based on this experience, to select a suitable position for practical phase and thesis. develop a better understanding of the application of scientific research also in industry.
Content	Students choose one course from the course catalogue (Elective B). this catalogue includes English- or German-language courses offered by lecturers from the department, the university or external lecturers. Courses from this category are intended to encourage students to acquire content from other natural sciences, especially those with an applied aspect. The Deparment aims at having several elective B courses offered by lecturers from industry. The catalogue of Elective Bs changes from year to year.
Assessment	Will be determined by the lectures responsible for the course and will be communicated to students during the first session of the module. Any form of examination mentioned in the examination regulation may be used for assessment. This course is not graded.
Teaching Style	To be decided by course leader; will be communicated to students during the first session of the module
Indicative Bibliography/Sources:	To be decided by course leader; will be communicated to students during the first session of the module

Module	**Elective C**
Semester	5. Semester
Course Leader	Lecturers of the university or external lecturers
Lecturer	Lecturers of the university or external lecturers
Language	English or German
Assignment to Curriculum	Elective course of semester 5 of the study program Appied Biology
Course units/credit hours	This module may comprise lectures, exercises, a practical class or a combination ot those.
Students' workload	90 hours made up by a combination of contact hours and sef study
Credits	3 ECTS
Prerequisites according to examination regulations	None
Recommended Prerequisites	None
Learning outcome	The students are able to correctly describe, explain, interpret, discuss and apply the content taught in the elective subject from non-scientific areas. By Having chosen the elective subject according to their interests. Having participated and actively contributed to the lectures, tutorials or seminars. Having applied the concepts taught In order to - acquire not only subject and methodological competence but also extra-subject skills which they will need initially in their practical phase but also in their later professional life.
Content	Students choose one course from the catalogue of elective courses Those in the Elective C category include courses in English or German offered by lecturers from the department, the university or external lecturers. In Elective C courses, students are given the opportunity to learn about content from non-biology courses in accordance with their interests - this could be content from the field of economics or philosophy, for example. Also language courses may also be taken as Elective C. If students prefer to take another natural science elective rather than elective C in order to prepare more intensively for their practical project in this way, this is also possible.
Assessment	Will be determined by the lectures responsible for the course and will be communicated to students during the first session of the module. Any form of examination mentioned in the examination regulation may be used for assessment. This course is not graded.
Teaching Style	To be decided by course leader; will be communicated to students during the first session of the module
Indicative Bibliography/Sources:	To be decided by course leader; will be communicated to students during the first session of the module

Module	**Practical training**
Semester	6. Semester
Course Leaders	Professors of the Department Natural Sciences
Lecturer	Professors of the Department Natural Sciences
Langauge	German/English
Assignment to curriculum	Compulsory course in B.Sc. Applied Biology, B.Sc. Nachhaltige Chemie und Materialien, B.Sc. Naturwissenschaftliche Forensik, Semester 6
Course units/credit hours	Three-month internship in a laboratory, research facility or the R&D department of a company
Students' workload	3 months (540 h)
Credits	18 ECTS
Prerequisites according to examination regulations	None
Recommended prerequisites	Successful participation in the modules of semester 1- 5
Learning Outcomes	Students will be able to: work increasingly independently on scientific projects and evaluate and critically interpret the data obtained in the process by conducting experiments on a given problem independently and under supervision dealing with problems and setbacks in experimental work in a solution-oriented manner applying previously acquired technical and analytical knowledge and methodological skills in a more complex context. establishing interdisciplinary links organizing their daily work in the laboratory independently and assume responsibility as part of a team evaluating acquired data in the context of the project's research question and the current literature in order to Apply and further develop learned skills in professional, scientific and business laboratory practice.
Inhalt:	The students independently search for a place in a working group whose research topic is of interest to them. During the three-month practical phase, they are integrated into the work processes of the research group. They apply the knowledge and skills they have acquired during their studies in practice and learn new methods and techniques. They assume responsibility for the project they have taken on and further develop their social skills as a team member. At the end of the practical phase, the students have obtained the results and data sets required for the bachelor thesis. During the practical phase, students are accompanied by a lecturer from the department.
Assessment	This module is ungraded. This module is ungraded. Prerequisites for passing the module examination are: 1. regular attendance at the internship site 2. proof of completion of the practical semester (certificate / report from the company) 3. successful participation in the final evaluation discussion with the supervisor.
Teaching style	Doesn't apply
Literature	Research reports, reviews, textbook material according to the research topic.

Module	**Bachelor thesis**
Semester	6
Course leader	The Lecturers of the Department
Lecturer	The Lecturers of the Department
Language	English/German
Assignment in Curriculum	Compulsary course Semester 6 in B.Sc. Applied Biology, Nachhaltige Chemie und Materien, Naturwissenschaftliche Forensik
Course Units/Credit hours	Written work completed within two months.
Students' workload	Two months (360 h)
Credits	12 ECTS
Prerequisites according to examination regulations	Students will be admitted to the final thesis if they have a maximum of two modules from semester 1-5 not finished successfully yet. Students will be admitted to the final examination "colloquium" if they have successfully finished all modules from semester 1 and 5 as well as their practical training.
Recommendations	None
Learning Outcome	Students will be able to: work within a defined period of time on a scientific task related to their study program using methods, skills and competencies aquired during their study program, present and defend their own scientific data, results or findings both in written form (Bachelor thesis) and in oral form (colloquium) by processing the experimental data usually obtained during the practical phase in an appropriate form compiling, interpreting and discussing these in the form of a scientific publication (Bachelor thesis) using appropriate scientific literature to evaluate their data addressing critical questions about the quality or validity of their results with professional competence and comprehensive knowledge of the literature. In order to present and communicate scientific results appropriately and to specific target groups in their further academic or professional life.
Content:	Final thesis: The students write up the data, observations, and findings, which they usually will have obtained in the preceding practical phase, in the form of a written final paper (Bachelor thesis). This document, prepared within two months, is submitted to the first and second supervisor for evaluation. The supervisors will assess the paper regarding the quality of the presentation, processing of the data obtained, problem-solving approaches and their implementation. The interpretation of the results obtained and their comparison with existing literature will also be evaluated. Colloquium: Students give a presentation on the topic of their thesis. To prepare for this final oral examination students perform in advance an extensive literature research and prepare a presentation. The talk gives an in-depth insight into the theory, methods and results of the thesis and allows an outlook on future research approaches. The 20 minutes talk is to be given in free speech. Afterwards, there will be a discussion on the content of the presentation and the Bachelor thesis as well as on related topics.
Assessment	Both, Bachelor thesis and Colloquium, are graded. The final thesis is passed if the grade is at least "sufficient" . The grade of the final thesis is included with 25% in the final Bachelor grade. The colloquium is passed if the grade is at least "sufficient. The grade of the colloquium is included with 10% in the final Bachelor grade.
Medienformen**:**	Does not apply.

Elective Courses

<table>
<tr><td>Module</td><td colspan="5">Applied Clinical Research (Elective A1 bzw. Elective A1/A2)</td></tr>
<tr><td>Semester</td><td colspan="5">4. Semester</td></tr>
<tr><td>Course Leader</td><td colspan="5">Prof. Dr. Martin Sieber</td></tr>
<tr><td>Lecturer</td><td colspan="5">Prof. Dr. Martin Sieber</td></tr>
<tr><td>Language</td><td colspan="5">English</td></tr>
<tr><td>Assignment of Curriculum</td><td colspan="5">Elective Course Semester 4 of the Applied</td></tr>
<tr><td>Course units/Credit hours</td><td colspan="5">The module is made up by a lecture, exercises and a practical course
Lecture: 2 credit hours
Exercises: 2 credit hours
Practical course: 2 credit hours</td></tr>
<tr><td rowspan="6">Students' Workload</td><td></td><td>A1: Contact hours</td><td>A1: Self study</td><td>A2: Contact hours</td><td>A2: Self study</td></tr>
<tr><td>Lecture</td><td>30</td><td>10</td><td>30</td><td>10</td></tr>
<tr><td>Exercise</td><td>30</td><td>20</td><td>0</td><td>0</td></tr>
<tr><td>Practicals</td><td>0</td><td>0</td><td>30</td><td>20</td></tr>
<tr><td></td><td>60</td><td>30</td><td>60</td><td>30</td></tr>
<tr><td>Total</td><td colspan="2">90 Hours</td><td colspan="2">90 Hours</td></tr>
<tr><td>Credits</td><td colspan="5">3 ECTS (Elective A1) or 6 ECTS (Elective A1/A2)</td></tr>
<tr><td>Prerequisites according to examination regulations</td><td colspan="5">None</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Successful participation in modules of semester 1 – 3</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">Students will be able to
Name and describe the basic principles of clinical research as well as the most important types of clinical studies and assign these to questions.
Evaluate clinical studies according to their internal and external validity.
Name the most important regulations for conducting clinical studies / trials (ICH-E6 (GCP), MDR CTR 536/2014 etc) and describe their content.
Plan projects using a Gantt Chart
name the most important steps of drug approval and assign their tasks and contents
name and describe the most important tasks and steps in the conduct of studies
name the regulation of medical devices in the EU and the USA, know their contents and can assign the most important development steps. Furthermore, they can assign medical devices to the corresponding risk classes.
By
have applied the contents learned in the lecture in simulations/planning games and have carried out individual tasks of clinical monitors/CRAs themselves
have independently applied simple statistical methods (Relative Risk, Odds Ration, Confidcence Interval etc).
in order to
apply the learned contents later in the profession in research, institutes or clinics.</td></tr>
<tr><td>Content</td><td colspan="5">Basic principles of clinical research and challenges of study design.
Study types in drug development; medical device development and epidemiology
Steps in drug development & medical device development
Clinical trials and basic principles in oncology, cardiology and radiology
Conducting clinical trials/trials & basics of project management
Activity of the clinical monitor
Analysis and presentation of data sets
Discreptive statistics</td></tr>
</table>

Assessment	Successful participation in the module with a workload of 6 ECTS as A1/A2 requires passing a written examination (90 min) on the contents of the lecture and exercise as well as successful participation in the practical course, which requires a certificate in the study report. Successful participation in half of the module (3 ECTS) requires passing the written examination (60 min) on the contents of the lecture and exercise. Participation in the practical course is not required.
Teaching Style	L/E:: Powerpoint Presentation, Blackboard/Whiteboard, digital content (z.B. Videos, Screenshots), textbooks P: Script, online videos
Indicative Bibliography/Sources	Liu & Davis: A Clinical Trials Manual From The Duke Clinical Research Institute: Lessons from a Horse Named Jim Friedman: Fundamentals in Clinical Trials Spiegelhalter: The Art of Statistics

Module:	**Biotechnology**
Semester:	4th Semester
Course Leader:	Prof. Dr. Dieter Reinscheid
Lecturer:	Prof. Dr. Dieter Reinscheid
Language:	English
Assignment in Curriculum:	Elective Course in 4th Semester Applied Biology
Course Units/Credit hours:	The teaching unit consists of lectures, accompanying exercises and experiments. V: 2 SWS Ü: 2 SWS; group size: max. 60 P: 2 SWS; group size: max. 18
Student´s workload:	Contact hours / Private study Lecture: 30 / 30 Exercise: 30 / 40 Lab work: 30 / 20 Sum: 90 / 90 Total Sum: 180 hours
Credits	6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Completion of the modules "Microbiology" and "Medical Microbiology".
Learning outcomes:	The students can select the appropriate bioreactor type and suitable fermentation conditions for different fermentations apply bioprocess engineering terms in a professional manner and name biotechnological applications in the fields of food production, bioplastics, diagnostics or biomedicine purify proteins chromatographically, immobilize them and detect them by enzymatic or immunological methods by learning the basics of biotechnological terminology, the use of bioreactors and the application of biotechnology in the fields of food production, bioplastics, protein- or DNA-based diagnostics, hormone therapy or homeostasis in the lectures linking the acquired knowledge in the exercises to other biological disciplines and applying it to practical applications learning in the laboratory the purification, immobilization and enzymatic or immunological detection of proteins to gain an overview of the field of biotechnological applications and industries gain practical experience in the purification, industrial application and detection of proteins
Summary indicative content:	The module teaches fundamentals in the field of process engineering, diagnostics or biotechnological production of food, plastics and biomedical products: Bioprocess engineering basics: fermenter design, bioreactor materials and sizes, aeration, mixing or sterilization. Cultivation conditions and purification strategies: primary and secondary metabolites, yield, productivity, volume-time yield, batch and fed-batch cultivation, chemostat, turbidostat, concentration of cells by centrifugation and filtration, cell disruption. Food biotechnology: beer brewing, wine pressing, fermented dairy products, vinegar, citric acid and amino acid production, conversion of starch into fructose syrup

	Production of biopolymers: Bioplastics from polylactide, polyhydroxyalkanoates or polysaccharides. Pharmaceutical biotechnology: hormones and growth factors, enzymes and enzyme modulators Plant biotechnology: genetically modified food, meristem propagation, plant improvement. Performance of chromatographic protein purification, enzyme immobilization and enzymatic or immunological protein detection.
Assessment:	Successful participation in the module with a workload of 6 ECTS as A1/A2 requires passing a written examination (90 min) on the contents of the lecture and exercise as well as successful participation in the practical course, which requires a certificate in the study report. Successful participation in half of the module (3 ECTS) requires passing the written examination (60 min) on the contents of the lecture and exercise. Participation in the practical course is not required.
Teaching style:	L/E: Powerpoint presentation, blackboard/whiteboard, digital content for post-processing (e.g. teaching videos, screenshots), textbooks P: written instructions for experiments, online tutorials and educational videos
Indicative Bibliography/Sources:	Schmid: Pocket Guide to Biotechnology and Genetic Engineering, Wiley-VCH Verlag, Weinheim, 2003 Glick & Pasternak: Molecular Biotechnology, 6. Edition, American Society for Microbiology, Washington D.C., 2022. Thieman & Palladino: Introduction to Biotechnology, 4. Edition, 2019 Ratledge & Kristiansen: Basic Biotechnology, 3. Edition, Cambridge University Press, Cambridge, 2006 Herren: Introduction to Biotechnology: An Agricultural Revolution, 2. Edition, Thomson Delmar Learning, New York, 2013. Scragg: Environmental Biotechnology, 2. Edition, Oxford, University Press, Oxford, 2005.

Module	**Cell Migration (Elective B)**		
Semester	5. Semester		
Course Leader	Dr. Alexander Glassmann		
Lecturer	Dr. Alexander Glassmann		
Language	English		
Assignment to curriculum	Elective Course 5. Sem. B.Sc Applied Biologie (Elective B)		
Course units/Credit hours	The course consists of lecture and exercises. Lecture : 2 contact hours Exercises: 1 contact hour		
Students' workload		Contact hours	Self Study
	Lecture	30	30
	Exercise	15	15
	Practicals	0	0
	Sum	45	46
	Sum total	90 Hours	
Credits	3ECTS		
Prerequisites according to examination regulations	Keine		
Recommended prerequisites	Successful participation in Cell Biology, Human Biology, Immunology		
Learning Outcomes	The students are able to explain and characterise the cellular and biochemical processes of cell migration at the single cell level up to the complex tissue. set up experiments to describe and characterise cell migration describe cell migration in developmental biology processes and manifest in detail in brain development the necessity of neuron migration explain the correlation of migrating cells of the immune system to the development of the complex immune response recognise the association of cell migration with pathophysiological processes such as the metastatic behaviour of tumour cells by learning the theoretical basis for the complexity of cell migration in the lecture and explaining experimental approaches to analyse cell migration behaviour. discussisng the individual aspects of cell migration in the exercises and learn the analytics of cell migration by means of examples. In order to learn the scientific aspects in the development of complex biological assays (bioassays) that can be used up to preclinical studies		
Content	The module teaches the basics and strategies of the analysis of cell migration 1. mechanisms of cell migration 2. methods of analysis for the investigation of cell migration 3. cell migration in developmental biological processes 4. cell migration for the prevention of infections 5. cell migration in pathophysiological processes		
Assessment	Written Exam 60 min, ungraded		
Teaching Style	V/Ü: Power Point presentation, Blackboard/ Whiteboard, digital content, textbooks		
Indicative Bibliography/Sources:	Cell Motility From Molecules to Organisms Anne Ridley, Michelle Peckham, Peter J. Clark ISBN: 978-0-470-09409-9 April 2005, Wiley Cell Migration: Signalling and Mechanisms Frank Entschladen, Kurt S. Zänker ISBN: 978-3-8055-9321-2 2010, Karger		

	Cell Migration in Development and Disease Doris Wedlich ISBN: 978-3-527-60407-4 March 2006, Wiley-Blackwell

Modulbezeichnung	**Astrobiology and Space Microbiology (Elective B)**
Semester	5
Course Leader	Prof. Dr. Ralf Moeller
Lecturer	Prof. Dr. Ralf Moeller
Language	Englisch
Assignment to Curriculum	Elective Course 5. Semester BSc Applied Biology
Course units/Credit hours	The course consists of lectures, exercises, practical classes Lecture: 2 credit hours Exercises : 2 credit hours Practicals: 2 credit hours
Students' workload	Contact hours / Self Study Lecture: 10 / 10 Exercises: 10 / 10 Practical Class 20 / 20 Sum: 40 / 50 Sum total 90 Hours
Credits	3 ECTS
Prerequisites according to examination regulations	None
Recommended prerequisites	Participation in the modules Microbiology and Biotechnology
Learning Outcomes	Students will be able to Answer questions & gain knowledge on: Search for life in the universe? Evolution and origin of life on Earth? Understand microbial colonisation of extreme habitats and consider the need to explore analogous sites in terrestrial space (evidence of microbial activity). - Understand microbial fitness, the importance for planetary conservation and the current need for microbiology and astrobiology for space exploration. By Learning the basics of astrobiology: organic material in space, habitable zones, connection between habitability and life, origin of life, microbial life, extremophiles, effects of extreme environmental conditions and the use of space stations, space ships in the fields of space microbiology and astrobiology Reflecting in the exercises the learned knowledge with other biological disciplines and applying it in practice learning in the laboratory when testing microbial resistance, fitness and the use of microbial model organisms and systems for astrobiology/space research in order to perform and evaluate microbiological tests/experiments in the space "working environment". Getting an overview of space biology, life sciences, astro- and space microbiology Gaining insight into current scientific research strategies/roadmaps of DLR, ESA, NASA and terrestrial application for space/space biology research.
Content	The module provides an overview and basics in the field of astrobiology, applied extreme environmental and space microbiology: Effects of planetary and extreme habitat conditions on past, present and future (microbial) life. Effects of space conditions on microbial model systems Current scientific methods and research methods for studying microorganisms in the ISS and beyond Insights into the cultivation, detection, decontamination and use of microbial species for spaceflight and the life sciences

	Laboratory work on microbial response to ionising and UV radiation, simulated microgravity, nutrient limitation and water/chemical stress Dealing with polyextremophilic microbial species Insights into the design of space experiments/projects
Assessment	Written exam 90 min. and presentation, not graded
Medienformen:	PowerPoint presentations, Blackboard/Whiteboard, Videos or other digital content. Written Script for the practical class.
Indicative Bibliography/Sources:	1. Horneck & Baumstark-Khan (Astrobiology: the quest for the conditions of life) ISBN-13:978-3-642-63957-9, DOI: 10.1007/978-3-642-59381, Springer-Verlag Berlin Heidelberg, 2002 2. Norberg (Human Spaceflight and Exploration) ISBN 978-3-642-23724-9, DOI 10.1007/978-3-642-2, Springer-Verlag, 2013 3. Yamagishi, Kakegawa, Usui (Astrobiology: From the Origins of Life to the Search for Extraterrestrial Intelligence), ISBN 978-981-13-3638-6, DOI 10.1007/978-981-13-3639-3, Springer Nature Singapore, 2019 4. Horneck, Rettberg (Complete Course in Astrobiology) ISBN: 978-3-527-40660-9, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2007 5. Madigan, Bender, Buckley, Sattley, Stahl (Brock Biology of Microorganisms, 15th edition), ISBN 978-0-13-426192-8, Pearson Education, 2019 6. Pepper, Gerba (Environmental Microbiology: A Laboratory Manual, 2nd edition), ISBN: 0-12-550656-2, Elsevier Inc., 2005 7. Talaro, Chess (Foundations in microbiology, 10th edition), ISBN 9781259705212, NY McGraw-Hill Education, 2018

Module:	**Parasitology**
Semester:	5rth Semester
Course Leader:	Prof. Dr. Dieter Reinscheid
Lecturer:	Prof. Dr. Dieter Reinscheid
Language:	English
Assignment in Curriculum	Elective Course in 5th Semester Applied Biology
Course Units/Credit hours:	The teaching unit consists of lectures and accompanying exercises. L: 2 SWS E: 1 SWS; group size: max. 30
Student´s workload:	Contact hours / Private study Lecture: 30 / 30 Exercise: 15 / 15 Sum: 45 / 45 Total Sum: 90 hours
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful participation in the modules ´Microbiology´ and ´Medical Microbiology´.
Learning outcomes:	The students can - name transmission routes of parasites and typical symptoms of individual parasitic diseases - describe life cycles of individual parasites and demonstrate their use in the therapy of parasitic diseases - develop strategies for the control of parasites and their vectors by - learning in the lecture the development cycles of different parasites, their species-typical organelles or organs, the protection of parasites from the immune system as well as the diagnosis and treatment of parasitic diseases to - perform and evaluate parasitological tests in the diagnostic work environment - characterize pathogenicity mechanisms of parasites in the field of parasitological research or to conduct studies on the mode of action of antiparasitic substances.
Summary indicative content:	The module teaches the basics of the interaction between parasites and humans Developmental and larval stages of parasites; structures of attachment, tissue damage, penetration of tissues Structure/function of species-specific organelles or organs in parasites Causes of epidemic or endemic occurrence of parasitic diseases Diagnostic procedures and drug therapy Measures to control parasites or their vectors Socioeconomic consequences of parasitic diseases
Examination Assessment:	Module examination – non graded Written final exam (60 min)
Teaching style:	L/E: Powerpoint presentation, blackboard/whiteboard, digital content for post-processing (e.g. teaching videos, screenshots), textbooks
Indicative Bibliography/Sources:	Diagnostic Medical Parasitology, LS Garcia, American Society for Microbiology Press, Washington, 2016 2. Foundations of Parasitology, LS Roberts, J Janovy, S Nadler, McGraw Hill Higher Education, Boston, 2013 3. Human Parasitology, BJ Bogitsh, CE Carter, TN Oeltmann, Academic Press, 2018

Module:	**Foreign languages**
Semester:	Semester 5
Course Leader:	Language Centre (see coordinators for the individual languages on https://www.h-brs.de/en/spz/faculty-and-staff)
Lecturer:	Faculty and casual staff from the Language Centre (see course description in LEA)
Language:	Defined by the respective offer of the university's own Language Centre (e.g. Chinese, French, Italian, Japanese, Norwegian, Spanish, etc.).
Assignment in Curriculum:	**Elective course in 5th Sem. Applied Biology** **Elective course in 5th Sem. Chemistry** **Elective course in 5th Sem. Forensics**
Course Units/Credit hours:	Exercise: 3 credit hours; max. group size: 20
Students workload:	Contact hours Private study Exercise:: 45 45 **Total Sum: 90 hours**
Credits	3 ECTS
Prerequisites according to examination regulations:	none
Recommendations:	Language skills according to the required entry level (depending on the course) In addition to the respective target language of the course, German or English will be used as the language of instruction; further information can be found in the respective course commentary on LEA.
Learning outcomes:	The students will be able to • acquire and extend language competencies in speaking, writing, listening and/or reading (depending on their language level) by • practising communicative language activities such as reception, production, interaction and mediation in oral and/or written form in an interactive course setting with different forms such as group, pair or individual work and an e-learning component • expanding their vocabulary, acquiring functional grammatical knowledge and getting to know types of verbal interaction and language registers • being introduced to the regional and cultural studies as well as to the mentality of the cultural area of the target language in order to • deal with situations in everyday life, studies and/or work in written and oral form in a communicative way appropriate to the level • reach the target level in the respective foreign language.
Summary indicative content:	The exact course content depends on the respective level of the course according to the Common European Framework of Reference for Languages (CEFR); information on the levels and corresponding skills of the Common European Framework of Reference for Languages can be found at https://www.h-brs.de/files/ger.pdf. Further information on the respective course content will be made available on LEA at the beginning of the course.
Assessment:	**Prerequisites for the awarding of credit points** Active participation in at least 75% of the course. **Possible forms of assessment** • Portfolio: The exact requirements for the portfolio will be announced at the beginning of the semester for the respective courses.

	• Written or oral final examination **Passing of module - graded**
Teaching style:	Textbooks according to CEFR, audio-visual materials, scripts developed by teachers, LEA
Indicative Bibliography/Sources:	-