Module Handbook BSc Applied Biology

Compulsory Courses: **Page**

Elective Courses:

Module:	**Mathematics**
Semester:	1. Semester
Course Leader:	Prof. Dr. Draber and Prof. Dr. Oligschleger
Lecturer:	Prof. Dr. Draber and Prof. Dr. Oligschleger
Language:	English
Assignment in Curriculum:	**1st Semester Applied Biology**
Course Units/Credit hours:	Lecture: 4 credit hours Exercise: 2 credit hours; max. group size: 20
Students workload:	Contact hours / Private study Lecture: 60 / 60 Exercise: 30 / 30 Sum: 90 / 90 **Total Sum: 180 hours**
Credits:	6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Bridging course Mathematics
Learning outcomes:	<u>At the end of the lectures</u> • the students are able to understand basic concepts of mathematical problems and the special written forms (functions, differential calculus, numerics). • the students have the knowledge to apply the necessary tools to solve mathematical problems. <u>At the end of the exercises</u> • the students can apply these basic concepts to problems. • the students have the knowledge to use the tools for practical problems.
Summary indicative content:	<u>Lectures:</u> • Sets, real numbers and intervals, linear and quadratic equations, binomial theorem • Functions and curves: definition and presentation, understanding as transformation, general properties of functions, polar coordinates, sequences, limits and continuity of a function, polynomials, rational function, power function, trigonometric function and inverse trogonometric functions, exponential function and logarithmic function, logarithmic presentations (logarithmic paper) • Differential calculus: derivation as slope of the tangent, derivation of elementary functions, rules of derivation, higher derivations, linearisation of a function, characteristic plot-points on curves and exercises with extreme values, curve sketching, numerical determination of roots • Integral calculus: integration as inversion of derivation, the definite integral as area, the indefinite integral, fundamental

	theorem of differential and integral calculus, important integrals, calculus of definite integrals, rules and methods of integration, substitution, partial integration, numeric integration, some applications of integral calculus • Power series, Taylor series: infinite series, power series, Taylor series, rule of de L'Hospital Exercises: • Tasks and applications to sets, real numbers and intervals, linear and quadratic equations, binomial theorem, functions and curves, sequences, logarithmic presentations (logarithmic paper) • Differential calculus, higher derivatives, linearisation of a function, characteristic plot-points on curves and exercises with extreme values, curve sketching, numerical determination of roots • Integral calculus, the definite integral as area, the indefinite integral, important integrals, calculus of definite integrals, rules and methods of integration, substitution, partial integration, numeric integration, some applications of integral calculus • Power series, Taylor series: infinite series, power series, Taylor series, rule of de L'Hospital
Assessment:	Passing of module – graded Written examination, active participation in the tutorials accompanying the lectures is tested in exercises.
Teaching style:	Lecture: blackboard, overhead, power point Exercise: blackboard
Indicative Bibliography/Sources:	1. Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, vieweg Verlag, Braunschweig Wiesbaden. Band 1,2 und 3. 2. Manfred Brill, Mathematik für Informatiker, Hanser Verag, München, Wien, 2. Auflage, 2005 3. K. Gieck, R. Gieck, Technische Formelsammlung, Gieck Verlag, Germering, 1995, 30. erweiterte Ausgabe. 4. Alan J. Cann, Maths from Scratch for Biologists, John Wiley & Sons.

Module:	**Laboratory Skills / Computing Sciences**
Semester:	1st Semester
Course Leader:	Dr. Annette Menke and Prof. Dr. Ulrich Eßmann, respectively
Lecturer:	The lecturers of the Department of Natural Sciences
Language:	English
Assignment in Curriculum	**Compulsory Course in 1st Semester Applied Biology**
Course Units/Credit hours	**Laboratory Skills Unit:** Lecture: 1 credit hour Exercise: 1 credit hour; max. group size: 25 **Computing Sciences Unit:** Lecture: 2 credit hours Lab work: 2 credit hours; max. group size: 60
Students workload:	Contact hours / Private study Lecture: 45 / 40 Exercise: 15 / 60 Lab work: 30 / 20 Sum: 90 / 120 **Total Sum: 210 hours**
Credits	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	None
Learning outcomes:	**Laboratory Skills:** The module Laboratory Skills provides general study skills for first semester students. Having attended the lecture students are familiar with strategies for preparing and revising courses as well as coping with exams. Students know about the significance, structure and form of laboratory reports. They are able to distinguish between different forms of scientific presentations (oral or written) and are able to use PowerPoint to develop their own presentations. They are familiar with different forms of scientific publications and know how to use online databases for literature research. They can critically judge the reliability of other internet resources. After successful participation in the exercise students can use the acquired knowledge in order to work out a short presentation covering a scientific topic and to present and discuss their work. **Computing Sciences:** Having attended the lecture, the students understand the structure and functionality of the World-Wide-Web. They are able to describe the syntax of HTML and the basic instructions to format a WWW page. Furthermore, the students know the possibilities and typical application of spread sheet programs in the laboratory and can use them for statistical analyses of laboratory data. They know the

	general structure of programming languages, are able to explain the elementary language constructs and understand basic algorithms and data structures. Due to the lab course the students are able to apply the concepts of the lecture to practical problems. They are able to design and implement simple WWW pages, to analyze experimental data with a spread sheet program and to implement simple program independently.
Summary indicative content:	**Laboratory Skills:** • Time management during study course • Structure and preparation of laboratory reports • Different forms of scientific presentations, use of PowerPoint • Scientific publications; research for publications using online resources • Preparation of a short presentation using PowerPoint **Computing Sciences:** Lecture: • Computer systems (hardware) • Computer science (informatics) • Internet, WWW • HTML • Basics of structured programming Lab: • Working with a computer • Performing spreadsheet calculations in addition to the lecture in mathematics • Creating web pages with HTML • Basics of structured programming with Visual Basic
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:	HTML: 1. Selfhtml (the English version is still (early 2005) in its infancy at: http://www.selfhtml.org/ 2. HTML course of the W3schools at: http://www.w3schools.com/html/default.asp Microsoft Excel 1. Joseph E. Billo, Excel for chemists, Wiley, New York 2001 (has a lot of tips and tricks relevant for scientists) Visual Basic 1. Microsoft Visual Basic 6.0 programmer's guide, Microsoft Press Redmond, 1999 (advanced textbook)

Module:	**Cell Biology**
Semester:	1st Semester
Course Leader:	Dr. Annette Menke
Lecturer:	Dr. Annette Menke
Language:	English
Assignment in Curriculum	**Compulsory Course in 1st Semester**
Course Units/Credit hours	Lecture: 3 credit hours Exercise: 2 credit hours; max. group size: 80 Lab work: 1 credit hours; max. group size: 16
Students workload:	Contact hours / Private study Lecture: 45 / 45 Exercise: 30 / 60 Lab work: 15 / 15 Sum: 90 / 120 **Total Sum: 210 hours**
Credits	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	None
Learning outcomes:	Having finished lecture and exercises of the module Cell Biology students know about the differences and similarities of pro- and eukaryotic cells, as well as structure and function of cell organelles including cell membranes and cytoskeleton. They are able to distinguish between types, structure and function of cellular macromolecules and to explain their synthesis pathways (replication, transcription, translation, protein maturation) including regulation. They know aerobic respiration and fermentation as important metabolic pathways. They have understood the significance of the cell-cycle and are able to describe its course and regulation. Students are familiar with different types of cell-cell junctions, their structure and function. Having finished the practical class participants are able to use a light microscope in order to study morphology and behaviour of unicellular eukaryotic organisms. They are familiar with the effect of osmotic stress on erythrocytes and are able to extract DNA from vegetable or animal sources. They are able to present, analyse and discuss their own data and observations in a lab report.
Summary indicative content:	Lecture • Structure and morphology of the cell • Macromolecules, structure and function • Biological membranes, membrane transport • Introduction to gene expression and its regulation • Molecular and cellular basics of cell reproduction • Cell Biochemistry • Cell-cell junctions, structure and function

	Practical class: • Light microscopic analysis of eukaryotic cells • Determination of the osmoresistance of erythrocytes via photometric analysis • Light microscopic analysis of mitotic stages • DNA-extraction from plant or animal tissue
Assessment:	The module is graded. The final grade is made up by the student's performance in the exam (75%) and in the laboratory (25%).
Teaching style:	Lecture: Projector, Blackboard Exercise: Blackboard Practical course: Script
Indicative Bibliography/Sources:	1. Alberts et al.: Essential Cell Biology, 2003, Garland Publishing Inc., US 2. Alberts et al.: Molecular Biology of the Cell, 2008, Taylor and Francis 3. Lodish et al.: Molecular Cell Biology, 2007, Palgrave Macmillan

Module:	**General Chemistry**
Semester:	1st Semester
Course Leader:	Prof. Dr. Gerd Knupp
Lecturer:	Prof. Dr. Gerd Knupp / Dr. Ulf Ritgen
Language:	English
Assignment in Curriculum:	**Compulsory Course in 1st Semester Applied Biology** **Compulsory Course in 1st Semester Forensic Sciences**
Course Units/Credit hours:	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 60 Lab work: 2 credit hours; max. group size: 30
Students workload:	Contact hours / Private study Lecture: 30 / 30 Exercise: 30 / 60 Lab work: 30 / 30 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture students • know the fundamental models in chemistry as well as basic theories of matter, • are familiar with the systematic order of substances, • are familiar with the different types of reaction, the kinetics of chemical reactions and the law of mass action, • know the fundamentals of stoechiometry, • know the fundamentals of electrochemistry. Exercise: After having participated regularily students • are able to formulate chemical equations and perform chemical calculations, • are able to draw conclusions and perform calculations using mass action law and simple kinetic models, • are able to formulate acid-base equilibrium, calculate pH, buffer-systems • are able to perform simple electrochemical calculations. Practical Work: At the end of the laboratory course students • are familiar with the basic operations in the laboratory, • are able to assess sources of danger in the laboratory and draw the appropriate conclusions for safe working

	• are able to run experiments on items mentioned below using experimental instructions and safe operating procedures for hazardous materials, • are able to present and interpretate experimental data and to make up their mind about future steps.
Summary indicative content:	Lecture/Exercise: • Atomic structure, Bohr-Rutherford model of the atom, orbital model, atomic spectra • Structure of the periodic table of the elements • Chemical bonds: ionic bond, covalent bond, metallic bond, coordinate covalent bond, intermolecular bonds • Chemical reactions: reaction kinetics, chemical equilibrium, Law of Mass Action, reaction types, reaction energy (thermochemistry) • Acids and bases, pH, dissociation constant, calculation of pH, titration, buffer systems • Solubility products • Redox reactions: redox potential, Galvanic cells • Exercises with calculations consolidate the content. Practical Work: During six lab-days students run practical experiments on acid/base-reactions, titration, pH-value, mass action law, reaction kinetics , electrochemistry,simple synthesis .
Assessment:	The overall grade for the modul examination consists of 1. the completion of all experiments and writing of two elaborate lab reports (20%), 2. a written examination (80%) which has a pass mark of 50% of the points that can be obtained. Both examination components must be passed.
Teaching style:	Lecture: Overhead, blackboard, projector, online-tutorial Exercise: Prepared tasks, blackboard Practical work: Lab manual and safe operating procedures for hazardous materials
Indicative Bibliography/Sources:	1. Ebbing, D.D., Gammon S.D., General Chemistry, 7th Ed., Houghton Mifflin Company, Boston, New York, 2. Mortimer, C. E., Müller U., Chemie - Das Basiswissen der Chemie, 8. Auflage, Thieme Verlag, Stuttgart, 3. Atkins, P., Jones, L., Chemical Principles. The Quest for Insight, Palgrave Macmillan, Hampshire, UK

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:	At the end of the module the students are able: Lecture: • to explain the fundamental phenomena and principles in mechanics, mechanics of fluids and thermodynamics and describe these phenomena mathematically. Exercise: • to develop solutions for simple problems in the fields mentioned above. Practical course: • to perform simple experiments and to analyze the data. • to use the basic measurement equipment. • to solve experimental tasks in a team. • to perform statistical analyses of the experimental data and determine the possible sources of error.
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:	Passing of module – graded The total grade of the module is comprised of a mark for the laboratory course (30%) and a mark for the final exam in Physics and Statistics (70%) or two exams during the semester (35% each). 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**: 1. Fundamentals of Physics, Halliday, Resnick, Walker, Wiley, 2001 2. Physics in Biology and Medicine, Davidovits, Harcourt Academic Press 3. Physics for Pre-Med, Biology, and Allied Health Students, Hademenos, McGraw-Hill 4. Physics with illustrative examples from Medicine an Biology, Biological Physics Series 5. College physics, Urone, Brooks/Cole, Pacific Grove, CA **Statistics:** 1. An Introduction to Error Analysis, Taylor, University Sci. Books, 1982 2. Fundamentals of Biostatistics, Rosner, Duxbury, 2000

Module:	**Microbiology**
Semester:	2nd Semester
Course Leader:	Dr. Annette Menke
Lecturer:	Dr. Annette Menke
Language:	English
Assignment in Curriculum:	**Compulsory Course in 2nd Semester Applied Biology**
Course Units/Credit hours:	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 45 Lab work: 2 credit hours; max. group size: 16
Students workload:	Contact hours / Private study Lecture: 30 / 30 Exercise: 30 / 60 Lab work: 30 / 30 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful participation in the module Cell Biology
Learning outcomes:	Having finished lecture and exercise "Microbiology" students know about the significance of microorganisms and microbial products for daily life, industry, or human and animal health. They are familiar with the morphology of microorganisms and are able to mention and to explain functions of general and specialized structures of microbial cells. Students can distinguish between different taxonomic or phylogenetic approaches used in the classification of microorganisms and are familiar with the use of scientific nomenclature. Students have understood and can distinguish between physical and chemical factors that influence microbial growth in nature. They are able to explain metabolic properties of microorganisms determining those growth requirements. They are able to distinguish between different types of growth media used in the lab and to describe their use. Students are familiar with different physical or chemical techniques to inhibit or prevent unwanted growth of microorganisms and are able to explain how and when to use these methods. They have developed an understanding for the diversity of microbial life and are able to explain significance, habitat and metabolism of representative microorganisms. Having finished the practical course students have acquired skills in the use of the light microscope to study microbial cells, including application of staining techniques. They are familiar with techniques for cultivation and sterilization and are able to apply them correctly. Students are able to execute different techniques for the determination of cell number and to evaluate results achieved critically. Applying different taxonomic classification techniques they are able to identify and determine an unknown microorganism. They know how to analyze the effect of antimicrobial agents on microbial

	cells experimentally and have studied the changed metabolic behaviour of bacterial cells in response to a changing environment.
Summary indicative content:	<u>Lecture and exercise:</u> • Introduction to microbiology; history of microbiology, microscopy, structure and composition of microbial cells, morphology of prokaryotic cells, bacterial cell wall, gram staining, specialized structures of the prokaryotic cell: their structure and function. • Microbial growth: physical and chemical conditions influencing microbial growth in nature and in the lab, culture media and culture techniques, growth parameters, measuring microbial growth. • Control of microbial growth: physical and chemical methods for growth control. • Identification and classification of microorganisms • Representative prokaryotic microorganisms, microbial diversity • Representative eukaryotic microorganisms: fungi, protozoa, algae • Viruses <u>Practical class:</u> • Light microscopic analysis of stained or unstained pro- or eukaryotic microorganisms. • Identification of an unknown bacterium based on morphological and biochemical analysis. • Determination of the cell number of coliform bacteria in a water sample. • Examination of the effect of antimicrobial agents on growth and viability of selected bacteria. • Gene regulation in bacteria: The lac operon of E.coli.
Assessment:	The module is graded. The final mark is made up by the students' performance in the exam covering the content of lecture and exercise (60%) and the practical course (40), evaluated by a lab report and a short test during the practical course.
Teaching style:	Lecture: Projector, Blackboard Exercise: Blackboard Practical course: Script
Indicative Bibliography/Sources:	1. Tortora, Funke & Case: Microbiology – An introduction, Benjamin-Cummings, San Francisco 2. Black: Microbiology: Principles and exploration, John Wiley & Sons, Hoboken 3. Madigan, Martinko & Parker. Brock Microbiology of Microorganisms, Benjamin Cummings, San Francisco

Module:	**Human Biology, Histology**
Semester:	2nd Semester BSc. Applied Biology
Course Leader:	Prof. Dr. Heinz-Joachim Häbler
Lecturer:	Prof. Dr. Heinz-Joachim Häbler
Language:	English
Assignment in Curriculum:	**Compulsory Course in 2nd Semester Applied Biology**
Course Units/Credit hours:	Lecture: 3 credit hours Exercise: 1 credit hour; max. group size: 80 Lab work: 2 credit hours; max. group size: 15
Students workload:	Contact hours / Private study Lecture: 45 / 90 Exercise: 15 / 15 Lab work: 30 / 15 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful participation in Cell Biology
Learning outcomes:	Lectures/Exercises: Students are capable of • applying the basic discipline specific terminology. • identifying and describing in detail the basic types of tissues. • localising the most important organs and organ systems (skin, cardiovascular system, lungs, digestive system, kidney and urogenital tract) in an anatomically correct way and describing their macroscopic and microscopic structure. Lab work: • examining histological sections under the light microscope and communicating the results properly. • producing their own histological sections.
Summary indicative content:	Lecture, exercise: • Tissue processing and production of histological sections • Structure and usage of the light microscope, electron microscopy • Basic types of tissue • Anatomy and microscopic anatomy of skin, cardiovascular system, lungs, digestive system, kidney and urogenital tract • Basic anatomy of the nervous system Lab work: • Production of histological sections • Light microscopic identification and analysis of histological specimens

	• Short presentations by all students
Assessment:	Module examination with marks. Written test 70%, lab report 30%.
Teaching style:	Lecture and exercise: Overhead, blackboard Lab: Written instruction, demonstration of histological specimens
Indicative Bibliography/Sources:	1. Tortora & Derrickson, Principles of Anatomy and Physiology, 11th ed., Wiley 2. Young & Heath, Wheater´s Functional Histology, 4th ed., Churchill Livingstone

Module:	**Organic Chemistry**
Semester:	2nd Semester
Course Leader:	Prof. Dr. Margit Schulze
Lecturer:	Dr. Kai Jakoby, Prof. Dr. Margit Schulze
Language:	English
Assignment in Curriculum:	**Elective Course 2nd Sem. Applied Biology**
Course Units/Credit hours	Lectures: 2 credit hours Exercises: 2 credit hours; max. group size: 40 Lab work: 2 credit hours; max. group size: 20
Students workload:	Contact hours / Private study Lecture: 30 / 40 Exercise: 30 / 35 Lab work: 30 / 45 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful completion of module General Chemistry (1st Sem.)
Learning outcomes:	Lecture: At the end of the course, the students: • are familiar with the most important classes of organic substances and their physical and chemical properties; • are able to identify typical chemical reactions on the basis of the corresponding structures and properties; • are familiar with the basics of stereochemistry; • are familiar with the most important principles and techniques of the classic preparative organic chemistry. Exercises: At the end of the course: • students are able to transfer their knowlegde (lecture topics) to corresponding exercise problems; • e.g. students are able to formulate and explain the corresponding reaction equations and mechanisms. Laboratory work: • Students can apply theoretical knowledge. • They gain first practical experience in preparation, purification and characterisation of organic substances (e.g. distillation methods, resolution of racemates, synthesis of substituted aromatic compounds).
Summary indicative content:	Lecture and exercises: Purpose, scope and principles of organic chemistry; introduction to different classes of organic substances with a special focus on low-molecular and macromolecular biochemical compounds; physical and

	chemical properties of organic compounds; basics of stereochemistry; preparation, purification and characterisation of organic compounds; introduction to spectroscopic methods for the analysis of organic compounds. Special focus on biologically active substances. Lab work: Basic techniques in organic synthesis (e.g. distillation methods, preparation of organic compounds as esters).
Assessment:	Written final examination (80 %) Written lab reports (20 %) Both parts have to be passed separately.
Teaching style:	Lectures and Exercises: Blackboard, overhead, projector, written documents (exercise problems) Laboratory: Written documents to perform experiments and prepare lab reports
Indicative Bibliography/Sources:	1. K.P.C. Vollhardt, N.E. Schore, Organic Chemistry: Structure and Function, Freeman, New York. 2. P.Y. Bruice, Organic Chemistry, Prentice Hall, New York. 3. R.T. Morrison, R.N. Boyd, Organic Chemistry, Prentice Hall, and Inc., New York and corresponding Study Guide. 4. H.P. Latscha, H.A. Klein, Organische Chemie, Springer-Verlag. 5. Ulrich Lüning, Organische Reaktionen, Spektrum Akad. Verlag. 6. R. Brückner, Reaktionsmechanismen, Spektrum Verlag. 7. H.G.O. Becker et al., Organikum, Wiley-VCH.

Module:	**Instrumental Analysis**
Semester:	3rd Semester
Course Leader:	Dr. Kai Jakoby
Lecturer:	Dr. Kai Jakoby
Language:	English
Assignment in Curriculum:	**Compulsory Course in the 3rd Sem. Applied Biology**
Course Units/Credit hours:	Lecture: 3 credit hours, Exercise: 2 credit hours, max. group size: 60 Lab work: 1 credit hour, max. group size: 24
Students workload:	Contact hours / Private study Lecture: 45 / 50 Exercise: 30 / 45 Lab work: 15 / 25 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Mathematics (1st Sem.), General Chemistry (1st Sem.), Physics/Statistics (2nd Sem.)
Learning outcomes:	Lecture: Students have acquired knowledge about the basic principles of common electrophoretic and chromatographic separation techniques as well as about the fundamentals of UV-Vis spectroscopy and mass spectrometry. They know major application areas of those techniques, their advantages or shortcomings for certain separation problems and the required technical appliances. Exercise: Students are able to assess the significance of different experimental parameters and their effects on the results of a separation technique. They know how to develop suitable methods for specified simple separation problems, how to carry out stoichiometric calculations for sample preparation and how to determine experimental parameters by evaluating simple chromatograms or spectra. Practical course: They gained practical experience with gel electrophoresis, UV-Vis spectroscopy and/or chromatography. They know how to operate the technical appliances after instructions by a tutor, and they are capable of evaluating gels, spectra or chromatograms independently.
Summary indicative content:	Lecture: • Fundamentals and basic applications of gel and capillary electrophoresis, UV-Vis spectroscopy and mass spectrometry • Fundamentals and major applications of HPLC, GC, TLC, ion exchange and size exclusion chromatography, basic principles of method development by means of simple examples

	• Presentation of relevant sample preparation techniques Practical course: • Laboratory experiments on gel electrophoresis (e.g. SDS-PAGE) • UV-Vis spectroscopy and/or chromatography (e.g. HPLC)
Assessment:	Passing of module – graded Practical course (written tests and reports): 20% Written examination: 80%. Practical course and written examination have to be passed independently.
Teaching style:	Lecture: Projector, blackboard Exercise: Written compilation of problems, blackboard Practical course: Written experimental instructions
Indicative Bibliography/Sources:	1. F. Lottspeich, J.W. Engels, Bioanalytik, Spektrum Akademischer Verlag. 2. R. Westermeier, Electrophoresis in Practice, Wiley. 3. M. Hesse, H. Meier, B. Zeeh, Spectroscopical Methods in Organic Chemistry, Thieme Verlag. 4. L.R. Snyder, J.J. Kirkland, J.L. Glajch, Practical HPLC method development, Wiley. 5. M. Kinter, N.E. Sherman, Protein Sequencing and Identification Using Tandem Mass Spectrometry, Wiley. 6. R.L. Grob, E.F. Barry, Modern Practice of Gas Chromatography, Wiley. 7. E. Hahn-Deinstrop, Applied Thin Layer Chromatography, Wiley-VCH.

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:	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 80 Lab work: 2 credit hours; max. group size: 15
Students workload:	Contact hours / Private study Lecture: 30 / 15 Exercise: 30 / 35 Lab work: 30 / 20 Exam: 2 / 18 Sum: 92 / 88 **Total Sum: 180 hours**
Credits:	6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful participation in the module ´Microbiology´.
Learning outcomes:	<u>At the end of the lecture and exercise, the students are able:</u> 1. to select antibiotics according to their area of use. 3. to diagnose infectious diseases with typical symptoms. 4. to know portals of entry of pathogenic organisms and have learnt to protect themselves against them. 5. to obtain epidemiological data of infectious diseases. <u>At the end of the laboratory course, the students are able:</u> 1. to isolate pathogenic organisms from clinical samples and to identify them according to physiological traits. 2. to cultivate pathogens with appropriate safety standards. 3. to perform antibody-based tests for the identification of pathogens.
Summary indicative content:	<u>Content of lecture and exercise:</u> 1. Definitions and terms of Medical Microbiology 2. The normal human flora: tissue tropism, microbial metabolism, health-promoting or damaging effects to the host 3. Disease Development: transmission, attachment to and invasion into the host, damage to the host, bacterial evasion from the immune system 4. Toxins: classification, mode of action, pharmaceutical use 5. Antibiotics: classification, mode of action, area of use

	6. Infectious diseases of the skin, the gastrointestinal- and urogenital tract, the cardiovascular system, the nervous system, and the respiratory tract: pathogens, mode of transmission, symptoms/disease, virulence factors and therapy Content of the laboratory course: Isolation and characterization of pathogenic organisms; epidemiological study on the distribution of Staphylococcus aureus and its antibiotic resistance; streptococcal diagnostics; differentiation between non-pathogenic and pathogenic yeasts
Assessment:	Passing of module – graded The total grade of the module is comprised of: 1. a written exam about the content of the lecture and the exercises, which has to be passed with at least 50% of the total points. The grade of the exam contributes by 60% to the total grade of the module. 2. successfully performing all laboratory experiments. Grading of the lab performance contributes by 12% to the total grade of the module. 3. writing an individual laboratory report. Grading of the lab report contributes by 28% to the total grade of the module.
Teaching style:	Lecture: Projector, blackboard, online script Exercises: Online questions, blackboard Laboratory course: Online script about experiments
Indicative Bibliography/Sources:	1. Tortora, Funke & Case: Microbiology - An introduction, 8. Edition, Benjamin-Cummings, San Francisco. 2. Black: Microbiology: Principles and Explorations, 6. Edition, John Wiley & Sons, Hoboken. 3. Salyers & Whitt: Bacterial Pathogenesis. A molecular approach, 2. Edition, ASM Press, Washington 4. Madigan, Martinko & Parker. Brock Biology of Microorganisms, 11. Edition, Benjamin Cummings, San Francisco

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
Recommendations:	Passing of the modules of the 1st and 2nd semester
Learning outcomes:	At the end of the lecture the students are able: 1. to know the most important molecular genetic processes in the cell, such as replication, regulation, variation, transcription, translation and expression, cell cycle and repair mechanisms. 2. to know the most important molecular genetic events in gene technology. 3. to judge ethical aspects of molecular genetics. At the end of the laboratory course the students are able: 1. to isolate, characterise and analyse genomic and plasmid DNA. 2. to perform bacterial gene transfer and bacteriophage titration.
Summary indicative content:	Content of the Lecture 1. Molecular structure and function of DNA and RNA 2. Replication, transcription and translation: Mechanisms and enzymes involved 3. Comparison of replication and gene expression in prokaryotes, eukaryotes and viruses: Similarities and differences 4. Regulation of gene expression in prokaryotes, viruses and eukaryotes 5. Variation and mutation 6. Repair mechanisms 7. The eukaryotic chromosome 8. The eukaryotic cell cycle 9. Mitosis and meiosis 10. Transposable elements 11. Profiling and polymorphisms

	12. Gene technology as applied molecular genetic: Techniques, enzymes, application 13. Ethical aspects of molecular genetics 14. 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:	Passing of module – graded The final mark of the module consists of: 1. a written test composed of questions to the content of the lecture and the provided protocol for the practical part. The written test must be passed with at least 50 % of the possible points and counts 70 % of the final mark. 2. the correct execution of the experiments in the laboratory which counts 10 % of the final mark. Writing the minutes of the experiments, which counts 20 % of the final mark.
Teaching style:	Lecture: Data projector (Powerpoint presentation) and black board, in part short movies or overhead projector Practical course: Written manuscript
Indicative Bibliography/Sources:	1. Lewin Genes VIII, Pearson Verlag 2. Griffiths, Gelbart, Miller, Lewontin; Modern Genetic Analysis; Freeman and Company 3. D. M. Knipe and P. M. Howley; Fields Virology; Lippincott Williams & Wilkins 4. Birge; Bacterial and Bacteriophage Genetics; Springer Verlag Alberts, Bray, Lewis, Raff, Roberts, Watson, Molekularbiologie der Zelle, VHC Verlagsgesellschaft 5. Clark, Molecular Biology, Understanding the Genetic Revolution Kippers, Molekulare Genetik, Thieme Verlag 6. Nicholl; Gentechnische Methoden; Spektrum Verlag (German) 7. Henning; Genetik, Springer Verlag (German) 8. Lewin; Molekularbiologie der Gene; Spektrum Verlag (German)

Module:	**Physiology**
Semester:	3rd Semester BSc. Applied Biology
Course Leader:	Prof. Dr. Heinz-Joachim Häbler
Lecturer:	Prof. Dr. Heinz-Joachim Häbler
Language:	English
Assignment in Curriculum:	**Compulsory Course in 3rd Semester Applied Biology**
Course Units/Credit hours:	Lecture: 3 credit hours Exercise: 1 credit hour; max. group size: 80 Lab work: 2 credit hours; max. group size: 15
Students workload:	Contact hours / Private study Lecture: 45 / 90 Exercise: 15 / 15 Lab work: 30 / 15 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful participation in Human Biology/Histology
Learning outcomes:	Lectures/Exercises: Students are capable of • understanding the basic principles of homeostatic body regulations. • understanding and analyzing the basic principles of organ and systems specific physiological functions. • explaining simple patho-physiological conditions on the basis of understanding normal physiological functions. Practicals: Students are able to conduct and analyse simple physiological experiments thereby applying their acquired knowledge.
Summary indicative content:	Lectures, exercise: • Blood: Physiology of corpuscular and non-corpuscular components • Cardiovascular system: General regulation of the circulation, exchange processes in the microcirculation, cardiac physiology • Respiration physiologie, oxygen transport in blood, acid-base balance • Kidney physiology • Endocrine regulation • Basic neurophysiology: Resting membrane potential, cellular excitability, signal conduction, synaptic transmission, neuronal integration in the central nervous system

	Lab: • Computer simulations relating to special chapters of cardiovascular physiology, respiration, muscle, ion channels • Registration of ECG, EEG, nerve conduction velocity
Assessment:	Module examination with marks. Written test 70%, lab report 30%.
Teaching style:	Lecture and exercise: Overhead projector, blackboard Lab: Written instruction, computer simulation programmes
Indicative Bibliography/Sources:	1. Tortora & Derrickson, Principles of Anatomy and Physiology, 11th ed., Wiley 2. Guyton & Hall, Medical Physiology, 10th ed., Saunders 3. Kandel, Schwartz & Jessell, Principles of Neural Science, 4th ed., McGraw-Hill

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
Students 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:	At the end of the module the students are able to: Lecture: • understand the fundamental principles in the field of electricity, magnetism, oscillations and waves and to use the fundamental equations in these fields. Exercise: • develop solutions for simple problems in the above mentioned fields. Practical course: • perform simple experiments and to analyze the data. • use the basic measurement equipment. • solve experimental tasks in a team. • perform statistical analyses of the experimental data and determine the possible sources of error.
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:	Passing of module – graded The total grade of the module is comprised of a mark for the laboratory course (30%) and a mark for the final exam (70%) or two exams during the semester (35% each). 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: 1. Fundamentals of Physics, Halliday, Resnick, Walker, Wiley, 2001 2. Physics in Biology and Medicine, Davidovits, Harcourt Academic Press 3. Physics for Pre-Med, Biology, and Allied Health Students, Hademenos, McGraw-Hill 4. Physics with illustrative examples from Medicine and Biology, Biological Physics Series 5. Gerthsen; Physik, Springer-Verlag, Berlin Measuring techniques: 1. H.-R. Tränkler, Taschenbuch der Messtechnik, Verlag R. Oldenbourg, München 2. J. Niebuhr, G. Lindner: Physikalische Messtechnik mit Sensoren, Oldenbourg Verlag 3. J. Hoffmann, Taschenbuch der Messtechnik, Fachbuchverlag Leipzig Statistics: 1. Fahrmeir, Hamerle, Tutz; Multivariate statistische Verfahren; de Gruyter-Verlag 2. Backhaus, Erichson, Plinke, Weiber; Multivariate Analysemethoden; Springer-Verlag 3. Zell; Simulation neuronaler Netze; Oldenburg-Verlag 4. Richard O. Duda, Peter E. Hart, David G. Stork; Pattern Classification; Wiley-Interscience-Verlag 5. K. Fukunaga; Introduction to Statistical Pattern Recognition; Academic Press 6. Hans-Friedrich Eckey, Reinhold Kosfeld, Martina Rengers; Multivariate Statistik – Grundlagen

Module:	**Biochemistry**
Semester:	4h Semester
Course Leader:	Professor Dr. Maria-Paz Weißhaar
Lecturer:	Professor Dr. Maria-Paz Weißhaar
Language:	English
Assignment in Curriculum:	**Compulsory Course in the 4th Semester Applied Biology**
Course Units/Credit hours:	Lecture: 2 credit hours Seminar: 2 credit hours; max. group size: 45 Lab work: 2 credit hours; max. group size: 16
Students workload:	Contact hours / Private study Lecture: 30 / 40 Exercise: 30 / 50 Lab work: 30 / 30 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules of the 1st, 2ndand 3rd semester, especially Instrumental Analysis
Learning outcomes:	At the end of the lecture and the seminar the students are able to: • work with enzymes, know their function, catalytic activity, regulation and characteristics. • know the central metabolic pathways, and understand the main mechanisms of chemical reactions and their regulation, anabolic and catabolic pathways and their regulation: glycolysis, citric acid cycle, respiration chain, fatty acid metabolism and oxidation, gluconeogenesis and glycogen metabolisms. • organize group work and implement team and communication skills. At the end of the laboratory course the students are able to: • calculate and prepare buffers. • perform and calculate the enzyme kinetics: enzyme activity/specific activity, pH dependency and inhibition. • calculate and determine the protein concentration. • perform and apply isoelectric focusing for meat sample determination. • organize group work and implement team and communication skills.
Summary indicative content:	Lecture: • Enzyme kinetics and enzyme regulation • Metabolism: Anabolic and catabolic metabolism and regulation

	• Intermediary metabolism: glycolysis, citric acid cycle, respiration chain. Gluconeogenesis and glycogen metabolism, fatty acids metabolism and ß-Oxydation Practical course: • Michaelis-Menten kinetics of alkaline phosphatase • Isoelectric focusing of proteins • Regulation of enzyme synthesis: Enzyme induction and catabolic repression • Repression and derepression of the biosynthetic threonindesaminase
Assessment:	Passing of module – graded The total grade of the module is comprised of a mark for the seminar (50%) and a mark for the laboratory course (50%, lab report). The mark for the seminar is comprised of an oral presentation (25 %) and a test (25%).
Teaching style:	Lecture: Projector Seminar: Oral PowerPoint presentations Practical course: Manuscript for the practical course
Indicative Bibliography/Sources:	1. Voet D., Voet J-G.: Fundamentals in Biochemistry. J. Wiley and Sons, Inc, Publisher, New York 2. L. Stryer: Biochemistry, Freeman and Company 3. Dion & Webb: Enzymes. Logman Group LTD

Module:	**Bioinformatics / Quality Assurance**
Semester:	4th Semester
Course Leader:	Prof. Dr. Ulrich Eßmann and Prof. Dr. Ernst-Jürgen Pomp
Lecturer:	Prof. Dr. Ulrich Eßmann and Prof. Dr. Ernst-Jürgen Pomp
Language:	English
Assignment in Curriculum:	**Compulsory Course in the 4th Semester Applied Biology**
Course Units/Credit hours:	Lecture: 2 credit hours Bioinformatics 1 credit hour Quality Assurance Exercise: 2 credit hours Bioinformatics 1 credit hour Quality Assurance
Students workload:	Contact hours / Private study Lecture: 45 / 60 Exercise: 45 / 60 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules Computing Science, General Chemistry, Physics/Statistics, Instrumental Analysis
Learning outcomes:	**Bioinformatics** At the end of the lecture the students are able: • to know the content of the most important data bases. • to understand the basic concepts of the alignment algorithms. • to use the Blast programs and interpret and analyze the results. • to describe the possibilities and limitations of protein structure prediction programs. • to describe the possibilities and limitations of modelling programs. • to describe the possibilities and limitations of drug design programs. Exercise: • to apply the programs to practical biological problems. **Quality Assurance** At the end of the lecture the students are able: • to understand the principles of the Good Manufacturing Practice (GMP). • to describe GMP is an international requested documentation system in the areas of finished medicinal products and cosmetics.

	• to implement this knowledge within the bounds of production and quality control of the pharmaceutical and cosmetic industry. • to control the processes' validity and their robustness. • to control the efficiency of the performance of analytical equipment by using validated documentation systems. Exercise • The students are able to organize independently the planning and control to carry out validity and qualification under the aspect of quality assurance and to report about it.
Summary indicative content:	**Bioinformatics** Lecture: • Overview of biological databases • Organisation of the genome; genome and proteome • Dot plots; scoring matrices • Pair wise alignment; multiple alignment • BLAST program • Phylogenetic trees • Protein structure determination and protein structure databases • Programs for the rendering of proteins • Physicochemical aspects of proteins • Application of hydrophobicity profiles • Classification of protein structures; protein structure prediction • Homology modelling; modelling methods • Drug design tools Exercise: The content of the lecture is applied to the concepts and algorithms of practical biological programs. **Quality Assurance** Lecture: • Basic concept and requests of Good Manufacturing Practice • Admission procedure of finished medicinal products (Specification and examination regulations) • Standard Operating Procedures (SOP) • Production (Staff, rooms, process control) • Production (Cleaning- and process validation) • Quality control (Sampling, reagents, standards, methods, documentation, ooS results) • Quality control (staff, training, job description, double check, audits) • Quality control (Stability testing) • Qualification of analytical equipment (Planing/types of tests: GAP, FMEA, V-Modell) • Qualification of a climate chamber (practical realisation)

	Exercises: • Creation of a Standard Operating Procedure (SOP) • Creation of a performance test for an analytical equipment • Realization of a raw data check
Assessment:	Passing of module – graded The successful participation is demonstrated by working out the weekly lab exercises and a written examination at the end of the semester. The total grade of the module is comprised of a written exam about the content of the lecture and the exercises, which has to be passed with at least 50 % of the total points.
Teaching style:	Lecture: PowerPoint Presentation, blackboard Exercise: Practical computer exercises
Indicative Bibliography/Sources:	**Bioinformatics** 1. Arthur M. Lesk: Introduction to Bioinformatics, 2nd Edition Oxford University Press 2006 2. Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison: Biological sequence analysis. Cambridge University Press 1998 3. Andreas D. Baxevanis, B. F. Francis Ouellette: Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, Wiley, 2004 **Quality Assurance** 1. EG-Leitfaden der Guten Herstellungs-Praxis 8. Aufl., ECV 2. Deutscher Inspektions-Leitfaden, Maas & Peither Verlag 3. Der GMP-Berater, Maas & Peither Verlag 4. Das kleine QM Lexikon, Wiley VCH 5. 21 cfr part 210 / 211, www.fda.gov 6. GAMP 5, Leitfaden zur Validierung automatisierter Systeme, www.ispe.org 7. Statistik für Anwender, Wiley VCH

Module:	**Immunology**
Semester:	4th Semester
Course Leader:	Prof. Dr. Harald Illges
Lecturer:	Prof. Dr. Harald Illges
Language:	English
Assignment in Curriculum:	**Compulsory Course in 4th Semester Applied Biology**
Course Units/Credit hours:	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 80 Lab work: 2 credit hours; max. group size: 15
Students workload:	Contact hours / Private study Lecture: 30 / 40 Exercise: 30 / 50 Lab work: 30 / 30 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Biology 1-4; Biochemistry
Learning outcomes:	<u>At the end of the study unit lecture/exercise the students are able:</u> • to explain the origin of immunological cells from the bone marrow and thymus, • to understand differentiation and activation of immunological cells, • to understand the reaction of the immune system to infections. The exercise serves to discuss the content of the lecture based on questions. Both have the same content. <u>At the end of the practical course the students are able:</u> • to work with blood cells and analyze these in blood smear, • to apply FACS technology towards the allergen specific degranulation of basophils, • to sort lymphocyte subsets via magnetic cell sorting, • to isolate immune cells from different organs and analyze them, • to test blood groups.
Summary indicative content:	<u>Lecture and exercise:</u> • Basics of the immune system; knowledge of immunological techniques: Components of the immune system, immunological organs, structure and function of organs, cells of the immune system • Innate immune systeme:Protective function of skin and mucosal tissues, phagocytes, complement system, natural killer cells, cytokines, chemokines, inflammatory reaction

	• Adaptive immunsystem: B-cell system, ´receptors, antigen recognition, antibody production, functions of antibodies; • T-cell-system: receptors, antigen recognition, effetor cells, mechanisms of cellular immunity; immunological memory. signal transduktion in the immune system Content of the practical course: • Magnetic sorting of cells • Degranulation of Basophils with allergens • Determination of blood groups, blood picture • Flow cytometry • Isolation of primary lymphocytes • Determination of blood groups
Assessment:	Passing of module – graded The total grade of the module is comprised of: 1. a written exam about the content of the lecture and the practical course, which has to be passed with at least 50% of the total points. The grade of the exam contributes by 70% to the total grade of the module. 2. writing an individual laboratory report. Grading of the lab report contributes by 30% to the total grade of the module.
Teaching style:	Lecture: Projector, blackboard, online lecture, power point presentations Exercises: Online questions, blackboard Laboratory course: Online script about experiments
Indicative Bibliography/Sources:	Immunobiology. C.A. Janeway, P. Travers, M. Walport and J.D. Capra, latest edition

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
Recommendations:	Passing of the modules of the 1st, 2nd and 3rd semester
Learning outcomes:	<u>At the end of the lecture the students are able:</u> • to know the cell culture equipment. • to know how to get information about cell lines and order them. • to discriminate cell lines from primary cells and lab scale from technical scale. • to recognize chromosome banding patterns. • to discriminate contaminations and their sources. • to know the basic of apoptosis. <u>At the end of the laboratory course the students are able:</u> • 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.
Summary indicative content:	<u>Lecture:</u> • 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 <u>Lab work:</u> • 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
Assessment:	Passing of module – graded The final mark of the module consists of: 1. a written test composed of questions to the content of the lecture and the provided protocol for the practical part. The written test must be passed with at least 50 % of the possible points and counts 50 % of the final mark. 2. the correct execution of the experiments in the laboratory which counts 20 % of the final mark. Writing the minutes of the experiments which counts 30 % of the final mark.
Teaching style:	Lecture: Data projector (Powerpoint presentation) and black board, in part short movies or overhead projector Practical course: Written manuscript
Indicative Bibliography/Sources:	1. R.I. Freshney; Culture of Animal Cells; ISBN 0-471-34889-9; Wiley-Liss 2. J. Walker; Methods in Molecular Biology: Basic Cell Culture Protocols; ISBN 0-89603-384-8; Humana Press 3. T. Lindl; Zell- und Gewebekultur (6th ed.); ISBN 3-82-74-1194-7; Spektrum Verlag

Module:	**Genetic Engineering**
Semester:	5. Semester
Course Leader:	Prof. Dr. Hans Weiher
Lecturer:	Prof. Dr. Hans Weiher
Language:	English
Assignment in Curriculum:	**Compulsory Course in 5th Semester Applied Biology**
Course Units/Credit hours:	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 80 Lab work: 2 credit hours; max. group size: 15
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:	Successful attendance of the modules "Biochemistry" und "Molecular Genetics"
Learning outcomes:	Lecture: After successful attendance of the lecture and exercise "Genetic Engineering" students will be able to understand and explain the basics of applications of genetic engineering. Students are familiar with the general procedure, methods and techniques involved in molecular cloning and are able to explain their molecular or biochemical background. Students know different types of vectors used in genetic engineering and can evaluate their use for different cloning purposes. Students know about the significance of gene libraries and are familiar with the procedures involved in constructing them. Techniques involved in the generation of transgenic plants or animals are known, current applications can be mentioned and explained. Moreover students are able to interprete and evaluate current scientific research and applied technologies in the field of genetic engineering. After successful attendance of the practical course students are able to: • produce and molecularly clone in vitro recombined nucleic acids in a bacterial host, • identify molecular clones and analyse the expression of a cloned gene.
Summary indicative content:	Lecture: • Basics of working with recombinant DNA; cloning techniques • Restriction endonucleases

	• Ligases • Heterologous gene expression • Vectors and plasmids • Transformation of bacterial cells • Cloning of a DNA molecule into a plasmid vector • Analysis of recombinant DNA • Screening methods • Hybridisation of nucleic acids • Applications of the genetic engineering technology in the biotechnology field <u>Exercises:</u> • Solving problems and questions developing from the lectures issues. • Working on literature from the field. <u>Practical course:</u> • Molecular cloning of a PCR fragment in E.coli using an expression vector • Ligase reaction of the fragment with the vector molecule • Generation and use of competent cells • Generation of bacterial clones • Analysis for the presence of the cloned gene fragment and of its expression in RNA and enzymatic activity, respectively
Assessment:	The final mark for this module is determined by: 1. A written exam on the subjects of the lecture and the exercises (50% of the final mark), in which at least 50 % of the potential maximum score has to be reached. 2. A lab report on the practical work (50% of the final mark)
Teaching style:	Lecture: Projector, blackboard, video, animations Exercises: Blackboard Practical course: Written laboratory manual
Indicative Bibliography/Sources:	1. Sambrook, Fritsch, Maniatis (2003): Molecular Cloning, a Laboratory Manual Vol.1, 2, and 3.; Cold Spring Harbor Laboratory Press. 2. Primrose and Twyman (2006): Principles of Gene Manipulation and Genomics; Blackwell Pubishing 3. Nicholl (2008): Genetic Engineering; Cambridge University Press 4. Howe (2007): Gene Cloning and Manipulation; Cambridge University Press

Module:	**Microbial Physiology**
Semester:	5th Semester
Course Leader:	Professor Dr. Maria-Paz Weißhaar
Lecturer:	Professor Dr. Maria-Paz Weißhaar
Language:	English
Assignment in Curriculum:	**Compulsory Course in the 5th Semester BSc Applied Biology**
Course Units/Credit hours:	Lecture: 2 credit hours Seminar: 2 credit hours; max. group size: 45 Lab work: 2 credit hours; max. group size: 16
Students workload:	Contact hours / Private study Lecture: 30 / 40 Exercise:: 30 / 50 Lab work: 30 / 30 Sum: 90 / 120 **Total Sum: 210 hours**
Credits:	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules of the 1st, 2nd, 3rd, and 4th semester
Learning outcomes:	<u>At the end of the lecture and seminar the students are able:</u> • to discriminate microorganisms according to their physiological properties. • to understand the differences between respiration and fermentation and to take this knowledge into account in the cultivation of organisms. • to know the basis of and the molecular response to bacterial stress, and to avoid bacterial stress in the production of biotechnological products. <u>At the end of the laboratory course the students are able:</u> • to select and prepare growth media for the differentiation of microorganisms. • to differentiate between microorganisms according to their physiological properties. • to cultivate microorganisms in a fermenter.
Summary indicative content:	• Metabolic Diversity of bacteria: carbohydrate metabolism, metabolism of aromatic compounds, fermentation types, nitrogen metabolism, energy-conserving reactions • Bacterial response to stress: microbial adaptation • Fermenter technology
Assessment:	Passing of module – graded The total grade of the module is comprised of a mark for the seminar (50%) and a mark for the laboratory course (50%). The mark for the seminar is comprised of an oral presentation (50%) and a written report (50%).

	The mark for the laboratory course is comprised of a test during the lab course (30%), a written laboratory report (60%), and a written record of work (10%).
Teaching style:	Lecture: Projector Seminar: Oral PowerPoint presentations Practical course: Manuscript for the practical course
Indicative Bibliography/Sources:	1. Moat , Foster & Spector: Microbial Physiology, Wiley-Liss 2. Madigan, Martinko & Parker. Brock Microbiology of Microorganisms, Benjamin Cummings, San Francisco

Module:	**Developmental Biology**
Semester:	5. Semester
Course Leader:	N.N.
Lecturer:	N.N.
Language:	English
Assignment in Curriculum	**Compulsory Course in 5th Semester Applied Biology**
Course Units/Credit hours	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 80 Lab work: 2 credit hours; max. group size: 15
Students workload:	Contact hours / Private study Lecture: 30 / 40 Exercise:: 30 / 50 Lab work: 30 / 30 Sum: 90 / 120 **Total Sum: 210 hours**
Credits	7 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful attendance to the modules "Biochemistry" und "Molecular Genetics"
Learning outcomes:	After successful attendance of the module "Developmental Biology" students will be able to: Lecture/Exercise • understand the basics of developmental biology in different model species. • interpret and evaluate current scientific research and in the field of developmental biology. Practical work • isolate, experimentally manipulate and study embryos from different species. • identify transgenic embryos and individuals and study transgenic expression.
Summary indicative content:	Lecture and Exercises: • Fundamental principles • Model organisms • Pattern formation • Morphogenesis • Cellular differentiation • Organogenesis • Development of the nervous system • Germ cells and sexual development • Regeneration, growth • Evolution

	Practical course: Isolation and study of different developmental stages of different species (worms, insects, vertebrates).
Assessment:	The final mark for this module is determined by: A written exam on the subjects of the lecture and the exercises (50% of the final mark), in which at least 50 % of the potential maximum score has to be reached. A lab report on the practical work (50% of the final mark).
Teaching style:	Lecture: Projector, blackboard Exercises: Blackboard Practical: Written laboratory manual
Indicative Bibliography/Sources:	1. Gilbert, S. Developmental Biology, 8th edition (2003), Sinauer Associates 2. Wolpert, L. et al. Principles of Development 3rd ed. (2006), Oxford University Press

Module:	**Interdisciplinary Project**
Semester:	5. Semester
Course Leader:	The lecturers of the department
Lecturer:	The lecturers of the department
Language:	English or German
Assignment in Curriculum	**Compulsory Course in 5th Semester Applied Biology** **Compulsory Course in 5th Semester Chemie mit Materialwissenschaften** **Compulsory Course in 5th Semester Naturwissenschaftliche Forensik**
Course Units/Credit hours	The unit consits of experiments and the training of practical skills, which are planned, performed and presented under supervision. Lab work: 3 credit hours; max. group size: 20
Students workload:	Contact hours Private study Lab work: 45 45 **Total Sum: 90 hours**
Credits	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules of the first four semesters
Learning outcomes:	At the end of the course students have extended their practical skills and know how to apply new methods in time and project management. They are able to work independently and as team members.
Summary indicative content:	Students work in small groups and self-organized on a topic given to them by a member of the department. The subject of research is overlapping different scientific disciplines and often performed in cooperation with other research institutes or the industry. The students set up time frames for their experiments, organize the different tasks among each other and learn to coordinate their own research project. This includes planning, practical work in the laboratory and presentation of the results.
Assessment:	Passing of module – not graded Concept, performance and final presentation are being assessed.
Teaching style:	On demand
Indicative Bibliography/Sources:	On demand

Module:	**Practical Phase**
Semester:	6. Semester
Course Leader:	The lecturers of the department
Lecturer:	The lecturers of the department
Language:	German or English
Assignment in Curriculum:	**Compulsory Course in 6th Semester Applied Biology** **Compulsory Course in 6th Semester Chemie mit Materialwissenschaften** **Compulsory Course in 6th Semester Naturwissenschaftliche Forensik**
Course Units/Credit hours:	The course consists of a 3 months practical training at a company or research institute in Germany or abroad. Training takes place in a department that offers a research topic that complies with the learning outcome of the study program. Alternatively, the practical phase can be substituted by a study semester at a foreign university. During the practical phase students are supervised by a lecturer from the department who also evaluates the report about the practical training.
Students workload:	**3 months** practical training at a company/institute (40 h/week)
Credits:	18 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules of the first five semesters.
Learning outcomes:	Students evaluate the acquired knowledge with regard to their specialist, analytical, technical and social knowledge. They are enabled to apply their knowledge on a practical and occupational field. Furthermore, they gain special knowledge and skills in the research field they are working in and to interprete their findings interdisciplinarily. The students are trained in solving problems, both by working independently and as a team member. Thus, the practical phase not only increases the scientific competence of the students but also trains their social behavior.
Summary indicative content:	Students are integrated into the workflow of a company/institute and get the option to apply the acquired knowlegde during their studies in a practical project. Furthermore, they are confronted with practical problems and time-management tasks. In addition, the students achieve new technical skills and knowledge, related to the project they are working on.
Assessment:	Passing of module – not graded For passing of the module, the students have to 1. bring a certificate about the successful completion of their practical phase (certificate/credential from company/institute) 2. write a final report about the content of their practical phase 3. successfully perform a final meeting and discussion about the practical phase with their supervisor.
Teaching style:	Not applicable
Indicative Bibliography/Sources:	On demand

Module:	**Thesis**
Semester:	6. Semester
Course Leader:	The lecturers of the department
Lecturer:	The lecturers of the department
Language:	German or English
Assignment in Curriculum:	**Compulsory Course in 6th Semester Applied Biology** **Compulsory Course in 6th Semester Chemie mit Materialwissenschaften** **Compulsory Course in 6th Semester Naturwissenschaftliche Forensik**
Course Units/Credit hours:	In general the bachelor thesis is being compiled at a German or international company or research institution which is able to offer a work place compatible with the goals of the study program. The thesis is supervised by at least one professor of the department, who is also responsible for the grading. Details can be found in the examination regulations (Bachelor Prüfungsordnung).
Students workload:	**2 month** (Application for an extensions of 4 weeks at the most is possible.)
Credit points:	12 ECTS
Prerequisites according to examination regulations:	Requirements for admission to the thesis: 1. not more than two module exams of all other exams in the study program are uncompleted. 2. or, all exams of semester 1 to 4 have been passed.
Recommendations:	None
Learning outcomes:	As team members as well as independently students are able to solve complex scientific tasks in given time and according to scientific principles. Results of scientific work can be presented adequately both oral and in written form. The bachelor thesis proves the students competence to work scientifically and to apply analytical skills to a practical problem. It demonstrates problem solving skills as well as social competences.
Summary indicative content:	Scientific knowledge and skills of the courses of the study program are applied to problems of practical relevance. Results of the work are documented in written form as a bachelor thesis within a fixed time frame. Students present and defend them in a discussion.
Assessment:	Bachelor-Thesis: graded (25% weight of the final grade) Oral exam: graded (10% weight of the final grade)
Teaching style:	Not applicable
Indicative Bibliography/Sources:	On demand

Module:	**English 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** **Elective Course in 1st and 2nd Sem. Chemie mit Materialwissenschaften** **Elective Course in 1st and 2nd Sem. Naturwissenschaftliche Forensik**
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:	None
Recommendations:	Secondary School English level
Learning outcomes:	• Improvement of knowledge in English (especially talking and listening skills) • Obtaining technical terminology • Acquiring a basic standard in English • Ability to participate in scientific talks and meetings • Exchange of scientific information in seminars and discussion groups
Summary indicative content:	• The Periodic Table • Genetics • Chemical bonds and reactions • Cell Biology • Human Biology • The influence of drugs and other substances on the human body • Disease • Microscopy
Assessment:	Passing of module – graded Written exam (50%), scientific presentation (50%)
Teaching style:	Script, Videos
Indicative Bibliography/Sources:	Script: English for Biology

Module:	**Languages 1 & 2**
Semester:	1. and 2. Semester
Course Leader:	James Chamberlain
Lecturer:	Hauptmann / Ruiz Vega / Grambach
Language:	Norwegian / Spanish
Assignment in Curriculum:	**Elective Course in 1st and 2nd Sem. Applied Biology** **Elective Course in 1st and 2nd Sem. Chemie mit Materialwissenschaften** **Elective Course in 1st and 2nd Sem. Naturwissenschaftliche Forensik**
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:	None
Recommendations:	None
Learning outcomes:	Aim of this module is to introduce a new foreign language to the students. The two courses form a unit, by which the students achieve level A2 of the Common European Reference Frame for Languages, i.e. • Listening: understanding of the essentials in short, clear and simple statements • Reading: identification of important information in general literature, and understanding of short and simple letters • Talking: simple conversation, making first verbal contacts • Writing: writing of short, simple notes and letters
Summary indicative content:	• Practical training in the four core disciplines: Listening, Reading, Speaking and Writing • Introduction to grammar of the foreign language • Introduction to regional and cultural aspects of the country
Assessment:	Passing of module – graded Written exam (50%), scientific presentation, projects, simulation, quizzes (50%)
Teaching style:	Script, Videos
Indicative Bibliography/Sources:	Scripts and textbooks from the lecturers

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:	Lecture: 2 credit hours Exercise: 2 credit hours; max. group size: 60 Lab work: 2 credit hours; max. group size: 30
Students workload:	<u>for 3 ECTS:</u> Contact hours / Private study Lecture: 30 / 15 Exercise: 30 / 15 Sum: 60 / 30 **Total Sum: 90 hours** <u>for 6 ECTS :</u> Contact hours / Private study Lecture: 30 / 15 Exercise: 30 / 15 Lab work: 40 / 50 Sum: 100 / 80 **Total Sum: 180 hours**
Credits	3 or 6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Completion of the modules "Microbiology" and "Medical Microbiology".
Learning outcomes:	<u>At the end of the lecture and exercise, the students are able:</u> • to select the appropriate bioreactor for different types of fermentations. • to use terms of bioprocess engineering appropriately. • to monitor processes in food biotechnology. • to construct genetically modified organisms, and to screen them for increased productivity. • to produce biopolymers and to purify them. • to classify vaccines and hormones as therapeutics to their area of use. • to select microorganisms according to their physiological properties for the bioremediation of contaminated soil.

	At the end of the laboratory course, the students are able: • to identify genetically modified food by analytical techniques. • to produce proteins in a heterologous system, purify them by chromatography, size-separate them by SDS-PAGE, and specifically detect them by Western blot. • to produce fermented foods, e.g. wine and yoghurt. • to specifically detect biotechnological products, like proteases and dihydroxyacetone, respectively. • to produce different types of bioplastics. • to use different strategies for enzyme immobilization, and subsequently test the enzyme for functionality.
Summary indicative content:	Content of lecture and exercise: • Bioprocess Engineering: fermentor design, size and materials of bioreactors, aeration, temperature control, sterilization • Culturing conditions and purification strategies: primary and secondary metabolites, growth yield, productivity, time-volume-yield, batch and fed-batch cultivation, chemostat, turbidostat, concentration of cells by centrifugation and filtration, cell disruption • Food Biotechnology: beer brewing, making of wine, fermented dairy products, acetic acid, citric acid and amino acid production, conversion of starch to high fructose syrup, strategies for overproducing metabolites by microorganisms • Production of Biopolymers: bioplastic made of polylactide, polyhydroxyalkanoates or polysaccharides, emulsifying agents made of alginate, dextran or xanthan • Enzymes in washing powder for the making of food or textiles; diagnostic enzymes, enzymes for the production of fine chemicals • Pharmaceutical Biotechnology: hormones and growth factors, enzymes and enzyme modulators, vaccines, monoclonal antibodies • Plant Biotechnology: genetically modified food, cloning by meristem propagation, introducing desired traits • Environmental Biotechnology: degradation of xenobiotics, wastewater treatment plants, bioremediation Laboratory Course: • Protein purification and detection • Microbial production of dihydroxyaceton • Detection of potential allergens in food by ELISA • Production of wine and yoghurt, respectively • Enzyme immobilization • Production of different bioplastics
Assessment:	Passing of module – not graded At the end of the module the content of the lecture and exercises is tested in an exam. Passing of the 3 ECTS module requires passing of the exam (obtaining at least 50% of the total amount of points). Passing of the 6 ECTS module requires: 1. passing of the exam (obtaining at least 50% of the total amount

	of points) 2. performing the laboratory experiments successfully and writing a marked laboratory report.
Teaching style:	Lecture: Blackboard, online script exercises: Online questions, blackboard laboratory course: Online script about experiments
Indicative Bibliography/Sources:	1. Schmid: Pocket Guide to Biotechnology and Genetic Engineering, 1. Edition, Wiley-VCH Verlag, Weinheim. 2. Glick & Pasternak: Molecular Biotechnology, 3. Edition, American Society for Microbiology, Washington D.C. 3. Thieman & Palladino: Introduction to Biotechnology 4. Ratledge & Kristiansen: Basic Biotechnology, 3. Edition, Cambridge University Press, Cambridge. 5. Herren: Introduction to Biotechnology: An Agricultural Revolution, 1. Edition, Thomson Delmar Learning, New York. 6. Scragg: Environmental Biotechnology, 2. Edition, Oxford, University Press, Oxford.

Module:	**Applied Clinical Research I and II**
Semester:	4th Semester
Course Leader:	Priv.Doz. Dr. Dr. Thomas Schöndorf
Lecturer:	Priv.Doz. Dr. Dr. Thomas Schöndorf
Language:	English
Assignment in Curriculum:	**Elective Course in the 4th Semester Applied Biology**
Course Units/Credit hours:	For 3 ECTS the course unit consists of: Lecture: 2 credit hours Seminar: 1 credit hour; max. group size: 60 For 6 ECTS the course unit consists of: Lecture: 2 credit hours Seminar: 1 credit hour; max. group size: 60 Exercises: 3 credit hours; max. group size: 15
Students workload:	<u>For 3 ECTS:</u> Contact hours / Private study Lecture: 30 / 20 Seminar: 15 / 25 Sum: 45 / 45 **Total sum: 90 hours** <u>For 6 ECTS:</u> Contact hours / Private study Lecture: 30 / 20 Seminar: 15 / 25 Exercise: 45 / 45 Sum: 90 / 90 **Total sum: 180 hours**
Credits:	3 resp. 6 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Passing of the modules of the 1st, 2nd and 3rd semester
Learning outcomes:	<u>Lecture and Seminar:</u> After successful attendance of the lectures and seminars students have a general comprehension of procedures, responsibilities and terminology in the field of clinical research. They know the basics and methods in clinical research for the market authorization of drugs as well as the complete schedule of a clinical trial and understand the practical approach to clinical research projects. Furthermore they got to know the given statutory and ethical framework for the implementation of study projects with

	humans and the necessary documents and requirements. In addition they are able to prepare and present an informative paper at short notice. <u>Exercises:</u> After successful attendance of the exercises students are able: • to practically implement the knowledge acquired in lectures and seminars. • to organise projects. • to perform clinical trials.
Summary indicative content:	<u>Lecture and Seminar:</u> • Basics and methods in clinical research • Statutory and ethical guidelines • Good clinical practice (GCP) • Responsibilities within the scope of clinical trials • Practical implementation of studies • Presentation techniques <u>Exercises:</u> • Practical implementation of laws, procedures and guidelines in clinical research • Project management
Assessment:	Passing of module – not graded By request of the students the module can be graded. For 3 ECTS: At the end of the course units students have to take a written exam which has to be passed with at least 50% of the total points. For 6 ECTS: In addition to the written exam students have to give an oral presentation in the seminar. In case of requested grading the presentation accounts for 50% of the final grade.
Teaching style:	Lecture: Projector, oral discussions, guest lectures from professional areas in clinical research (CRO, investigators) Seminar: Oral PowerPoint presentations
Indicative Bibliography/Sources:	None

Module:	**Renewable Resources / Nachwachsende Rohstoffe**
Semester:	5th Semester
Course Leader:	Prof. Dr. Margit Schulze
Lecturer:	Prof. Dr. Margit Schulze
Language:	English / German (depending on participants)
Assignment in Curriculum:	**Elective Course Applied Biology, 5th Sem.** **Elective Course 5th Semester, Chemie mit Materialwissenschaften** **Elective Course 5th Sem. Naturwissenschaftliche Forensik**
Course Units/Credit hours:	Lecture: 1 credit hour Exercise: 1 credit hour Lab work: 1 credit hour
Students workload:	Contact hours / Private study Lecture: 15 / 15 Seminar: 15 / 15 Exercise: 15 / 15 Sum: 45 / 45 **Total Sum: 90 hours**
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful passing of the following modules: General Chemistry, Analytical Chemistry, Organic Chemistry, Instrumental Analysis.
Learning outcomes:	Lecture/Exercise: At the end of the course the students are: • familiar with the most important fossil and renewable resources and corresponding chemicals that are available; • able to define and explain correlation between chemical structure and material properties; • able to specify and explain appropriate materials for specific applications and describe their functionalities (e.g. renewable materials in automotive industry, construction and medicine); • able to describe methods and processes for material production, analysis and characterization, recycling and degradation. Laboratory work: The students are able to synthesize an organic material based on renewable resources (e.g. an ester using natural oils).
Summary indicative content:	Lecture/Exercise: • Sustainability and sustainable development in chemistry and natural sciences • Renewable resources in chemical industry • Availability and accessibility, production, purification, treatment methods of renewable resources

	• Corresponding building blocks • Structure-property-relationships • Properties of materials from renewable resources • Applications, degradation processes and recycling • Biorefinery concepts (in comparison to crude oil refineries and petrochemicals) <u>Laboratory work:</u> Representative example for synthesis of materials based on renewable resources (e.g. ester from natural oils).
Assessment:	Written examination has to be passed (no grade). Active participation during the whole course is required.
Teaching style:	Black board, projector, overhead, handouts, recent scientific publications (will be provided).
Indicative Bibliography/Sources:	1. C. Stevens, R. Verhe (Eds.), Renewable Bioresources: Scope and Modification for Non-Food Applications, WILEY-VCH. 2. H. Zoebelein (Ed.), Dictionary of Renewable Resources, WILEY-VCH. 3. B. König et al., Neues und nachhaltigeres organisch-chemisches Praktikum Multiplattform-CD-ROM, Harry Deutsch Verlag. 4. Collection of recent scientific publications (will be provided).

Module:	**Modelling of Biological Applications / Modellieren von Molekülen**
Semester:	4. or 5. Semester
Course Leader:	Prof. Dr. Oligschleger
Lecturer:	Prof. Dr. Oligschleger
Language:	German or in study programme Applied Biology English
Assignment in Curriculum:	**Elective Course in 4th or 5th Semester Applied Biology** **Elective Course in 5th Semester Naturwissenschaftliche Forensik** **Elective Course 5th Semester, Chemie mit Materialwissenschaften**
Course Units/Credit hours:	Seminar/Exercise: 3 credit hours; max. group size: 20
Students workload:	Contact hours Private study Seminar/ Exercise: 45 45 **Total Sum: 90 hours**
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Mathematics, Computing Sciences
Learning outcomes:	Seminar: The students know the most important methods and tools in simulation and and their limitations. Exercises: The students are able to decide which program can be applied to concrete problems. They are able to interpret and analyze the results of these simulations. They are be able to use the different packages.
Summary indicative content:	Seminar: Introduction into basic quantum theory, potentials, force fields, structure resolution (diffraction experiments, scanning tunneling microscopy), basics of dynamics (Monte-Carlo-methods and Molecular Dynamics), basic thermodynamics and kinetcs (protein folding) Exercise: Introduction into MOPAC, Z-matrices, calculation of molecules (determination of ground state geometries, vibrations, reactions), visualisation using freeware programs
Assessment:	Report/presentation about simulations and/or methods for structure determination. Alternatively, they are assessed in a written examination.
Teaching style:	Seminar/Exercise: Blackboard, overhead projector, projector, practical training in the computer laboratory.
Indicative Bibliography/Sources:	1. Kutzelnigg, Einführung in die Theoretische Chemie (Bd. 1 und 2), 2. Jonathan A. Goodman, Chemical Applications of Molecular Modelling

Module:	**Cost and Activity Accounting**
Semester:	5th Semester
Course Leader:	MSc, Dipl. Kauf (FH) Simone Fritzen
Lecturer:	MSc, Dipl. Kauf (FH) Simone Fritzen
Language:	German
Assignment in Curriculum:	**Elective Course in the 5th Semester Applied Biology** **Elective Course in the 5th Semester Naturwissenschaftliche Forensik** **Elective Course in the 5th Semester Chemie mit Materialwissenschaften**
Course Units/Credit hours:	The tutorial consists of lectures and exercises. Lecture: 2 credit hours; max. group size: 20 Exercises: 1 credit hour; max. group size: 20
Students 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:	None
Learning outcomes:	Lecture: • Attendants know the basics of cost and activity accounting and can explain them. • Students know the tasks of cost-type accounting. • Students can setup a BAB (company accounting sheet). • Students are able to use output costing and overhead calculation. • They know the necessity of cost and activity accounting and are able to project them on lab work. Exercises: • During the exercises students learn how to use and calculate the learned methods.
Summary indicative content:	Lecture and exercise: • Tasks of cost unit accounting • Basic terms of cost and activity accounting • Cost-type accounting: tasks, dividing costs, gathering of cost types imputed costs • Cost centre accounting: tasks • BAB: accomplishment • Cost centre accounting: tasks and calculation
Assessment:	Written exam based on the lecture and exercises.

Teaching style:	Lecture: Projector, blackboard Exercise: Blackboard, group work
Indicative Bibliography/Sources:	1. Haberstock: Kostenrechnung I 2. Haberstock: Kostenrechnung II 3. Moews: Kosten- und Leistungsrechnung

Module:	**Personalmanagement**
Semester:	5th Semester
Course Leader:	MSc, Dipl. Kauf (FH) Simone Fritzen
Lecturer:	MSc, Dipl. Kauf (FH) Simone Fritzen
Language:	German
Assignment in Curriculum:	**Elective Course in the 5th Semester Applied Biology** **Elective Course in the 5th Semester Naturwissenschaftliche Forensik** **Elective Course in the 5th Semester Chemie mit Materialwissenschaften**
Course Units/Credit hours:	The tutorial consists of lectures and exercises. Lecture: 2 credit hours; max. group size: 20 Exercises: 1 credit hour; max. group size: 20
Students workload:	Contact hours / Private study Lecture: 30 / 25 Exercise: 15 / 20 Sum: 45 / 45 **Total Sum: 90 hours**
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: • Students are able to recognize basic organisation types and know their pros and cons. • Students know methods of personnel development and acquirement. • They can explain tasks and aims of personnel development. • Students know the importance of co-worker motivation and methods for motivating co-workers. • They know different leadership style theories and their pros and cons. • Students know the leadership process and the tasks connected with it. • The students have basic knowledge about mobbing and mediation. Exercise: • Working in groups the students will learn how to face leadership tasks and problems connected to them in everyday business.
Summary indicative content:	Lecture and exercise: • Line organisation, divisional organisation, matrix organisation • Personnel requirement planning: calculation gross personnel requirement, reserve requirements, net personnel

	requirements • Motivation process, motives and basic types of co-workers (the powerless co-worker, the economic man, the social man), motivation theories (content theory, expectation valence theories, balance theory), practical methods of motivation • Styles of leadership theories (Blake and Mouton, 3D-Model of Reddin, Fiedler) • Steps of the leadership process: defining goals, planning, decision making, realization, control • Leadership tasks: management by objectives, delegation, giving orders, problem management, information management, co-worker control, recognition and criticism, conflict management • Mobbing and mediation
Assessment:	Passing of module – not graded Written exam
Teaching style:	Lecture: Projector, blackboard Exercise: Blackboard, group work
Literature	1. Jung, Personalwirtschaft; 2. Eisenführ, Einführung in die Betriebswirtschaftslehre; 3. Olfert, Personalwirtschaft

Module:	**Organic Chemistry 2**
Semester:	4th Semester
Course Leader:	Prof. Dr. Margit Schulze
Lecturer:	Prof. Dr. Margit Schulze, Dr. Kai Jakoby
Language:	English / German (depending on participants)
Assignment in Curriculum:	**Elective Course 4th Semester Applied Biology** **Elective Course 4th Semester Chemie mit Materialwissenschaften** **Elective Course 4th Semester Naturwissenschaftliche Forensik**
Course Units/Credit hours:	Lecture: 1 credit hour Seminar: 1 credit hour Lab work: 1 credit hour
Students workload:	Contact hours / Private study Lecture: 15 / 15 Seminar: 15 / 15 Lab work: 15 / 15 Sum: 45 / 45 **Total Sum: 90 hours**
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Successful Passing of General Chemistry, Analytical Chemistry, Organic Chemistry.
Learning outcomes:	Lectures: Based on the first Module ‚Organic Chemistry' the knowledge of properties of organic compounds and their reactivity will be deepened and enlarged. At the end of the module: • students know the typical reactions of various classes of organic substances and they are able to apply them. • students are familiar with mechanistic and stereochemical aspects of important C-C-coupling reactions and special modern synthesis methods (e.g. organo-metallic reagents, asymmetric syntheses). • they can explain those reactions and apply them. Exercises: • students are able to transfer the lecture topics according to corresponding exercise problems; • students can formulate and explain the corresponding reaction equations and mechanisms. Laboratory work: • students deepened their practical experience; • students are introduced into further elemental methods of organic synthesis, e.g. how practically to realize carbon-carbon-coupling (e.g. via chemical reactions such as Wittig

	and Cannizzaro reaction).
Summary indicative content:	Lecture/Seminar: • Reaction mechanism, in particular various different C-C-coupling reaction mechanism • Organo-metallic reactions • Stereochemical reactions • Special topics in organic chemistry, e.g. heterocycles, natural compounds, asymmetric synthesis • Technically important methods of main industrial products Laboratory work: Two experiments concerning synthesis and treatment of organic compounds, e.g. Wittig reaction, Cannizzaro reaction.
Assessment:	Passing of module – graded Written laboratory report (20%) Written examination (80%) Both parts have to be passed separately.
Teaching style:	Lecture/Seminar: Blackboard, overhead, beamer, manuscript. Practical course: Manuscript for the practical course.
Indicative Bibliography/Sources:	1. K.P.C. Vollhardt, N.E. Schore, Organic Chemistry, Wiley-VCH. 2. P. Y. Bruice, Organic Chemistry, Prentice Hall, New York. 3. R.T. Morrison, R.N. Boyd, Organic Chemistry, Prentice Hall, and Inc., New York and corresponding Study Guide 4. R. Brückner, Reaktionsmechanismen, Spektrum Verlag.

Module:	**Interdisziplinäre Anwendungen in der Mathematik**
Semester:	4. Semester
Course Leader:	Prof. Dr. Oligschleger
Lecturer:	Prof. Dr. Oligschleger
Language:	German
Assignment in Curriculum:	**Elective Course A1 in 4th Semester Applied Biology**
Course Units/Credit hours:	Seminar/Exercise: 3 credit hours; max. group size: 20
Students workload:	Contact hours Private study Seminar: 45 45 **Total Sum: 90 hours**
Credits:	3 ECTS
Prerequisites according to examination regulations:	None
Recommendations:	Mathematics, Computing Sciences
Learning outcomes:	After attending the seminar the students know analytical and numerical methods for interdisciplinary applications. They got to know different interdisciplinary problems and are able to apply analytical and numerical methods. Furthermore they are able to carry out calculations themselves.
Summary indicative content:	Vectorial analysis and its application in biology, chemistry and physics, deeper knowledge of differential equations, matrices, espacially determination of eigenvalues and eigenfunctions including application of numerical methods
Assessment:	Active participation in the tutorials accompanying the lectures is tested in exercises.
Teaching style:	Exercise: Blackboard, script, practical training in the computer laboratory.
Indicative Bibliography/Sources:	1. Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, vieweg Verlag, Braunschweig Wiesbaden. Band 1,2 und 3. 2. Thomas Rießinger, Mathematik für Ingenieure : eine anschauliche Einführung für das praxisorientierte Studium, Springer Verlag, Berlin ; Heidelberg, 1996, VII, 656 S. 3. Hans G. Zachmann, Mathematik für Chemiker, VCH, Weinheim, 1994, 5., erw. Aufl. XVIII, 700 S. 4. I.N. Bronstejn, Taschenbuch der Mathematik, Verlag Deutsch, Frankfurt am Main, 1999,4., überarb. und erw. Aufl. der Neubearb. 1151 S. 5. K. Gieck, R. Gieck, Technische Formelsammlung, Gieck Verlag, Germering, 1995, 30. erweiterte Ausgabe