Bonn-Rhine-Sieg University
of Applied Sciences

Module Catalogue for the Bachelor's Degree Programme in "Forensic Sciences" (English)

Department of Natural Sciences

Bonn-Rhein-Sieg University of Applied Sciences

Date: 3 July 2015

Appendix B: Module Catalogue

Compulsory Courses: Page

Elective Courses (Natural Sciences): Page

Elective Courses (Other): **Page**

Module:	**General Chemistry**
Semester:	1st semester
Course leader:	Prof. Dr Margit Geißler
Lecturer:	Prof. Dr Margit Geißler
Language:	English
Assignment to curriculum:	**Compulsory course in the 1st semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (experiments). Lecture: 2 lesson hours per week (SWS) Tutorial: 2 lesson hours per week (SWS); max. group size: 60 Laboratory course: 2 lesson hours per week (SWS); max. group size: 30
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 30 / 60 Laboratory course: 30 / 30 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will: know the fundamental models in chemistry as well as basic theories of matter, be familiar with the systematic order of substances, be familiar with the different types of reaction, the kinetics of chemical reactions and the Law of Mass Action, the fundamentals of stoichiometry and the fundamentals of electrochemistry. Tutorial: At the end of the tutorial, the students will: be able to formulate chemical equations and perform stoichiometric calculations, be able to draw conclusions and perform calculations using the Law of Mass Action and simple kinetic models, be able to describe acid-base equilibriums and perform calculations of pH values and buffers, be able to perform simple electrochemical calculations. Laboratory course: At the end of the laboratory course, the students will: be familiar with the basic operations in the laboratory, be able to assess sources of danger in the laboratory and draw the appropriate conclusions for safe working, be able to conduct experiments on the items mentioned below using experimental instructions and safe operating procedures for hazardous materials, be able to present and interpret experimental data and, if necessary, to draw consequences for further action.

Summary indicative content:	Lecture/ Tutorial: • Structure of atoms, Bohr-Rutherford Model of the Atom, atomic orbital model, atomic spectra • Structure of the Periodic Table of Elements • Chemical bonding: ionic bonds, atomic bonds, metallic bonds, coordinate covalent bonds, intermolecular bonds • Chemical reactions: reaction kinetics, chemical equilibrium, Law of Mass Action, types of reaction, reaction energy (thermochemistry) • Acids and bases, pH value, pK value, calculation of pH values, titration, buffers • The solubility product • Redox reactions: redox potential, Galvanic cells • The Nernst equation Laboratory course: During the laboratory course, the students conduct practical experiments on: • acid/base reactions, • titration, • pH values, • the Law of Mass Action, • reaction kinetics, • electrochemistry, • simple synthesis.
Assessment:	Modular examination – graded. Laboratory course (oral examinations and lab reports): 20%; Written final examination: 80%. Both parts of the examination must be passed independently of each other.
Teaching style:	Lecture: Overhead projector, blackboard, computer projector, online tutorial Tutorial: exercises, blackboard Laboratory course: 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, 8th edition, Thieme Verlag, Stuttgart, 3. Atkins, P., Jones, L., Chemical Principles. The Quest for Insight, Palgrave Macmillan, Hampshire, UK

Module:	**Criminalistics: Material Evidence and Crime Scene Investigation**
Semester:	1st semester
Course leader:	Prof. Dr Eßmann
Lecturer:	Chief of the Criminal Devision M. Mohr / Detective Chief Superintendent G. Prüfling
Language:	German
Assignment to curriculum:	**Compulsory course in the 1st semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	Lecture: 1 lesson hour per week Tutorial: Laboratory course: 1 lesson hour per week; max. group size: 20
Student workload:	Contact hours / Private study Lecture: 15 / 30 Tutorial: Laboratory course: 15 / 30 Total: 30 / 60 **Total (contact hours + private study: 90 hours**
Credits	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will: • understand the importance of a crime scene and of evidence in criminal proceedings, • know the basic principles of evidence recovery at crime scenes and the requirements for acting as court-appointed experts in criminal proceedings, • be versed in the main features of securing evidence and analysing traces, • understand the importance of documentation that is accepted in court, • be versed in the methodical investigation of various forensic traces. Laboratory course: At the end of the laboratory course, the students will: • have gained practical experience of various search and securing methods, • be able to secure traces that are accepted as evidence in court and to analyse these traces independently, • understand the principles of trace analyses that are accepted in court, • have gained practical experience of how to document the evaluation results of these analyses.
Summary indicative content:	Lecture: • The importance of a crime scene and of material evidence in criminal proceedings

	• The role of the court-appointed expert in criminal proceedings • Forms of evidence, kinds of traces and methods of analysis • Searching for and securing evidence • Case study <u>Laboratory course:</u> • Searching for and recovering evidence that is accepted in court • Independent analysis and documentation of this evidence • Defence and discussion of the results.
Assessment:	Modular examination - ungraded. Active participation will be demonstrated by preparing a lab report and a case study.
Teaching style:	L: overhead projector, computer projector, blackboard P: written experiment instructions; PC
Indicative bibliography/Sources:	• R. Weihmann: Lehr- und Studienbrief Krimilnalistik, VdP- Verlag, 2006 • Versuchsvorschriften und Sicherheitshinweise des FB Angewandte Naturwissenschaften • P. White (ed), Crime Scene to Court, The Essentials of Forensic Science, The Royal Society of Chemistry, London, 2004 • M. Benecke, Dem Täter auf der Spur. So arbeitet die moderne Kriminalbiologie - Forensische Entomologie und Genetische Fingerabdrücke, Lübbe Verlag, 2006 • B. Herrmann, K.S. Saternus, Biologische Spurenkunde, Bd.1, Kriminalbiologie 1; Springer Verlag, Berlin, 2007

Module:	**Computing Sciences**
Semester:	1st semester
Course leader:	Prof. Dr Ulrich Eßmann
Lecturer:	Prof. Dr Ulrich Eßmann
Language:	English
Assignment to curriculum:	**Compulsory course in the 1st semester of Forensic Sciences**
Course units/ Lesson hours per week (SWS):	Lecture: 2 lesson hours per week Tutorial: 2 lesson hours per week; max. group size: 30
Student workload:	Contact hours / Private study Lecture: 30 / 15 Exercise: 30 / 45 Lab work: 0 / 0 Total: 60 / 60 **Total (contact hours + private study): 120 hours**
Credits	4 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	At the end of the lecture, the students will: • be able to deploy computers and standard applications beneficially, • have gained insights into the basic structure and operating modes of computers, • be able to present their own projects using HTML, • be able to perform data evaluations and calculations using spreadsheet programs, • have a basic knowledge of programming, especially algorithms and data structures.
Summary indicative content:	Lecture: Computer systems and IT/computing science Internet, WWW, HTML Calculations based on spreadsheet programs Basics of programming Tutorial: Basics of handling a computer Spreadsheet calculations, accompanied by the basics of mathematics and statistics Basics of creating web pages with HTML Basics of programming with Visual Basic
Assessment:	The students provide evidence of active participation in the tutorial relating to the lecture by solving exercises in class and/or by taking a written test at the end of the semester.
Teaching style:	Lecture: computer projector presentation, notes on the blackboard Tutorial: notes on the blackboard, work sheets, practical computer exercises
Indicative bibliography/Sources:	1) HTML: • Self html (the English version is still (early 2005) in its infancy at: http://www.selfhtml.org/ • HTML course of the W3schools at:

	http://www.w3schools.com/html/default.asp 2) Microsoft Excel • Joseph E. Billo, Excel for chemists, Wiley, New York 2001 (contains a lot of tips and tricks relevant for scientists) 3) Visual Basic • Microsoft Visual Basic 6.0 programmer's guide, Microsoft Press Redmond, 1999 (advanced textbook)

Module:	**Structure and Characteristics of Materials**
Semester:	1st semester
Course leader:	Dipl.-Ing. (FH) Irina Marschall
Lecturer:	Dipl.-Ing. (FH) Irina Marschall
Language:	German
Assignment to curriculum:	**Compulsory course in the 1st semester of Forensic Sciences** **Compulsory course in the 1st semester of Chemistry with Material Science**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 2 lesson hours per week Exercise: 2 lesson hours per week; max. group size: 30 Laboratory course: 2 lesson hours per week; max. group size: 20
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 30 / 45 Laboratory course: 30 / 45 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will be able to: • describe and understand the basic structures of materials and how they develop, • relate the microscopic structure of materials to macroscopic characteristics , • understand essential characteristics of materials and how they are determined. Tutorial: At the end of the tutorial, the students will be able to apply the knowledge they have acquired during the lecture to specific tasks and case studies. Laboratory course: At the end of the laboratory course, the students will be able to independently conduct basic tests to characterise structures as well as mechanical and physical characteristics.
Summary indicative content:	Lecture: • Terms and definitions • The texture and structure of metallic and polymer materials • Crystal lattices • Slip planes

	• Imperfections • Macromolecules and principles of synthesis methods • Homo-polymers and copolymers • Blends, bonding types and characteristics • Structural formula and property spectrum • Texturing in metallic and polymer materials • Introduction to the mechanics of solids: elasticity, elastic-plastic material performance, fatigue, toughness, abrasion and wear, thermal material performance, creep deformation and creep fracture, methods of mechanical material testing <u>Tutorial:</u> Exercises and case studies relating to the content of the lecture <u>Laboratory course:</u> Experiments to characterize the structure and determine important physical and mechanical characteristics of metals, and polymers (e.g. determination of density, electric conductivity, heat conductivity, coefficient of thermal expansion and glass temperature, microstructure characterization, tests to determine corrosive properties and corrosion/insulation rating, tests to identify plastics and polymerization, tensile and bending tests)
Assessment:	Modular examination - graded. Written final examination: 100%.
Teaching style:	Lecture: computer projector, overhead, blackboard Tutorial: compilation of exercises, blackboard, overhead, computer projector Laboratory course: written experiment instructions
Indicative bibliography/Sources:	Ashby / Jones: Werkstoffe 1, Spektrum Akademischer Verlag HORNBOGEN, EGGLER, WERNER: Werkstoffe Hellerich, Harsch, Haenle: Werkstoff-Führer Kunststoffe, Thieme-Verlag HORNBOGEN, WARLIMONT: Metalle

Module:	**Mathematics**
Semester:	1st semester
Course leader:	Prof. Dr Draber and Prof. Dr Oligschleger
Lecturer:	Prof. Dr Draber and Prof. Dr Oligschleger
Language:	English
Assignment to curriculum:	**Compulsory course in the 1st semester of Applied Biology** **Compulsory course in the 1st semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 4 lesson hours per week Exercise: 2 lesson hours per week; max. group size: 20
Student workload:	Contact hours / Private study Lecture: 60 / 60 Exercise: 30 / 30 Total: 90 / 90 **Total (contact hours + private study): 180**
Credits:	6 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Bridging course "Mathematics"
Learning outcomes:	At the end of the course, the students will: • know the basic methods of mathematics and be able to apply these to practical problems, • be able to perform basic calculations independently.
Summary indicative content:	• Sets, real numbers and intervals, complex numbers, linear and quadratic equations, binomial theorem • Functions and curves: definition and representation, interpretation as a graph, general properties of functions, polar coordinates • Sequences: limit and continuity of a function, polynomials, rational functions, power functions, trigonometric functions and inverse trigonometric functions, exponential functions and logarithmic functions, logarithmic representations (logarithmic paper) • Differential calculus: derivatives as slopes of tangent lines, derivatives of elementary functions, rules of derivation, higher derivatives, 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 an area, the indefinite integral, the fundamental theorem of differential and integral calculus, important integrals, calculation of definite integrals, rules and methods of integration, substitution, partial integration, numerical integration, some applications of integral calculus • Power series, Taylor series: infinite series, power series, Taylor series, rule of de L'Hospital •
Assessment:	Written examination. Active participation in the tutorial is a prerequisite for admission to the final written examination.
Teaching style:	Lecture: blackboard, overhead, computer projector Tutorial: blackboard

Indicative bibliography/Sources:	1. Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, vieweg Verlag, Braunschweig Wiesbaden. Volumes 1,2 und 3. 2. Manfred Brill, Mathematik für Informatiker, Hanser Verag, München, Wien, 2nd Edition, 2005 3. K. Gieck, R. Gieck, Technische Formelsammlung, Gieck Verlag, Germering, 1995, 30. extended version. 4. Alan J. Cann, Maths from Scratch for Biologists, John Wiley & Sons.

Module:	**English for Chemistry 1 & 2**
Semester:	1st and 2nd semesters
Course leader:	Peter Kapec
Lecturer:	Peter Kapec et al.
Language:	English
Assignment to curriculum:	**Elective course in the 1st and 2nd semesters of Chemistry with Material Sciences** **Elective course in the 1st and 2nd semesters of Forensic Sciences**
Course units/Lesson hours per week (SWS)	Tutorial: 6 lesson hours per week; max. group size: 20
Student workload:	Contact hours Private study Tutorial:: 90 90 **Total (contact hours+private study): 180 hours**
Credits	6 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Basic course (German "Grundkurs") in English at university entrance level (German Abitur) or equivalent
Learning outcomes:	At the end of the tutorial, the students will: • have improved their general knowledge of English (especially their speaking and listening skills), • know the technical terminology, • be able to give scientific presentations, • be able to exchange specialist information and to take part in expert talks.
Summary indicative content:	• The Periodic Table of Elements, chemical bonds and reactions • Metals and alloys, ceramics • Composites, microscopy • Cell biology, genetics • The influence of drugs and other substances on the human body.
Assessment:	Modular examination – graded Written examination (50%), scientific presentations (50%)
Teaching style:	Tutorial: script, videos
Indicative bibliography/ Sources:	Script: English for Chemistry

Module:	**Foreign Language 1 & 2**
Semester:	1st and 2nd semesters
Course leader:	James Chamberlain
Lecturer:	Hauptmann / Ruiz Vega / Grambach
Language:	Norwegian / Spanish
Assignment to curriculum:	**Elective course in the 1st and 2nd semesters of Applied Biology** **Elective course in the 1st and 2nd semesters of Chemistry with Material Science** **Elective course in the 1st and 2nd semesters of Forensic Sciences**
Course units/Lesson hours per week (SWS):	Tutorial: 6 lesson hours per week; max. group size: 20
Student workload:	Contact hours Private study Exercise:: 90 90 **Total (contact hours + private study): 180 hours**
Credits:	6 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Desired learning outcomes:	The aim of this module is to introduce a new foreign language to the students. The two courses form a unit that enables the students to achieve level A2 of the Common European Reference Framework for Languages, i.e. • Listening: understanding the essentials of short, clear and simple messages and announcements, • Reading: scanning everyday texts for important information, as well as understanding short and simple personal letters, • Speaking: communicating in simple routine situations, establishing contact through a brief conversation, • Writing: writing short, simple notes, messages and personal letters.
Summary indicative content:	• Practical training in the four core disciplines: Listening, Reading, Speaking and Writing, • Introduction to the grammar of the target language • Introduction to aspects of the area, culture and mentality of the cultural setting for the target language
Assessment:	Modular examination – graded Written examination (50%) and oral tasks, projects, simulation, quizzes (50%)
Teaching style:	Tutorial: script, videos
Indicative bibliography/ Sources:	Scripts and textbooks developed by the lecturers

Module:	**Analytical Chemistry**
Semester:	2nd semester
Course leader:	Prof. Dr Gerd Knupp
Lecturer:	Prof. Dr Gerd Knupp / Dr Ulf Ritgen
Language:	German
Assignment to curriculum:	**Compulsory course in the 2nd semester of Chemistry with Material Science** **Compulsory course in the 2nd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (experiments). Lecture: 2 lesson hours per week Tutorial: 2 lesson hours per week; max. group size: 60 Laboratory course: 2 lesson hours per week; max. group size: 30
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 30 / 60 Lab work: 30 / 30 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will: • understand the analytical process from sample taking, sample preparation and the determination method through to analysis and evaluation, • be familiar with the basic principles and techniques of traditional analytical chemistry and a selection of electro-analytical methods. Tutorial: At the end of the tutorial, the students will: • be proficient in dealing with information on concentration as well as stoichiometric calculations, • be able to identify errors and possible errors in analytical procedures, to evaluate them statistically and to draw the consequences for further action where required. Laboratory course: At the end of the laboratory course, the students will: • be familiar with basic quantitative chemical operations in the laboratory, • be able to assess sources of danger in the laboratory and draw the appropriate conclusions for safe working, • be able to conduct experiments in the subject areas mentioned below using written experiment instructions and safe operating procedures,

	• be able to document experimental data, to perform content and concentration calculations and conduct error analyses, • be able to interpret their findings and to draw consequences for further action where required.
Summary indicative content:	Lecture/ Tutorial: • Tasks, possibilities and principles of analytical chemistry • The analytical process • Sample taking, sample preparation • Gravimetric and volumetric analysis in aqueous solutions • Electro-analytical methods (potentiometry, conductometry, coulometry) • Stoichiometry • Basic statistical evaluation of analytical results Laboratory course: • Tests in the subject areas of complexometry, iodometry, permanganometry, ion-sensitive electrodes, electrogravimetry, conductometry.
Assessment:	Modular examination - graded The overall grade for the module is based on a written examination at the end of the semester. Active participation in the tutorial relating to the lecture and in the practical laboratory course will be examined by means of prepared tasks and written lab reports. Active participation is a prerequisite for admission to the final modular examination.
Teaching style:	Lecture: overhead, blackboard, computer projector Tutorial: exercises, blackboard Laboratory course: written experiment instructions and safe operating procedures
Indicative bibliography/Sources:	– U. R. Kunze, G. Schwedt, Grundlagen der qualitativen und quantitativen Analyse, Georg Thieme Verlag, – G.Schwedt, Analytische Chemie, Grundlagen, Methoden und Praxis, Georg Thieme Verlag, – Jander/Jahr, Maßanalyse, Verlag de Gruyter, – H. Lux, W. Fichtner, Quantitative Anorganische Analyse, Springer Verlag, – H. Mayer, Fachrechnen Chemie, VCH

Module:	**Fundamentals of Biology**
Semester:	2nd semester
Course leader:	Prof. Richard Jäger
Lecturer:	Prof. Richard Jäger
Language:	English
Assignment to curriculum:	**Compulsory course in the 2nd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS)	The course consists of: Lecture: 4 lesson hours per week Laboratory course: 2 lesson hours per week; max. group size: 16
Student workload:	Contact hours / Private study Lecture: 60 / 60 Lab work: 30 / 60 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will: • know the basics of cell biology and of genetics • have acquired a basic knowledge of the fundamentals of biochemistry and molecular biology, including the functional interrelations of biological processes. Laboratory course: At the end of the laboratory course, the students will: • be able to apply basic diagnostic techniques to the analysis of materials, • be able to independently plan, implement and evaluate simple bioanalytical methods.
Summary indicative content:	Lecture: • Introduction to the biology of cells and organisms. • The cell: cell organelles, biomembranes, energy metabolism, enzymes. • Proteins: structure and function • Nucleic acids: Biosynthesis, transcription and translation, human chromosomes the cell cycle, mitosis • Fundamentals of genetics: meiosis, polymorphisms, Mendelian genetics, sex-linked and mitochondrial inheritance • human biology: tissues, cell types, immunology Laboratory course: • Microscopic analysis of cells from human blood and the mucosa of the mouth • forensic identification of blood, blood group analysis • restriction digest, PCR analysis, agarose gel electrophoresis of DNA • SDS-PAGE of immunoglobulins

Assessment:	Modular examination – graded. Laboratory course (oral examination and lab reports): 33 % Written final examination: 67 % Active participation in the laboratory course is a prerequisite for admission to the final examination. The final examination must be passed independently of the practical part.
Teaching style:	Lecture: Power Point Presentation, textbook Laboratory course: written experiment instructions, textbooks
Indicative bibliography/Sources:	1. Bruce Alberts et al. : Essential Cell Biology, 2003 Garland Science 2. Ricki Lewis: Human Genetics, 2009 McGraw Hill

Module:	**Forensic Microscopy**
Semester:	2nd semester
Course leader:	Prof. Dr Bernhard Möginger Dipl.-Ing. (FH) Irina Marschall
Lecturer:	rof. Dr Bernhard Möginger Dipl.-Ing. (FH) Irina Marschall
Language:	German
Assignment to curriculum:	**Compulsory course in the 2nd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS)	The course consists of: Lecture: 2 lesson hours per week Tutorial: 2 lesson hours per week Laboratory course: 2 lesson hours per week
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 30 / 45 Laboratory course: 30 / 45 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations	None
Recommendations:	Pass in the modular examination for the course entitled "Structure and Characteristics of Materials"
Learning outcomes:	At the end of the course, the students will: • know the basic functional principles of various microscopes and their areas of application, • know how to use them advantageously to perform forensic and scientific tasks.
Summary indicative content:	Lecture: • Terms and definitions • Systematic approach to microscopy • Methods of investigation based on light microscopy • Methods of investigation based on electron microscopy • Preparation methods for light and electron microscopy Tutorial: • Tasks and forensic case studies relating to the lecture Laboratory course: • Conduction of investigations using light and electron microscopes • Practical applications of various preparation techniques • Conduction of forensic investigations of defined microscopic specimen slides • Identification of common textile fibers • scinetific photography for analysis and documentation

Assessment:	Modular examination – graded Written final examination; seminar presentations
Teaching style:	Lecture: notes on the blackboard, computer projector Tutorial, laboratory course: Learning by Doing (example exercises under supervision)
Indicative bibliography/Sources:	Schade, Karl-Heinz; Lichtmikroskopie: Technologie und Anwendung; verlag moderne industrie; Landsberg / Lech; 1993; ISBN 3-478-93107-X Kern, Martin: Mikroskopische Technik für die industrielle Anwendung: Präparation, Digitale Fototechnik, Mikroskopie, Bildverarbeitung; Brünne-Verlag; Berlin; 2003; ISBN 3-9804762-4-3 Kern, Martin, Jörg Trempler: Beobachtende und messende Mikroskopie in der Materialkunde: Ein Leitfaden für die Praxis; Brünne-Verlag; Berlin; 2007; ISBN 978-3-9809848-6-7

Module:	**Physics/Statistics**
Semester:	**2nd semester**
Course leader:	**Prof. Dr Ulrich Eßmann**
Lecturer:	Prof. Dr Ulrich Eßmann
Language:	English
Assignment to curriculum:	**Compulsory course in the 2nd semester of Applied Biology** **Compulsory course in the 2nd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (experiments). Lecture: 2 lesson hours per week of physics + 1 lesson hour per week of statistics Tutorial: 1 lesson hour per week of physics + 1 lesson hour per week of statistics max. group size: 30 Laboratory course: 1 lesson hour per week of physics max. group size: 24 (as a rule, 2 hours per experiment)
Student workload:	Contact hours / Private study Lecture: 45 / 30 Tutorial: 30 / 30 Laboratory course: 15 / 30 Total: 90 / 90 **Total (contact hours + private study): 180 hours**
Credits	6 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Module Mathematics (1st semester)
Learning outcomes:	Physics: Lecture: At the end of the lecture, the students will: • be able to explain the fundamental phenomena and principles of mechanics, • be able to explain the mechanics of liquids and thermodynamics, • be able to describe these phenomena mathematically. Tutorial: At the end of the tutorial, the students will be able to develop solutions to simple problems from the areas mentioned above. Laboratory course: At the end of the laboratory course, the students will: • be able to conduct and evaluate simple experiments, • be able to use basic measurement equipment, • be able to solve experimental tasks in a team, • be able to conduct statistical analyses of the experimental data and determine possible sources of error. Statistics: Lecture and tutorial: At the end of the lecture and the tutorial, the students will: • be able to apply the basic methods of statistics to the analysis of measurement data, • be able to explain the fundamental principles of probability

	calculus, • be able to define and apply the terms "probability density" and "distribution function" and • be able to explain some important distribution functions.
Summary indicative content:	**Physics:** Lecture: • Mechanics (kinematics and dynamics, forces, work and energy, momentum, mechanics of liquids and gases) • Thermodynamics (definition of temperature, physical changes of solids and liquids due to temperature changes, ideal gases, kinetic theory of gases, First and Second Law of Thermodynamics, equation of states for real gases and vapors, heat conduction, material transport) Tutorial: • The concepts acquired during the lecture are applied to concrete situations to enhance the students' understanding of the principles involved. Laboratory course: • In small groups (as a rule, two students per experiment setup), the students conduct a range of experiments in the various subject areas of the module. (The types of experiments can vary within the framework of the study programme reforms). The experiments, taken from the subject areas of mechanics (translational motion with air tracks, density determination of liquids) and thermodynamics (e.g. temperature measurement, determination of heat capacities and enthalpies), are aimed at practising quantitative experimental work, including statistical analyses and error analyses (random versus systematic errors, error propagation, linear regression). In addition, the students widen the expertise acquired during the lecture and the tutorial by applying it to concrete practical examples. **Statistics:** Lecture: • Samples; parameters of samples; error propagation: random and systematic errors, regression and correlation; linear regression; fitting of parametric functions; direct least square minimisation • Probability calculus: combinatorics; probability experiments; probability; calculation of probabilities; conditional probabilities; probability density; definition of probability density; distribution functions; parameters of probability distributions; normal distribution Tutorial: • The concepts acquired during the lecture are applied to concrete situations to enhance the students' understanding of the principles involved.

Assessment:	Modular examination – graded The overall grade for the module consists of: a grade for the laboratory course in physics (30%), a grade for the final written examination in physics und statistics (70%) or two partial examinations per semester (35 % each). Successful participation in the laboratory course is a prerequisite for passing the modular examination.
Teaching style:	Lecture: blackboard, demonstration experiments, computer demonstrations (Applets) Tutorial: written compilation of exercises, blackboard Laboratory course: written experiment instructions
Indicative bibliography/ Sources:	Physics: • Physics in Biology and Medicine, Davidovits, Harcourt Academic Press • Physics for Pre-Med, Biology, and Allied Health Students, Hademenos, McGraw-Hill • Physics with illustrative examples from Medicine an Biology, Biological Physics Series • College physics, Urone, Brooks/Cole, Pacific Grove, CA • Fundamentals of Physics, Halliday, Resnick, Walker: 6th Ed. Wiley, New York 2001 Statistics: • Mathematik für Ingenieure und Naturwissenschaftler, L. Papula, Volume 3, 2nd Edition. • Experimental Methods, Les Kirkup, Wiley, Brisbane 1994 • Primer of Biostatistics, S. A. Glantz: 5th Ed., McGraw-Hill, New York 2002 • Introduction to Statistics for Forensic Scientists, David Lucy, Wiley, 2006

Module:	**Fundamentals of Organic Chemistry and Biochemistry**
Semester:	3rd semester
Course leader:	Prof. Dr Margit Schulze
Lecturer:	Dr. Kai Jakoby, Prof. Dr. Margit Schulze
Language:	English
Assignment to curriculum:	**Compulsory course in the 3rd semester of the BSc programme in Forensic Sciences**
Course units/Lesson hours per week (SWS)	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (including experiments). Lecture: 3 lesson hours per week Tutorial: 2 lesson hours per week; max. group size: 30 Laboratory course: 1 lesson hour per week; max. group size: 20
Student workload:	Contact hours / Private study Lecture: 45 / 45 Tutorial: 30 / 50 Laboratory course: 15 / 25 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	General Chemistry (1st sem.), Analytical Chemistry (2nd sem.)
Learning outcomes:	**Lectures and Tutorials:** 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 physical properties and chemical reactions of organic substances based upon their molecular structures, to understand fundamental organic reaction mechanisms and to reproduce them on their own, • understand how functional groups can be converted into one another under certain reaction conditions; • are familiar with fundamental stereochemical aspects in organic chemisty, • are able to understand the structure and properties of essential classes of biomolecules (such as amino acids, carbohydrates, lipids, proteins, nucleic acids). **Laboratory Work:** • Students are familiar with important techniques of classic preparative and analytical organic chemistry. • They gained first practical experience in the preparation, purification and characterization of organic substances.

Summary indicative content:	**Lectures and Tutorials:** • Fundamental principles of organic chemistry (such as theory of chemical bonds and molecular structure), • Introduction into important classes of organic substances (including essential classes of biomolecules) with a special focus on their physical and chemical properties (such as volatility, polarity, solubility, acidity / basicity). • Presentation of typical chemical reactions of organic compounds including reaction mechanisms, • Influences of stereochemical aspects on the molecular structure as well as the physical and chemical properties of organic substances. • Comparison of chemical and biochemical reaction pathways for selected reactions (such as oxidations and acetylations) **Laboratory Work:** • Basic techniques of organic synthesis (such as heating under reflux, recrystallization, liquid-liquid extraction), • Basic techniques of analytical organic chemistry (such as determination of melting points and optical purities)
Assessment:	Modular examination - graded Written final examination: 90 % Laboratory course (oral examination and lab report): 10 % Written examination and laboratory course must be passed independently.
Teaching style:	Lecture: blackboard, overhead, computer projector Tutorials: written compilation of exercises, blackboard, overhead Lab course: written experimental instructions, flip chart
Indicative bibliography/ Sources	1. K.P.C. Vollhardt, N.E. Schore, Organische Chemie, Wiley-VCH, 4th Edition, 2005. 2. P.Y. Bruice, Organische Chemie, Pearson Prentice Hall, 5th Edition., 2007. 3. J. McMurry, Fundamentals of Organic Chemistry, Brooks / Cole Cengage Learning, 2011. 4. R. H. Garrett, C. M. Grisham, Biochemistry, Brooks / Cole Cengage Leatning, 2011. 5. H.P. Latscha, H.A. Klein, Organische Chemie, Springer-Verlag, 5th Edition, 2002. 6. U. Lüning, Organische Reaktionen, Spektrum Akad. Verlag, 2nd Edition, 2007. 7. R. Brückner, Reaktionsmechanismen, Spektrum Verlag, 3rd Edition, 2004. 8. H.G.O. Becker et al., Organikum, Wiley-VCH, 22nd Edition, 2004.

Module:	**Forensic Biology**
Semester:	3rd semester
Course leader:	Prof. Richard Jäger
Lecturer:	Prof. Richard Jäger
Language:	English
Assignment to curriculum:	**Compulsory course in the 3rd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 4 lesson hours per week Laboratory course: 2 lesson hours per week; max. group size: 18
Student workload:	Contact hours / Private study Lecture: 60 / 60 Lab work: 30 / 60 Total : 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	none
Recommendations:	Fundamentals of Biology
Learning outcomes:	Lecture: At the end of the lecture, the students will: • be familiar with the main applications of forensic DNA typing • be familiar with methods of identification of biological forensic evidence, extraction and quantitation of DNA, • be able to explain the properties of and methods for analyzing various forensic markers (VNTRs, STRs, SNPs, INDELs, mtDNA), • be familiar with the analysis of STR profiles and mtDNA profiles using capillary electrophoresis • be familiar with the currently used forensic STR systems (Germany, EU, US) • be able to calculate random match probablilities of STR profiles using population data • understand and are able to calculate paternity indeces • are familiar with methods and applications of forensic identification of non-human species • are familiar with relevant databases (population databases, forensic DNA databases) Laboratory course: The students will: • be able to isolate DNA from various forensic sources, • be able to carry out PCR-based analytical methods, • be able to analyse, evaluate and interpret analytical data.

Summary indicative content:	Lecture: Application of forensic DNA profiling; identifying biological evidence; DNA isolation methods; short history of forensic biology; STR systems and their analysis via multiplex PCR and capilaary electrophoresis; population genetics, databses and calculation of random match probabilities; qPCR; profiling mtDNA; paternity testing; Y-STRs; forensic species determination (Cytb, COI, STRs) Practical course: DNA isolation from blood or buccal swabs; quantitation using real-time PCR; PCR-based genotyping of the SE33 locus; mtDNA-based determination of meat species; forensic sex typing (amelogenin)
Assessment:	Modular examination – graded Laboratory work (oral examinations and lab reports): 33%; Written final examination: 67% Active participation in the laboratory course is a prerequisite for admission to the final examination. The final examination must be passed independently of the practical part.
Teaching style:	Lecture: Power Point presentation, textbook Laboratory course: written experiment instructions, textbooks
Indicative bibliography/ Sources:	John M. Butler: Fundamentals of Forensic DNA Typing (Elsevier) William Goodwin, Adrian Linacre, Sibte Hadi: An Introduction to Forensic Genetics, 2nd Edition (Wiley-Blackwell)

Module:	**Solid Mechanics**
Semester:	3rd semester
Course leader:	Prof. Dr Michael Heinzelmann
Lecturer:	Prof. Dr Michael Heinzelmann
Language:	German
Assignment to curriculum:	**Compulsory course in the 3rd semester of Chemistry with Material Science** **Compulsory course in the 3rd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 2 lesson hours per week Tutorial: 4 lesson hours per week; max. group size: 30
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 60 / 60 Total: 90 / 90 **Total (contact hours + private study): 180 hours**
Credits:	6 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Basic lecture in Mathematics
Learning outcomes:	Lecture: The students will be familiar with the basic principles of the mechanical behaviour of solids and of strength calculation. Laboratory course: The students will be able to apply the expertise acquired during the lecture to concrete tasks and case studies.
Summary indicative content:	Lecture: • Basic terms and definitions • Static equilibrium at a point • Static equilibrium on a rigid body • Section sizes • Line loads • Calculation of the centre of gravity • Friction, stress tensor and Mohr's circle • Strain tensor • Material Law • Tensile stress/compressive stress, bending stress, torsion • Thin-walled containers under internal pressure • Superimposed stressing by mechanical loads • Euler bending

	Laboratory course: Exercises and case studies relating to the contents of the lecture
Assessment:	Modular examination – graded Written final examination 100%
Teaching style:	Lecture: notes on the blackboard Tutorial: notes on the blackboard, compilation of exercises on the internet
Indicative bibliography/Sources:	Heinzelmann, Lippoldt: Technische Mechanik in Beispielen und Bildern, Spektrum Akademischer Verlag

Module:	**Measuring Techniques/ Statistics 2**
Semester:	3rd semester
Course leader:	Prof. Dr Ulrich Eßmann/ Prof. Dr Peter Kaul
Lecturer:	Prof. Dr Ulrich Eßmann und Dr Sebastian Chmel
Language:	English
Assignment to curriculum:	**Compulsory course in the 3rd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (experiments). Lecture: 2 lesson hours per week Meas.Techniques + 1 lesson hour per week Statistics 2 Tutorial: 1 lesson hour per week Meas.Techniques + 1 lesson hour per week Statistics 2 max. group size: 30 Laboratory course: 1 lesson hour per week; max. group size: 24 (as a rule, 2 students per experiment)
Student workload:	Contact hours / Private study Lecture: 45 / 45 Tutorial: 30 / 45 Laboratory course: 15 / 30 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credit:	7 ECTS
Prerequisites according to Examination Regulations	None
Recommendations:	Modules Mathematics and Physics/Statistics 1
Learning outcomes:	<u>Measuring Techniques</u> <u>Lecture</u>: At the end of the lecture, the students will be able to: • explain and mathematically describe the basic phenomena and principles in the partial areas of electricity, magnetism, oscillations and waves as well as optics. <u>Tutorial:</u> At the end of the tutorial, the students will be able to: • develop solutions to simple tasks taken from the above areas. <u>Laboratory course:</u> At the end of the laboratory course, the students will be able to: • conduct and evaluate simple experiments, • use basic measurement equipment, • solve experimental tasks in a team, • statistically analyse experimental data and identify possible sources of error. <u>Statistics</u> At the end of the course , the students will: • know the several distributions and • can apply these distributions to fundamental problems of inferential statistics • know the most important statistical tests Tutorial • understand the problems and strategies of inferential statistics

	• be able to apply statistical tests
Summary indicative content:	Measuring Techniques Lecture: • Oscillations and waves (mathematical description, superimposition of oscillations and waves, interference) • Optics (Hygens' Principle, geometrical optics, wave optics, diffraction, interfererence, optical diffraction gratings, dispersion, polarisation) • Electricity (electrical charges, electrical field, electrostatics, electrical potential, electrical current, Ohm's Law, direct current circuits) • Magnetism (moving electrical charges, induction, self-inductivity, magnetism in matter, alternating current circuits) • Applications to physical measuring instruments Tutorial: • During the tutorial, the concepts acquired during the lecture are applied to concrete practical examples to enhance the students' understanding of the principles involved. Laboratory course: • In small groups (as a rule, 2 students per experiment set-up), the students conduct a range of experiments in the various subject areas of the module. (The types of experiments can vary within the framework of the study programme reforms.) The experiments, taken from the subject areas of oscillation and waves (including the parameters to describe waves), optics, wave optics and electricity, are aimed at practising quantitative exprimental work, including statistical analyses and error calculation (random versus systematic errors, error propagation, linear regression). • In addition, the students widen the expertise acquired during the lecture and the tutorial by applying it to practical examples. Statistics 2 Lecture: • Special distributions: binomial distribution, Poisson distribution, F-distribution, t-distribution, Chi-squared distribution • Hypothesis testing: F-test, t-test, outlier test, Chi squared goodness of fit test Tutorial: • The concepts acquired during the lecture are applied to concrete practical examples in the tutorial.. Laboratory course: • Not provided
Assessment:	Modular examination – graded Practical class with graded protocols (30%) plus a final written examination in Measuring Techniques and Statistics (70%) The sucessful participation in the practical class is a prerequisite to pass the module examination.
Teaching style:	Lecture: blackboard, demonstration experiments, computer demonstrations (Applets) Tutorial: written compilation of exercises, blackboard Laboratory course: written experiment instructions

Indicative bibliography/Sources:	Physics: - Fundamentals of Physics, Halliday, Resnick, Walker, Wiley, 2001 - Physics in Biology and Medicine, Davidovits, Harcourt Academic Press - Physics for Pre-Med, Biology, and Allied Health Students, Hademenos, McGraww-Hill - Physics with illustrative examples from Medicine an Biology, Biological Physics Series - Gerthsen Physik, Springer-Verlag, Berlin Measuring techniques: - H.-R. Tränkler, Taschenbuch der Messtechnik, Verlag R. Oldenbourg, Munich - J. Niebuhr, G. Lindner: Physikalische Messtechnik mit Sensoren, Oldenbourg Verlag - J. Hoffmann, Taschenbuch der Messtechnik, Fachbuchverlag Leipzig Statistics: - Fahrmeir, Hamerle, Tutz; Multivariate statistische Verfahren; de Gruyter-Verlag - Backhaus, Erichson, Plinke, Weiber; Multivariate Analysemethoden; Springer-Verlag - A. Zell; Simulation neuronaler Netze; Oldenburg-Verlag - Richard O. Duda, Peter E. Hart, David G. Stork; Pattern Classification; Wiley-Interscience-Verlag - K. Fukunaga; Introduction to Statistical Pattern Recognition; Academic Press - Hans-Friedrich Eckey, Reinhold Kosfeld, Martina Rengers; Multivariate Statistik – Grundlagen – Methoden – Beispiele; Gabler-Verlag

Module:	**Law 1**
Semester:	**3rd semester**
Course leader:	VRLG de Vries, Presiding Judge at the District Court
Lecturer:	VRLG de Vries, Presiding Judge at the District Court
Language:	German
Assignment to curriculum:	**Compulsory course in the 3rd semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture. Lecture: 3 lesson hours per week
Student workload:	Contact hours / Private study Lecture: 45 / 45 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	At the end of the course, the students will: • be able to deal with the relevant legal sources of information, • know the interrelations between law and laboratory work, • know the various limit values in criminal law and in administrative law as well as the probative value of an analysis of concomitant substances, • know appropriate laboratory tests for drugs and their legal significance, • know the difference between causality and attribution of responsibility, • know the fields of work in forensic medicine, • know the general terms and definitions relating to criminal law, • be able to differentiate between various types of violent offences, • know the legal requirements for DNA registers, • know the scientific investigation methods in the area of arson offences, • understand the differences between administrative law and criminal law as well as the legal consequences of criminal offences, • understand the systematic structure of the German Civil Code (Bürgerliches Gesetzbuch, BGB), with a focus on tort law (Schadensersatzrecht). The students shall: • develop an understanding for the methods of liability prevention in companies with hazardous substances, • develop an understanding for their own liability risks in their professional activity, • develop an understanding for the impacts of administrative law on the economy.
Summary indicative content:	• Legal sources of information • Driving under the influence of alcohol • Systematic structure of legislation on road traffic offences • Systematic structure of legislation on narcotics • Murder and manslaughter • Criminal law - general provisions • Sexual offences and assaults • Property damage, arson offences

	• Criminal law, administrative offences, police law • Legal consequences of criminal offences • Structure of the German Civil Code (Bürgerliches Gesetzbuch, BGB) • Product liability according to civil and criminal law • State liability and expert liability • Economic administrative law
Assessment:	Modular examination – graded Written examination
Teaching style:	V: overhead, computer projector, blackboard
Indicative bibliography/ Sources:	Nomos-Gesetzestexte Zivilrecht, Öffentliches Recht, Strafrecht *(texts on civil law, public law and criminal law; translator's comment)* Various court judgements (Federal High Court - Bundesgerichtshof, BGH; Higher Regional Court - Oberlandesgericht, OLG; Federal Constitutional Court - Bundesverfassungsgericht, BVerfG)

Module:	**Instrumental Analysis 2**
Semester:	4th semester
Course leader:	Prof. Dr Wolfgang Fink
Lecturer:	Prof. Dr Wolfgang Fink
Language:	German
Assignment to curriculum:	**Compulsory course in the 4th semester of Chemistry with Material Science** **Compulsory course in the 4th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (experiments). Lecture: 3 lesson hours per week Tutorial: 1 lesson hour per week; max. group size: 30 Laboratory course: 2 lesson hours per week; max. group size: 24
Student workload:	Contact hours / Private study Lecture: 45 / 60 Tutorial: 15 / 30 Laboratory course: 30 / 30 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	General Chemistry (1st semester), Analytical Chemistry (2nd semester), Physics/Statistics (2nd semester).
Learning outcomes:	Lecture: At the end of the lecture, the students will: • know the basic principles of chromatographic separation techniques and the properties of typical stationary and mobile phases, • be able to discuss the interrelations between experimental conditions and chromatographic parameters, • be familiar with the fundamental principles of method development, • understand the operating principles of chromatographs and the most important detectors, • know the fundamental physical principles of infrared spectroscopy, UV-Vis spectroscopy, mass spectrometry and nuclear resonance spectroscopy • be familiar with the basic principles of spectra evaluation. Tutorial: At the end of the tutorial, the students will be able to perform quantitative calculations for chromatography and to evaluate simple spectra.

	Laboratory course: At the end of the laboratory course, the students will: • have acquired practical experience of chromatography (e.g., TLC, HPLC and GC); • be able to operate the technical appliances in accordance with a tutor's instructions, • be capable of individually evaluating chromatograms, • understand the operating principles of the spectrometers and have practical experience with spectrometers. Depending on the given task, the students will be able to suggest, plan and use analytical methods. They will also be capable of evaluating the data derived from the conducted analyses.
Summary indicative content:	Lecture: • General fundamentals of chromatography • Special fundamentals of thin-layer chromatography (TLC), high-pressure liquid chromatography (HPLC) and gas chromatography (GC) • General fundamentals of molecular spectroscopy, special fundamentals of infrared spectroscopy, UV-Vis spectroscopy, mass spectronomy and nuclear resonance spectroscopy Laboratory course: Experiments on chromatography (e.g. TLC, GC, HPLC) and on spectroscopy (e.g. UV-Vis and IR spectroscopy)
Assessment:	Modular examination – graded Laboratory course (oral examinations and lab reports): 30%; Written final examination: 70%. Both parts of the examination must be passed independently of each other.
Teaching style:	Lecture: script, overhead, blackboard Tutorial: written compilation of exercises, overhead, blackboard Laboratory course: written experiment instructions
Indicative bibliography/ Sources:	1) M. Otto, Analytische Chemie, VCH WILEY- Verlag, 2) V. R. Meyer, Praxis der Hochleistungs - Flüssigchromatographie, Otto Salle Verlag 3) L. R. Snyder, J. J. Kirkland, J. L. Glajch, Practical HPLC method development John Wiley Inc. 4) B. Kolb, Gaschromatographie in Bildern, VCH WILEY- Verlag 5) Hesse, Meier, Zeeh, Spektroskopische Methoden in der organischen Chemie 6) D. H. Williams, I. Fleming, Strukturaufklärung in der organischen Chemie, Thieme Verlag, 7) H. Budzikiewicz, Massenspektrometrie, VCH WILEY- Verlag.

Module:	**Forensic Quality Assurance**
Semester:	4th semester
Course leader:	Prof. Dr Ernst-Jürgen Pomp
Lecturer:	Prof. Dr Ernst-Jürgen Pomp
Language:	German
Assignment to curriculum:	**Compulsory course in the 4th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying tutorial (exercises) and a laboratory course (experiments). Lecture: 4 lesson hours per week Tutorial: 1 lesson hour per week; max. group size: 20 Laboratory course: 1 lesson hour per week; max. group size: 15
Student workload:	Contact hours / Private study Lecture: 60 / 15 Tutorial: 15 / 30 Lab work: 15 / 45 Total: 90 / 90 **Total (contact hours + private study): 180 hours**
Credits:	6 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	General Chemistry (1st semester), Analytical Chemistry (2nd semester), Physics/Statistics (2nd semester), Instrumental Analysis (3rd semester)
Learning outcomes:	Lecture: At the end of the lecture, the students will: • be familiar with Good Documentation Practice (GDP), Good Laboratory Practice (GLP) and ISO 17025, • be familiar with the internationally prescribed quality assurance systems from the areas of research and toxicological tests in forensics. Tutorial: At the end of the tutorial, the students will have acquired the skills necessary to independently plan, conduct, report on and review forensic tests based on the ISO 17025 quality management system. Laboratory course: At the end of the laboratory course, the students will also be able to check analytical tests for their validity and robustness. In addition, they will be able to review the performance of analytical appliances and, in doing so, to use validated documentation systems.
Summary indicative content:	Lecture: • Quality assurance systems and their interfaces • Legal foundations and requirements of Good Laboratory Practice

	• Organisational structure and responsibilities • Standard instructions (SOP) • Test plans and test plan extensions • Implementation of tests ("Sample Chain") • Equipment review and equipment documentation • Method development, method review and their documentation • Documentation (raw data, evaluation, reporting, modern Laboratory Information and Data Management Systems (LIMS)) • Data archiving; inspections and certification; multi-site testing • Accreditation of test laboratories according to ISO 17025 • Quality policy and quality assurance manual • Independence and impartiality • Personal skills (staff training and staff qualification) • Technical skills (acquisition of qualifications, quality rule cards, validation, ring experiments, measuring inaccuracies), documentation • Findings that can be used as evidence in court (expert assessment and court proceedings), accreditation bodies • Method validations (DIN - German Industrial Standard, Guidance for Industry, PharmEU, OECD, etc.) • Certification of analytical measurement equipment (test types: GAP, FMEA, V-model) • Validation of computer-aided systems (GAMP 4: V-model, 21 CFR part 11) • Applied statistics <u>Tutorial</u>: • Drawing up Standard Opteration Procedures (SOP) • Drawing up certification plans (equipment test) • Planning the review of methods and evaluation systems (validation) • Planning a ring experiment • Good Documentation Practice, reviewing raw data (double check) <u>Laboratory course</u>: • Checking analytical instruments for quality assurance • Implementation, evaluation, reporting and statistical assessment within the framework of the ring experiment planned for the laboratory course/method validation
Assessment:	Modular examination – graded Written final examination: 70% Tutorial and laboratory course (work outcomes and lab reports): 30% Both parts of the examination must be passed independently of each other.
Teaching style:	Lecture: PowerPoint, overhead, blackboard Tutorial: written compilation of exercises, overhead, blackboard Laboratory course: written experiment instructions
Indicative bibliography/ Sources:	1) G.A. Christ, S.J. Harston, H.-W. Hembeck, GLP Handbuch für Praktiker, GIT Verlag 2) 4) OECD Konsensdokumente Nr. 1-15, source: www.bfr.bund.de

	3) BLAC Dokumente Nr. 1-3, source: www.bfr.bund.de ISO 17025, Beuth Verlag 4) ISO 17025, Beuth Verlag 5) W. Bosch, Wloka M., Allgemeine Anforderungen an die Kompetenz von Prüf- und Kalibrierlaboratorien, DIN e.V. 6) Das Qualitätssicherungshandbuch, Ein Leitfaden, Springer Verlag 7) Qualitätsmanagement für Ingeneure, Fachbuchverlag Leipzig 8) 21 cfr part 11, www.fda.gov 9) GAMP 5, Leitfaden zur Validierung automatisierter Systeme, www.ispe.org

Module:	**Metals and Alloys**
Semester:	4th semester
Course leader:	Prof. Dr. Dorothee Schroeder-Obst, Doctor of Engineering
Lecturer:	Prof. Dr. Dorothee Schroeder-Obst and Prof. Dr. Michael Heinzelmann, Doctors of Engineering
Language:	German
Assignment to curriculum:	**Compulsory course in the 4th semester of Chemistry with Material Science** **Compulsory course in the 4th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 2 lesson hours per week Tutorial: 2 lesson hours per week Laboratory course: 2 lesson hours per week
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 30 / 45 Laboratory course: 30 / 45 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Successful completion of the modules "Structure and Characteristics of Materials" as well as "Solid Mechanics"
Learning outcomes:	At the end of the course, the students will have acquired basic expertise on: • the composition and structure of metal materials and alloys, • material properties and • material testing techniques.
Summary indicative content:	Lecture: • Composition and structure of crystalline and amorphous alloys • Material properties • Changes in material properties through basic technological procedures • Ferrous materials • Non-ferrous-materials • Heat treatment procedures • Compound materials • Material testing techniques • Terms and definitions of materials, testing and quality standards • economic and ecological aspects of material selection • Sources and types of errors occurring in the production, recycling, processing and use of materials

	Tutorial: Exercises and case studies relating to the contents of the lecture Laboratory course: Determination of the mechanical-technological, chemical-technological and metallographic properties of materials used in technological processes (comparison)
Assessment:	Modular examination – graded Written final examination 100% Prerequisite: pass in the laboratory course
Teaching style:	Lecture: notes on the blackboard, computer projector Tutorial, laboratory course: Learning by Doing (exercises and laboratory work under supervision)
Indicative bibliography/Sources:	M. F. Ashby, D. R. H. Jones: „Werkstoffe 1, Eigenschaften, Mechanismen und Anwendungen“, edited by Michael Heinzelmann, Elsevier / Spektrum Akademischer Verlag, 2006, 317 p., € 34.50. M. F. Ashby, D. R. H. Jones: „Werkstoffe 2, Metalle, Keramiken und Gläser, Kunststoffe und Verbundwerkstoffe“, edited by Michael Heinzelmann, Elsevier / Spektrum Akademischer Verlag, 2006, 340 p., € 36.50.

Module:	**Pharmacology and Toxicology**
Semester:	4th semester
Course leader:	Prof. Dr Ulrike Bartz
Lecturer:	Prof. Dr Ulrike Bartz
Language:	English
Assignment to curriculum:	**Compulsory course in the 4th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, an accompanying seminar, a tutorial (exercises) and a laboratory course (experiments). Lecture: 3 lesson hours per week Seminar/Tutorial: 1 lesson hour per week; max. group size: 30 Laboratory course: 2 lesson hours per week; max. group size: 20
Student workload:	Contact hours / Private study Lecture: 45 / 60 Tutorial/Seminar: 15 / 30 Laboratory course: 30 / 30 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Successful completion of the modules General Chemistry (1st semester), Analytical Chemistry (2nd semester), Physics/Statistics (2nd semester), Instrumental Analysis (3rd semester)
Learning outcomes:	Lecture/Tutorial/Seminar: At the end of the lecture, the tutorial and the seminar, the students will: • be familiar with the various forms of drug absorption into the body, • be able to discuss the distribution, metabolism and excretion of drugs and other xenobiotics , • be able to describe the interaction between pharmacologically active compounds and target proteins, • be able to discuss aspects of chemical structure of drug molecules and their administration form on pharmakokinetics and pharmacodynamics. Laboratory course: At the end of the laboratory course, the students will have acquired practical experience of the modern experimental techniques used in pharmacology and toxicology.
Summary indicative content:	Lecture/Tutorial/Seminar: • Fundamentals of pharmacokinetics: administration of drugs, absorption, distribution, metabolism, excretion , compartment

	models , relevant anatomy and physiology • Fundamentals of pharmacodynamics: interaction between drug and receptors/enzymes, dose response curves, signal transduction , relevant anatomy and physiology • Fundamentals of toxicology: special pharmacology relating to substance abuse, intoxications, pharmacokinetics of the most important narcotics, recalculation Laboratory course: Experiments on pharmacology and toxicology
Assessment:	Modular examination – graded Laboratory course (lab reports): 30% Oral examination or written final examination: 70% The type of examination is announced at the beginning of each semester. Both practical course and oral examination must be passed independently.
Teaching style:	Lecture: script, overhead, blackboard, computer projector Tutorial: written compilation of exercises, overhead, blackboard, computer projector Laboratory course: written experiment instructions
Indicative bibliography/Sources:	1) Drug actions - Basic Principles and therapeutic aspects E. Mutschler/H. Derendorf; MedPharm Scientific Publishers (ISBN 3-88763-021-1) 2) Pharmacokinetic Processes, mathematics and applications Peter G. Welling Wiley Science (ISBN 0-471-47814-8) 3) Applied Biopharmaceutics and Pharmacokinetics L. Shargel/A.Yu; McGraw-Hill Medical Publishing Division; (ISBN-0-8385-0278-4) 4) Kojda G., Pharmakologie/Toxikologie systematisch

Module:	**Law 2**
Semester:	**4th semester**
Course leader:	VRLG de Vries, Presiding Judge at the District Court
Lecturer:	VRLG de Vries, Presiding Judge at the District Court
Language:	German
Assignment to curriculum:	**Compulsory course in the 4th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS)	The course is based on a lecture. Lecture: 3 lesson hours per week
Student workload:	Contact hours Private study Lecture: 45 45 Total: 45 45 **Total (contact hours + private study): 180 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Law 1
Learning outcomes:	At the end of the course, the students will: • have an overview of the time-scale of criminal proceedings. • have an understanding for the conflict between basic human rights, on the one hand, and coercive measures enforced by criminal proceedings, on the other, • understand the requirements for the form and content of criminal and civil sentences, • understand the time-scalef the main court hearing, including evidence-taking, • be able to develop an understanding for the role of a defence lawyer in a democratic state under the rule of law, • understand the requirements for the contents of written expert reports, • develop an understanding for the advantages of new DNA technology on the basis a case study, • recognise the difficulties in establishing proof by using a new method of evidence-taking (also based on a case study), • understand that errors occurring in the course of the investigation proceedings during the main court hearing often cannot be balanced out at a later date, • understand the various scientific methods of error avoidance, • understand the American literature on "Forensic Science" against the background of the American legal system, • understand the British literature on "Criminal Investigation" against the background of UK law, • have an understanding for the changes that are currently taking place in the areas of criminal and civil law within the framework of the European integration process.
Summary indicative content:	• Structure of the Code of Criminal Procedure • The criminal investigation procedure • The formal structure of the criminal sentence • Fundamental principles of evidence-taking • Fundamental principles of criminal defence • Routine utilisation of expert witnesses in the courtroom • Case study: Murder cleared up after 15 years • Case study: Difficulties in establishing proof using DNA

	• Case study: Death as a result of drug consumption • Error search in criminalistics • The American legal system • The UK legal system • European legal integration
Assessment:	Modular examination – graded Written examination
Teaching style:	Lecture: overhead, computer projector, blackboard
Indicative bibliography/Sources:	Nomos-Gesetzestexte Zivilrecht, Öffentliches Recht, Strafrecht (texts on civil law, public law and criminal law; *translator's comment)* Various court judgements (Federal High Court - Bundesgerichtshof, BGH; Higher Regional Court - Oberlandesgericht, OLG; Federal Constitutional Law - Bundesvefassungsgericht, BVerfG)

Module:	**Forensic Analysis**
Semester:	5th semester
Course leader:	Prof. Dr Ernst-Jürgen Pomp
Lecturer:	Prof. Dr Ernst-Jürgen Pomp
Language:	English
Assignment to curriculum:	**Compulsory course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, a tutorial (exercises) and a laboratory course (experiments). Lecture: 3 lesson hours per week Tutorial: 1 lesson hour per week; max. group size: 20 Laboratory course: 2 lesson hours per week; max. group size: 15
Student workload:	Contact hours / Private study Lecture: 45 / 30 Tutorial: 15 / 45 Laboratory course: 30 / 45 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Analytical Chemistry (2nd semester), Instrumental Analysis (4th semester), Forensic Quality Assurance (4th semester), Law (4th semester)
Learning outcomes:	Lecture: At the end of the lecture, the students will: • be able to describe analytical tasks relating to samples of various origins within their forensic context; • be able to systematically deal with these tasks with respect to the handling, preparation and measuring of samples; • be able to present the related findings in an appropriate way; • have acquired the analytical skills necessary to independently determine which testing parameters are required to solve a given task. Tutorial: At the end of the tutorial, the students will: • be able to independently plan, conduct and statistically evaluate forensic investigations on the basis of their expertise and to prove that their findings can be used as evidence in court. Laboratory course/Tutorial: At the end of the laboratory course and the tutorial, the students will:

	• be able to independently use analytical methods and to evaluate and provide information on the findings of their analyses.
Summary indicative content:	Lecture: • Qualitative and quantitative analysis of abused substances, especially based on standard matrices, using current analytical methods • Sample-taking: representative samples, sample-taking plans, prevention of contaminations, sample transport, volatile analytes, sample preservation, appropriate sample storage • Sample preparation: purification, loss, quenching, recovery, internal standards • Identification: Identification and determination limit, experimental concentration area, use of a second technique to provide for additional security • Quality assurance: statistical evaluation, interpretation, documentation and presentation of analytical data Tutorial: • Drawing up sampling plans and experiment instructions • Selecting suitable processing techniques and analytical instructions for forensic tasks • Selecting statistical models to test whether the analytical findings can be used as evidence in court; reporting Laboratory course: Experiments on current issues of forensic analysis: • Drug screening • Identification of abused substances • Identification of pharmacologially effective substances • Identification of environmental toxins
Assessment:	Modular examination - graded Written final examination: 70% Laboratory course (oral examinations and lab reports): 30% Both parts of the examination must be passed independently of each other.
Teaching style:	Lecture: PowerPoint, blackboard, overhead Tutorial: written compilation of exercises
Indicative bibliography/Sources:	1) Forensische Medizin für Studium und Praxis, Maudrich Verlag 2) The Analysis of controlled substances, Wiley & Sons 3) Forensic Chemistry, Pearson International Education 4) Toxikologie und Analytik der Rauschgifte, UTB Hüthig Verlag 5) Rauschgifte, GOVI Verlag 6) Advances in Forensic Applications of Mass Spectrometry, CRC Press 7) Haaranalytik, Deutscher Ärzte Verlag

Module:	**Forensic Failure Analysis**
Semester:	5th semester
Course leader:	Prof. Dr Dorothee Schroeder-Obst, Doctor of Engineering
Lecturer:	Prof. Dr Dorothee Schroeder-Obst, Doctor of Engineering
Language:	German
Assignment to curriculum:	**Compulsory course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS)	The course consists of: Lecture: 2 lesson hours per week Tutorial: 2 lesson hours per week Laboratory course: 2 lesson hours per week
Student workload:	Contact hours / Private study Lecture: 30 / 30 Tutorial: 30 / 45 Laboratory course: 30 / 45 Total: 90 / 120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Successful completion of the modules "Structure and Characteristics of Materials" as well as "Solid Mechanics"
Learning outcomes:	At the end of the course, the students will have acquired the basic skills necessary to conduct forensic failure analyses aimed at clearing up and preventing damage.
Summary indicative content:	Lecture: • Terms and definitions • Systematic approach to failure analysis • Failure mechanisms and typical manifestations • Specific approach to failure analysis Tutorial: • Presentation and discussion of typical cases of damage from forensic practice, e.g. with a focus on insurance fraud and plagiarism • Use of specimens for the conduction of failure analyses
Assessment:	Modular examination – graded Written final examination 100% Prerequisite: completion of the laboratory course
Teaching style:	Lecture: blackboard, computer projector Tutorial, laboratory course: Learning by Doing (exercises and experiments under supervision)
Indicative bibliography/ Sources:	• Engel, Lothar und Herrmann Klingele; Rasterelektronenmikroskopische Untersuchungen von Metallschäden; Ed. Gerling-Institut für Schadenforschung und Schadenverhütung; Köln; Carl Hanser Verlag; Munich; Vienna; 1982; ISBN 3-446-13416-6 • Systematische Beurteilung technischer Schadensfälle; Ed. Günter

	Lange; Deutsche Gesellschaft für Metallkunde e. V.; Informationsgesellschaft Verlag; Oberursel; 1997; ISBN 3-88355-070-1 • Werkstoffprüfung, Schadensanalyse und Schadensvermeidung; G. Lange und M. Pohl; Wiley-VCH Verlag; Weinheim; 2001; ISBN 3-527-30538-6 • Ehrenstein, Gottfried W.; Kunststoff-Schadensanalyse: Methoden und Verfahren; Carl Hanser Verlag; Munich; Vienna; 1992; ISBN 3-446-17329-3 (Re-edited 2nd half of 2006)

Module:	**Polymers and Composites**
Semester:	5th semester
Course leader:	Prof. Möginger
Lecturer:	Prof. Möginger
Language:	German
Assignment to curriculum:	**Compulsory course in the 5th semester of Chemistry with Material Science** **Compulsory course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 2 lesson hours per week Tutorial: 2 lesson hours per week; max. group size: 30 Laboratory course: 2 lesson hours per week; max. group size: 18
Student workload:	Contact hours / Private study Lecture: 30 / 45 Tutorial: 30 / 45 Laboratory course: 30 / 30 Total: 90120 **Total (contact hours + private study): 210 hours**
Credits:	7 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	"Structure and Characteristics of Materials"
Learning outcomes:	At the end of the course, the students will: • be able to deduce the basic properties of a polymer from its molecular structure, • be able to identify the scope for property modification and optimisation, • be able to name testing facilities for the properties and analytical methods, • be able to critically assess their findings. • to name plastics processing techniques with reference to their applications • use filling and reinforcing materials in composites - according to their properties
Summary indicative content:	• Types of polymers • Molecular structure and structure-based properties • Mechanical, thermal, electrical, optical, chemical and rheological properties of polymers • Plastics processing • Filling and reinforcing materials • Types and structures of compounds • Environmental aspects
Assessment:	Modular examination – graded Certificate of attendance for the laboratory course,

	graded assignment Examination at the end of the module
Teaching style:	Lecture: blackboard, transparencies Tutorial: compilation of exercises, blackboard, transparencies Laboratory course: written experiment instructions
Indicative bibliography/Sources:	- Hellerich, Harsch, Haenle - Werkstoff-Führer Kunststoffe, Thieme-Verlag - Elias - Makromoleküle, Hüthig & Wepf Verlag - Domininghaus - Die Kunststoffe und ihre Eigenschaften, VDI-Verlag - Michaeli - Einführung in die Kunststoffverarbeitung, Hanser-Verlag - Jones R.M. - Mechanics of Composite Materials, McGraw-Hill Book Company - Jones R. F. - Guide to Short Fiber Reinforced Plastics, Hanser Publisher, Munich - M.J. Folkes - Short Fibre Reinforced Thermoplastics, Research Studios Press - Michaeli, Wegener - Einführung in Technologie der Faserverbundwerkstoffe, Hanser-Verlag - W. Clegg, A.A. Collyer - Mechanical Properties of Reinforced Plastics, Elsevier Applied Science

Module:	**Project (Elective Course 3)**
Semester:	5th semester
Course leader:	The lecturers of the Department of Natural Sciences
Lecturer:	The lecturers of the Department of Natural Sciences
Language:	German or English
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of experiments and additional practical activities, which are planned, implemented and presented under supervision. Laboratory course: 3 lesson hours per week; max. group size: 20
Student workload:	Contact hours / Private study Laboratory course: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Completion of the modules of the first four semesters
Learning outcomes:	At the end of the project, the students will be able to: • analyse complex tasks, • identify problem-solving techniques and to apply these techniques beneficially. In addition, they will: • have gained practical experience of project management, • be able to work independently and as team members, • have acquired problem-solving skills.
Summary indicative content:	In small groups, the students independently work on a practical task given to them by a lecturer of the Department of Natural Sciences or by lecturers from other departments. This practical task combines several disciplines or is performed in close cooperation with other research institutes or the industry. The students will: • set up time frames for their experiments, • share out the individual tasks among each other, • gain insights into project coordination, • gain practical experience of research processes and develop problem-solving strategies by independently working on smaller research and development tasks. This includes: • drafting and implementing concepts as well as • presenting the students' findings.

Assessment:	Modular examination – ungraded Assessment is based on the concept, its implementation and its final presentation.
Teaching style:	As required
Indicative bibliography/ Sources:	To be announced individually

Module:	**Practical Phase**
Semester:	6th semester
Course leader:	The lecturers of the Department of Natural Sciences
Lecturers:	The lecturers of the Department of Natural Sciences
Language:	German or English
Assignment to curriculum:	**Compulsory course in the 6th semester of Chemistry with Material Science** **Compulsory course in the 6th semester of Forensic Sciences** **Compulsory course in the 6th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of a three-month internship in a domestic or foreign company or research institute. The external practical phase takes place in a facility that offers an internship related to the objectives of the degree programme. Alternatively, the students may complete a study semester at a university abroad. During the practical semester, the students are supervised by a professor from the Department of Natural Sciences, who also accepts and assesses the report on the practical semester.
Student workload:	Three-month internship in a company
Credits:	18 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	The modules to be taken during the first five semesters should have been completed.
Learning outcomes:	At the end of the practical semester, the students will: • be able to apply their previously acquired expertise to specialist, analytical, methodological and social issues and will • be able to apply their expertise to practical examples and to reflect it with respect to the occupational field they are working in. They will also: • have acquired new specialist expertise and skills in their research fields and will • be able to establish interdisciplinary connections with other research areas. The students will: • have acquired problem-solving skills and will • be able to work actively and interactively as team members. The practical phase is aimed at enhancing the students' specialist expertise and their social skills alike.
Summary indicative content:	The students will be • integrated into a company's work processes and will • be provided with the opportunity to apply the expertise and skills acquired during their degree programme to professional practice and to integrate questions arising from professional practice into their subsequent studies.

	The students will also: • acquire new expertise and skills related to their practical projects and the requirements placed on them by their companies.
Assessment:	Modular examination – ungraded To pass the modular examination, the students shall: • provide evidence of having completed the practical semester (notification/testimonial from the company), • submit the final report, • have successfully participated in a meeting and a final discussion about the project with the superviser.
Teaching style:	No information provided
Indicative bibliography/Sources:	As required

Module:	**Thesis /Thesis Defense**
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 Forensic Sciences**
Course Units/Credit hours:	Thesis (Final project): The final project has a period of two months and will be completed with a written thesis about a distinct topic in the context of the study program. The final project 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. Thesis defense: The students prepare an oral presentation about the content of their final project. In their thesis defense they demonstrate a thorough understanding of their research topic and their ability to evaluate their own findings in the context of their study program.
Students workload:	Thesis / Thesis defense: 2 months (40 h/week); The thesis is submitted not later than after two months; date of the thesis defense is agreed upon after submission of the thesis.
Credit points:	Thesis / Thesis defense: 12 ECTS
Prerequisites according to examination regulations:	Requirements for admission to the thesis: Not more than two modules in the study program are uncompleted. Alternatively, all exams of semester 1 to 4 have been passed. Requirements for admission to the thesis defense: All modules in the study program have been passed.
Recommendations:	None
Learning outcomes:	Thesis: In their final project students use their theoretical knowledge from the study program and the technical skills from their practical phase to investigate a sophisticated scientific topic. The thesis proves the competence of the students to work scientifically and to apply analytical skills to a practical problem. It demonstrates problem solving skills as well as social competences. Students write up their data according to scientific standards and discuss their findings with current literature. Thesis defense: Students are able to evaluate scientific data and to present them in a well-structured oral presentation. Students are familiar with modern

	presentation techniques, and can talk freely about a scientific topic. Following a presentation, students can answer questions about the topic of the presentation and related topics of their study program.
Summary indicative content:	Thesis: Students demonstrate their ability to address within a given time a scientific topic related to their study program. Students can apply techniques from their study program to solve the scientific question. In addition they are not only familiar with the scientific topic but also its relation to more global scientific implications. First supervisor of the final project is a professor of the department with whom the student agrees on the topic of the final project. Students document their scientific results as written thesis which will be graded both by the first and the second supervisor. Both supervisors evaluate the quality of the scientific approach, the obtained results and their discussion as well as the used literature for citations. Thesis defense: The students give an oral presentation about the topic of their final thesis. This requires an extensive literature research for preparation, as well as designing the final presentation. The presentation gives a detailed overview about theory, methods and results of the final thesis. It also includes an outlook on future experimental approaches. The colloquium is given in free speech within a given time. It is followed by a discussion about the presentation and related topics of the study program.
Assessment:	Thesis and thesis defense: graded The thesis has been passed if the grading by each of the two examiners is at least ´sufficient´. The total mark is an average of the marks by first and second supervisor. The thesis has a 25% weight of the final bachelor grade. The thesis defense has been passed if the grading by each of the two examiners is at least ´sufficient´. The total mark is an average of the marks by first and second supervisor. The thesis defense has a 10% weight of the final bachelor grade.
Teaching style:	Not applicable
Indicative Bibliography/Sources:	On demand

Module:	**Advanced Forensic DNA typing**
Semester:	5th semester
Course leader:	Prof. Richard Jäger
Lecturer:	Prof. Richard Jäger
Language:	English
Assignment to curriculum:	**Elective course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 2 lesson hours per week Laboratory course: 1 lesson hours per week; max. group size: 12
Student workload:	Contact hours / Private study Lecture: 30 / 30 Lab work: 15 / 15 Total : 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	none
Recommendations:	successful participation in "Forensic Biology"
Learning outcomes:	Lecture: At the end of the lecture, the students will: • be able to explain the properties of and methods for analyzing various forensic markers (VNTRs, STRs, SNPs, INDELs, mtDNA), • be familiar with the analysis of STR profiles and mtDNA profiles using capillary electrophoresis • be familiar with the currently used forensic STR systems (Germany, EU, US) • be familiar with relevant databases (population databases, forensic DNA databases) • be able to statsitically evaluate forensic DNA evidence • be familiar with methods and applications of forensic identification of non-human species • be familiar with next generation sequencing methods Laboratory course: The students will: • be able to analyze DNA polymorphisms using capillary electrophoresis • be able to analyse, evaluate and interpret analytical data.
Summary indicative content:	Lecture: Polymorphic DNA markers; ; forensic applications of various marker types; analysis of length polymorphisms; analysis of sequence polymorphisms; statistical evaluation of evidence; next generation sequencing Practical course: STR analysis and sequencing of mtDNA by capillary electrophoresis;

Assessment:	Modular examination – graded Laboratory work (oral examinations and lab reports): 33%; Written final examination: 67% Active participation in the laboratory course is a prerequisite for admission to the final examination. The final examination must be passed independently of the practical part.
Teaching style:	Lecture: Power Point presentation, textbook, current literature Laboratory course: written experiment instructions, textbooks
Indicative bibliography/ Sources:	John M. Butler: Fundamentals of Forensic DNA Typing (Elsevier) William Goodwin, Adrian Linacre, Sibte Hadi: An Introduction to Forensic Genetics, 2nd Edition (Wiley-Blackwell)

Module:	**Selected Methods of Instrumental Analysis**
Semester:	5th semester
Course leader:	Prof. Dr Wolfgang Fink
Lecturer:	Prof. Dr Wolfgang Fink
Language:	German
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a seminar and a laboratory course (experiments). Seminar: 2 lesson hours per week; max. group size: 20 Laboratory course: 1 lesson hour per week max. group size: 5
Student workload:	Contact hours / Private study Seminar: 30 / 25 Laboratory course: 15 / 20 Total: 45 / 45 **Total (contact hours + private study: 90 hours)**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Requirements:	Instrumental Analysis (4 th semester)
Learning outcomes:	At the end of the course, the students will: • be able to use scientific primary literature, • be able to plan, implement, report on and evaluate an analysis in a team and will • be able to present their own findings in accordance with scientific standards.
Summary indicative content:	The course contents may vary. The course always focuses on a modern practical technique of Instrumental Analysis. Subsequent to a theoretical introduction, the students will: • draw up experiment instructions, • conduct the experiment, • document, evaluate and present their findings. (Examples of typical topics include: development of a voltametric method for the quantitative determination of heavy metals in drinking water, development of a GC-MS method for a specific separation problem, validation of an HPLC method).
Assessment:	Modular examination – ungraded Participation in the seminar and presentation (50%) Lab report (50%)
Teaching style:	As required
Indicative bibliography/Sources:	Information on special literature will be provided at the beginning of the course.

Module:	**FACS (Fluorescent Activated Cell Sorting)**
Semester:	5th semester
Course leader:	Prof. Dr Harald Illges
Lecturer:	Prof. Dr Harald Illges
Language:	English
Assignment to curriculum:	**Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of : Laboratory course: 3 lesson hours per week max. group size: 18
Student workload:	Contact hours Private study Laboratory course: 45 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Expertise on the practical use of antibodies
Learning outcomes:	At the end of the course, the students will: • be able to independently conduct measurements of FACS (Fluorescent Activated Cell Sorting), • be able to perform simple maintenance works on the equipment, • be able to take, administer and evaluate FACS data, • be able to make statistical statements on data relevance.
Summary indicative content:	The students are introduced to the theoretical principles of FACS technology. They gain insights into the composition and operating principles of the equipment, divided into the areas of liquids/cells, optics/lasers and electronics. The equipment is controlled by the Cell Quest Pro program. The students are introduced to the basic principles of data administration on Apple computers and of work with the CellQuestProgram. They will be enabled: • control the machine using the program, • to calibrate and acquire data, • to conduct multi-parameter analyses of 4-colour experiments, • to statistically analyse populations of single-or multiple-stained cells, • to conduct dotblot and histogram analyses and • to evaluate DNA/cell cycle experiments. The students will learn how to operate the appliance and will subsequently evaluate the data independently.
Assessment:	Modular examination – ungraded
Teaching style:	Lecture: Introduction Laboratory course: written experiment instructions

Indicative bibliography/Sources:	• Handbook of flow cytometry methods, Robinson (Editor) • A Guide to Fluorescent Probes and Labelling Technologies, 10. Edition, Molecular Probes

Module:	**Rubber Materials**
Semester:	5th semester
Course leader:	Prof. Dr Möginger
Lecturer:	Prof. Dr Möginger
Language:	German
Assignment to curriculum:	**Compulsory course in the 4th semester of Chemistry with Material Science** **Compulsory course in the 4th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Tutorial: 3 lesson hours per week; max. group size: 30
Student workload:	Contact hours / Private study Tutorial: 45 / 45 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	At the end of the course, the students will: be able to name the basic structures of various elastomers and to deduce basic properties from them, be able to select materials with a view to their applications, be able to name appropriate testing techniques with respect to their applications, be able to describe processing techniques of elastomers and rubber materials.
Summary indicative content:	• Introduction, terms, definitions • Types of elastomers, filling agents and auxiliary materials • Testing of rubber materials; properties of rubber materials and aspects of application • Processing of rubber materials • Thermoplastic elastomers • Aspects of quality assurance
Assessment:	Modular examination – ungraded Assignment, examination at the end of the module
Teaching style:	Tutorial: written compilation of exercises, blackboard, transparencies
Indicative bibliography/ Sources:	Hellerich, Harsch, Haenle - Werkstoff-Führer Kunststoffe, Thieme-Verlag Elias - Makromoleküle, Hüthig & Wepf Verlag Domininghaus - Die Kunststoffe und ihre Eigenschaften, VDI-Verlag Michaeli - Einführung in die Kunststoffverarbeitung, Hanser-Verlag

	Jones R.M. - Mechanics of Composite Materials, McGraw-Hill Book Company Jones R. F. - Guide to Short Fiber Reinforced Plastics, Hanser Publisher, Munich M.J. Folkes - Short Fibre Reinforced Thermoplastics, Research Studios Press Michaeli, Wegener - Einführung in Technologie der Faserverbundwerkstoffe, Hanser-Verlag W. Clegg, A.A. Collyer - Mechanical Properties of Reinforced Plastics, Elsevier Applied Science

Module:	**Interdisciplinary Applications in Mathematics**
Semester:	5th semester
Course leader:	Prof. Dr Christina Oligschleger
Lecturer:	Prof. Dr Christina Oligschleger
Language:	German
Assignment to curriculum:	**Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology** **Elective course in the 5th semester of Chemistry with Material Science**
Course units/Lesson hours per week (SWS):	The course consists of: Tutorial: 3 lesson hours per week; max. group size: 20
Student workload:	Contact hours Private study Tutorial: 45 45 Total: 45 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Mathematics, IT/Computing Science
Learning outcomes:	At the end of the course, the students will: • have gained deepened insights into interdisciplinary applications of mathematics, • be able to perform basic calculations in selected areas independently.
Summary indicative content:	• Vectorial analysis and its application in biology, chemistry and physics • Deepening existing knowledge of differential equations • Deepening existing knowledge of matrix calculations, especially calculations of eigenvalues and eigenfunctions, including applications of numerical methods.
Assessment:	Modular examination – ungraded The students shall provide evidence of active participation in the tutorial by presenting calculations of mathematical tasks.
Teaching style:	Tutorial: blackboard, script, laboratory course in the PC pool
Indicative bibliography/ Sources:	• Lothar Papula, Mathematik für Ingenieure und Naturwissenschaftler, vieweg Verlag, Braunschweig Wiesbaden. Volumes 1,2 and 3. • Thomas Rießinger, Mathematik für Ingenieure : eine anschauliche Einführung für das praxisorientierte Studium, Springer Verlag, Berlin ; Heidelberg, 1996, VII, 656 p. • Hans G. Zachmann, Mathematik für Chemiker, VCH, Weinheim, 1994, 5th, extended version. XVIII, 700 p.

	• I.N. Bronstejn, Taschenbuch der Mathematik, Verlag Deutsch, Frankfurt am Main, 1999,4., überarb. und erw. Aufl. der Neubearb. 1151 S. (revised and extended version of the revised edition, 1151 pages) • K. Gieck, R. Gieck, Technische Formelsammlung, Gieck Verlag, Germering, 1995, 30. erweiterte Ausgabe (30th extended version)

Module:	**Novel Materials from Renewable Resources**
Semester:	5th semester
Course leader:	Prof. Dr Margit Schulze
Lecturer:	Prof. Dr Margit Schulze
Language:	German/English (depending on the composition of the group/by consent with the participants)
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of: 3 lesson hours per week (1 lecture /1 seminar/1 practical course)
Student workload:	Contact hours / Private study L: 15 / 15 S: 15 / 15 P: 15 / 15 Sum: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Success in General Chemistry (1st semester), Analytical Chemistry (2 nd semester), Organic Chemistry (3rd semester), Instrumental Analysis (4th semester)
Learning outcomes:	Lectures and seminars: At the end of the course, the students will: • be familiar with the most important conventional and renewable resources, • recognise and understand the relationship between chemical structures and properties of materials, • be able to name typical materials for certain areas of application, • be able to describe the operating principles of these materials. Practical course: • be able to suggest and conduct methods for the production and characterisation of biomass-based materials.
Summary indicative content:	Lectures and seminars: • Concepts on the issue of sustainability in chemistry (in companies and universities) • Renewable forms of energy and renewable resources in the chemical industry • Overview of availability, extraction, purification and processing of renewable resources • Derived products; typical structure-property relationships or property profiles of materials made from renewable resources • Areas of application for materials from renewable resources • Scope for the extraction and/or recycling of materials • Biorefinery concepts as an alternative to crude oil refineries

	Lab course: 2 experiments to synthesize materials from renewable resources (e.g. esters based on natural oils).
Assessment:	Modular examination - ungraded Written final examination and lab reports (for 2 experiments) Active participation in the seminars is a prerequisite for admission to the written test.
Teaching style:	Blackboard, computer projector, overhead, written compilation of exercises, current scientific publications
Summary 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, 2nd Ed., WILEY-VCH. 3. B. König et al., Neues und nachhaltigeres organisch-chemisches Praktikum Multiplattform-CD-ROM, Harry Deutsch Verlag. 4. Current scientific publications (literature search via SciFinder).

Module:	**Organic Chemistry 2**
Semester:	4th semester
Course leader:	Prof. Dr. Margit Schulze
Lecturer:	Prof. Dr. Margit Schulze, Dr. Kai Jakoby (Professurvertreter) und Prof. Dr. Klaus Lehmann
Language:	German / English (depending on participants)
Assignment to curriculum:	**Elective course, 4th semester of BSc Chemistry with Material Science** **Elective course, 4th semester of Forensic Sciences** **Elective Course, 4th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of: 3 lesson hours per week (1 lecture / 1 exercises / 1 practical course)
Student workload:	Contact hours / Private study L: 15 / 15 E: 15 / 15 P: 15 / 15 Sum: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	4 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Success in General Chemistry (1st semester), Analytical Chemistry (2nd semester), and Organic Chemistry (3rd semester)
Learning outcomes:	Lectures: Based on the first modul in „Organic Chemistry“ the knowledge will be deepended with specific focus on structure-property-relationsships and reactivity differences of organic compounds. At the end of the course, students are able to: - specify and apply typical reaction mechanisms for each class of compounds - handle mechanistic and stereochemical aspects of the most important C-C-coupling reactions (e.g. Aldol-, Michael-, Claisen- bzw. Perkin-reactions); - are introduced into modern synthetic methods (e.g. metallo-organic reagents, asymmetric syntheses) - to perform a scientific literature search based on modern online data bases (e.g. SciFinder), read and analyse scientific publications (preparation for bachelor thesis). Exercises: • Stdudents are able to apply topics of the lecture, e.g. develop reaction mechanisms, analyse and discuss alternatives and formulate structures of starting compounds, intermediates, side and main products of specific reactions. • Practical course: • Students deppen their experimental experience in synthesis and purification with special focus on C-C-coupling reactions (e.g. Aldol-, Wittig- bzw. Cannizzaro-reaction).
Summary indicative content:	Lectures/Exercises: Reaktionsmechanisms with specific focus on C-C-coupling reactions, including Aldol-, Wittig-, Cannizzaro-, Michael-, Claisen- and Perkin-reaction), oxidations and reductions of organic compounds, metallo-

	organic reagents, stereochemical reactions, and spezific aspects of Organic Chemistry (e.g. heterocycles, biomolecules, asymmetric synthesis), industrially relvant compounds (e.g. monomers for polymer synthesis) and biomass-based chemicals. Exercises are discussed for all lecture topics. Introduction into online data bases available via library at H-BRS (e.g. SciFinder) and programs for scientific writing (e.g. citavi) Practical course: Two experiments for the synthesis and purification of organic compounds (e.g. Wittig-, Aldol-, Cannizzaro-reaction)
Assessment:	Modular examination – graded Written final examination (80%), lab reports (20% for 2 experiments) and literature search (non graded) Active participation in the seminar is a prerequisite for admission to the final examination.
Teaching style:	Blackboard, computer projector, overhead, written compilation of exercises, current scientific publications
Indicative bibliography / Sources:	• K.P.C. Vollhardt, N.E. Schore, Organic Chemistry: Structure and Function, Freeman, New York. • P.Y. Bruice, Organic Chemistry, Prentice Hall, New York. • R.T. Morrison, R.N. Boyd, Organic Chemistry, Prentice Hall, and Inc., New York and corresponding Study Guide • R. Brückner, Reaktionsmechanismen, Spektrum Verlag. • Current scientific publications (available via online data bases, e.g. SciFinder)

Module:	**Scientific Photography**
Semester:	5th semester
Course leader:	Prof. Dr Michael Heinzelmann
Lecturer:	Prof. Dr Michael Heinzelmann
Language:	English
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of: Seminar: 1.5 lesson hours per week Laboratory course: 1.5 lesson hours per week
Student workload:	Contact hours / Private study Seminar: 22.5 / 22.5 Laboratory course: 22.5 / 22.5 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits	3 ECTS
Prerequisites according to Examination Regulations	None
Recommendations:	None
Learning outcomes:	At the end of the course, the students will be able to take photos in accordance with technical and scientific requirements.
Summary indicative content:	• Equipment (camera, camera lenses, lighting, camera tripods, filters, films, storage cards, equipment for macro- and microscopic photography) • Work techniques (photographic parameters such as shutter speed and aperture, light exposure measurement, white balance, photographic documentation) • Image reproduction (printer, papers, projectors) • Photographic processing (with Adobe Photoshop Elements)
Assessment:	Modular examination – ungraded Final examination and presentations
Teaching style:	P: case studies for seminars relating to the photographing techniques to be dealt with in class S: Presentation and discussion of the case studies
Indicative bibliography/ Sources:	Scientific Photography and Applied Imaging, Focal Press Experimenting With Science Photography, Franklin Watts Publishers

Module:	**Radiation and Radiation Protection: Part 1** Acquisition of the vocational qualification required to act as a Radiation Protection Commissioner for "Enclosed Radioactive Substances" (Strahlenschutzbeauftragter, SBB) Module GH, FA, vocational training group (Fachkundegruppe) S2.2, S5 (officially approved)
Semester:	**4th semester**
Course leader:	**Dr Peter-A. Gottschalk**
Lecturer:	Prof. Dr Eßmann, Dr Gottschalk
Language:	German
Assignment to curriculum:	**Elective course in the 4th semester of Chemistry with Material Science** **Elective course in the 4th semester of Forensic Sciences** **Elective course in the 4th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of a lecture, a tutorial (exercises) and a laboratory course (experiments). Lecture: 4 lesson hours per week Tutorial: included in the above-mentioned 4 lesson hours per week, max. group size: 25 Laboratory course: included in the above-mentioned 4 lesson hours per week (total of 5 hours of lab work); max. group size: 12 (or 3 per measurement setup)
Student workload:	Contact hours / Private study Lecture: 40 / 35 Tutorial: 15 / 15 Laboratory course: 5 / 10 Total: 60 / 60 **Total (contact hours + private study): 120 hours**
Credits:	4 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	■ Appropriate assessment of risks and hazards in the handling of enclosed radioactive substances, which is subject to official authorisation ■ Acquisition of the technical qualification required to act as a radiation protection commissioner (vocational training group S2.2, S5) Lecture: At the end of the lecture, the students will: • know the scientific basics of radiation protection (radiation

	physics, radiation biology), • know the legal foundations, recommendations and guidelines on radiation protection, • know the responsibilities and duties of a radiation protection superviser (Strahlenschutzverantwortlicher) and a radiation protection commissioner (Strahlenschutzbeauftragter) as well as their positions within a company • know the fundamentals of radiation protection measurement technology • know the fundamentals of practical radiation protection (radiation protection technology, radiation protection safety, protection in the workplace and radiation protection) • know typical applications of enclosed radioactive substances in industry and technology • know the regulations, responsibilities and duties relating to an employment requiring offical permission in third-party plants or facilities • have an understanding for radiation protection and the environment (exposition of man to natural or civilisation-related sources of radiation), with a focus on the tution contents of modules GH and FA, as specified in Appendix E of the relevant Guideline on Vocational Training in Technology (in accordance with the German Radiation Protection Ordinance - Strahlenschutzverordnung, StrlSchV). The students will be enabled to apply these regulations in professional practice. Tutorial: At the end of the tutorial, the students will: • be able to deal with example tasks from radiation protection, which are also typical of the (official) vocational training examination (amtliche Fachkundeprüfung). Laboratory course: At the end of the laboratory course, the students will: • have gained practical experience of handling radiation measurement equipment and of dealing with measuring tasks from radiation protection, and they will • have gained practical experience of determining the extent of exposition to external radiation. They will also: • know how to handle radioactive substances appropriately.
Summary indicative content:	Lecture, Tutorial (including exercises) and laboratory course: Tuition contents in accordance with Appendix E of the Guidline on Vocational Training in Technology, as specified in the German Radiation Protection Ordinance (Strahlenschutzverordnung, StrlSchV), GMBl. 2004, No. 40/41, p. 799 ff, modules GH und FA, vocational training groups (Fachkundegruppen) S2.2 and S5. The course provides the students with the expertise required to act as a radiation protection commissioner. This includes: • handling enclosed radioactive substances that require official permission and whose radiation level is up to 10^5 times the threshold; • supervising and organising activities requiring official permission in third-party plants or facilities;. • The course has been officially approved within the scope of

	the Radiation Protection Ordinance, which applies to the entire area of the Federal Republic of Germany. The course is self-contained and shall be completed with a written examination (multiple choice). Laboratory course: The topics of the laboratory course include: • Statistics of nuclear decay/disintegration and of radiation measurement technology • Measuring local dose performance • Distance Law/Inverse Square Law (?) • Beta backscattering (?)
Assessment:	Modular examination – ungraded According to the official authorisation, a minimum 90 % attendance as well as active participation in the laboratory course are required to successfully complete the course. In addition, the students are required to pass a written and graded exmination (multiple choice).
Teaching style:	Lecture: script, overhead, Power-Point, blackboard Tutorial: written compilation of exercises; overhead, blackboard; objects for presentation purposes Laboratory course: written compilation of exercises
Indicative bibliography/Sources:	Scripts (intranet), Radiation Protection Ordinance, Karlsruhe Nuclear Chart (Karlsruher Nuklidkarte), the relevant German Industrial Standards (DIN) (6814-5, 25422, 25425, 25426), Vogt-Schultz: Grundzüge des praktischen Strahlenschutzes, Carl Hansen, 1992, ISBN-3-446-15696-8

Module:	**Radiation and Radiation Protection: Part 2** Acquisition of the vocational qualification required to act as a Radiation Protection Commissioner for "Open Radioactive Substances" (Strahlenschutzbeauftragter, SSB), module OG, vocational training group (Fachkundegruppe) S4.1 (officially approved)
Semester:	5th semester
Course leader:	Dr Peter-A. Gottschalk
Lecturer:	Prof. Dr Eßmann, Dr Gottschalk
Language:	German
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS)	The course consists of a lecture, a tutorial (exercises) and a laboratory course. Lecture: 3 lesson hours per week Tutorial: included in the above 3 lesson hours per week; max. group size: 30 Laboratory course: included in the above 3 lesson hours per week (total of 5 hours of lab work); max. group size: 12 (or 3 per measurement set-up)
Student workload:	Contact hours / Private study Lecture: 30 / 20 Tutorial: 10 / 15 Laboratory course: 5 / 10 Total: 45 / 45 **Total (contact hours + private study)**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Module "Radiation and Radiation Protection 1" or qualification as Radiation Protection Commissioner, vocational training group S2.2 or S2.1
Learning outcomes:	• Appropriate assessment of risks and hazards in the handling of enclosed radioactive substances, which is subject to official authorisation • Acquisition of the expertise required to act as a radiation protection commissioner (vocational qualification group S4.1) <u>Lecture</u>: At the end of the lecture, the students will:

	• know the scientific basics of radiation protection (radiation physics, radiation biology), • know the legal foundations, recommendations and guidelines on radiation protection, • know the responsibilities and duties of a radiation protection superviser (Strahlenschutzverantwortlicher) and a radiation protection commissioner (Strahlenschutzbeauftragter) as well as their positions within a company, • know the fundamentals of radiation protection measurement technology, • know the fundamentals of practical radiation protection (radiation protection technology, radiation protection safety, protection in the workplace and radiation protection) • know with typical applications of open radioactive substances in industry and technology • have and understanding for radiation protection and the environment (exposition of man to natural or civilisation-related sources of radiation), with a focus on the tution contents of module OG, as specified in Appendix E of the relevant Guideline on Vocational Training in Technology (in accordance with the German Radiation Protection Ordinance - Strahlenschutzverordnung, StrlSchV). The students will be enabled to apply these regulations in professional practice, insofar as they refer to "open radioactive substances". Tutorial: At the end of the tutorial, the students will: • be able to deal with example tasks relating to radiation protection, which are also typical of the (official) vocational training examination (amtliche Fachkundeprüfung). Laboratory course: At the end of the laboratory course, the students will: • have gained practical experience of handling radiation measurement equipment and of dealing with measuring tasks from radiation protection, and they will • know how to handle radioactive substances appropriately.
Summar indicative content:	Lecture, tutorial, laboratory course: Tution contents in accordance with Appendix E of the Guideline on Vocational Training in Technology (Fachkunderichtlinie), as specified in the German Radiation Protection Ordinance (Strahlenschutzverordnung, StrlSchV), GMBI. 2004, No. 40/41, p. 799 ff, module OG. The course provides the students with the additional expertise required to act as a radiation protection commissioner. This includes supervising or organising the handling of open radioactive substances that require official permission and whose radiation level is up to 10^5 times the threshold (vocational training group S4.1). The course has been officially approved within the scope of the Radiation Protection Ordinance, which applies to the entire area of the Federal Republic of Germany. The course is self-contained and is completed with a written examination (multiple choice). Laboratory course: The topics of the laboratory course include:

	• Contamination measuring • Nuclear identification • Gammaspectrometry
Assessment:	Modular examination – ungraded According to the official authorisation, a minimum 90% as well as active participation are required to successfully complete the course. In addition, the students are required to pass a written and graded modular examination (multiple choice).
Teaching style:	Lecture: script, overhead, Power-Point, blackboard Tutorial: written compilation of exercises; overhead, blackboard; objects for presentation purposes Laboratory course: written experiment instructions
Indicative Bibliography/Sources:	Scripts (intranet), German Radiation Protection Ordinance (Strahlenschutzverordnung), Karlsruhe Nuclear Chart (Karlsruher Nukleidkarte), the relevant German Industrial Standards (6814-5, 25422, 25425, 25426), Vogt-Schultz: Grundzüge des praktischen Strahlenschutzes, Carl Hansen, 1992, ISBN-3-446-15696-8

Module:	**Sustainability in Chemistry**
Semester:	**5th semester**
Course leader:	Prof. Dr Klaus Lehmann
Lecturer:	Prof. Dr Klaus Lehmann
Language:	German
Assignement to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS)	The course consists of: Lecture: 1.5 lesson hours per week Tutorial: 1.5 lesson hours per week
Student workload:	Contact hours / Private study Lecture: 22.5 / 30 Tutorial: 22.5 / 15 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations	None
Recommendations:	The students should be willing to reflect on their personal attitudes. Organic chemistry.
Learning outcomes:	At the end of the course, the students will: • understand current usages of the term "sustainability", • be able to reflect on the term "sustainability" using appropriate methods (e.g. methods of communication theory and discourse theory), • be able to discuss problems associated with cornerstones of the social and ecological integration of scientific subject matters, • be able to weigh and reflect on the pros and cons of sustainability concepts in chemistry in discussions, • be able to mention and weigh the pros and cons of indicators, and they will • be able to mention recent organic-chemical developments from the area of Sustainable Chemistry.
Summary indicative content:	• Fundamentals of discourse theory based on the example of "nature" (fundamentals of ecological discourse) • Fundamentals of communication theory based on the example of "sustainability" • Ecological efficiency analysis (BASF AG) • MIPS concept (Wuppertal Institute) • EATOS (Oldenburg University) • Selected current developments on sustainable chemistry • Exercises aimed at practising the oral presentation of thoughts and ideas • Talks with experts about sustainability topics e.g. with business editor Deutsche Welle or Leiter Netzwirtschaft Westnetz.
Assessment:	Modular examination – ungraded
Teaching style:	Lecture: notes on the blackboard/transparencies Tutorial: written compilation of exercises/simulations/role plays, excursion

Indicative bibliography/ Sources	P. Saling, A. Kicherer, B. Dittrich-Krämer et al., Eco-efficiency Analysis by BASF: The Method, Int. J. LCA 2002 (Online First, 3rd June). M. Ritthoff, H. Rohn, C. Liedtke, Mips berechnen - Ressourcenproduktivität von Produkten und Dienstleistungen, Wuppertal Spezial 27, Wuppertal, 2002. M. Eissen, Bewertung der Umweltverträglichkeit organisch-chemischer Synthesen, Diss. Oldenburg, 2001. Deutscher Bundestag (Ed.), Konzept Nachhaltigkeit - Vom Leitbild zur Umsetzung, Abschlussbericht der Enquete-Kommission „Schutz des Menschen und der Umwelt" des 13. Deutschen Bundestages, Bonn, 1998. G. Lakoff, M. Johnson, Leben in Metaphern – Konstruktion und Gebrauch von Sprachbildern, Heidelberg, 2000. G. Böhme, Das Natürliche und das Künstliche, in: P. Janich, C. Rüchardt (Hg.), Natürlich,technisch,chemisch. Verhältnisse zur Natur am Beispiel der Chemie, de Gruyter, Berlin, 1996. W. Klöpfer, B. Grahl, Ökobilanz (LCA), Wiley-VCH, Weinheim, 2009. Supplemented by a selection of essays and text passages
Other information:	Excursion to companies for visiting their concret sustainability strategies e.g. Siegwerk Druckfarben AG, Siegburg

Module:	**Selected Topics in the Field of Biocatalysis (Enzymology)**
Semester:	5th semester
Course leader:	Prof. Dr. U.Bartz
Lecturer:	Prof. Dr. U.Bartz/ Chr. Breuer
Language:	English
Assignment to curriculum:	**Elective course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of a seminar and a laboratory course (experiments). Seminar: 2 lesson hours per week; max. group size: 15 Laboratory course: 1 lesson hour per week max. group size: 5
Student workload:	Contact hours / Private study Seminar: 30 / 25 Laboratory course: 15 / 20 Total: 45 / 45 **Total (contact hours + private study: 90 hours)**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Requirements:	Pharmacology & Toxicology (4th semester)
Learning outcomes:	At the end of the course, the students will: • be able to use scientific primary literature and plan experiments on enzyme kinetics/enzymology. • perform experiments, critically evaluate, report (protocol) and discuss within the group • be able to give a presentation on their own findings in accordance with scientific standards.
Summary indicative content:	After searching for literature the students will • propose the experimental design, • perform the experiments, • document the findings (protocol) and give a final presentation with a subsequent scientific discussion. Selected topics way vary. Reference is always made to forensic analysis/doping analysis (e.g. preanalytics for analysis of urinary Phase II metabolites, e.g. via ß-glucuronidase). Other examples are pharmacodynamic experiments for the characterisation of drug molecules as enzyme inhibitors (for selected drug targets: determination of substrate Km-value, of IC50-or Ki-values of inhibitors respectively; data analysis by using Graph Pad Prism software)
Assessment:	Modular examination – ungraded Participation in the seminar and presentation (50%) Lab report (50%)
Teaching style:	Powerpoint/Blackboard

Indicative bibliography/Sources:	Literature list will be provided dependent on the selected topic at the beginning of the course.

Module:	**Organic Chemistry 3**
Semester:	5th semester
Course leader:	Prof. Dr Margit Schulze
Lecturer:	Prof. Dr Margit Schulze
Language:	German / English (depending on participants)
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective Course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of: 3 lesson hours per week (1 lecture / 1 exercises / 1 practical course)
Student workload:	Contact hours / Private study L: 15 / 15 E: 15 / 15 P: 15 / 15 Sum: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Success in General Chemistry (1st semester), Analytical Chemistry (2nd semester), Organic Chemistry (3rd semester), Instrumental Analysis (4th semester)
Learning outcomes:	Lectures and exercises: Based on the first module on Organic Chemistry, the students will deepen and enlarge their expertise; they will improve the way they handle reaction mechanisms, and they will independently conduct retro-synthetic analyses. Based on the expertise they have acquired on the properties of organic compounds and their reactivity, the students will be able to conduct the related retro-synthetic of the bonding structure of a synthetic target module. Thus, at the end of the course students will: • have gained deepened insights into the spectroscopic and chromatographic analysis of classes of organic substances (e.g., ^{1}H-NMR, ^{13}C-NMR, IR, UV-VIS, mass spectrometry and GC-MS), • be able to use the scientific literature (publications, patents, etc.), and they will • be familiar with recent developments in the area of organic synthesis chemistry. Practical course: students will be able to • synthesize and purify organic compounds; characterize their structure via spectroscopic and/or chromatographic methods and give a detailed interpretation of the analytical data.
Summary indicative content:	Lectures and exercises: • Natural substance chemistry including stereochemistry

	• Metal-organic chemistry • Applications of various spectroscopic and chromatographic techniques (e.g., ^{1}H-NMR, ^{13}C-NMR, IR UV-VIS, MS and GC-MS) to determine the structure of organic compounds • Special chapters of Organic Chemistry (among others, supra-molecular chemistry) • Retro-synthetic analyses • Current developments, methods and concepts of Organic Chemistry <u>Lab course:</u> 2 experiments for synthesis and analysis (e.g. Diazotation and Sandmeyer-analogue reaction; reduction of carbonyl compounds to alcohols via hydrid transfer).
Assessment:	Modular examination – ungraded Written final examination and lab reports (for 2 experiments) Active participation in the seminar is a prerequisite for admission to the final examination.
Teaching style:	Blackboard, computer projector, overhead, written compilation of exercises, current scientific publications
Indicative bibliography/Sources:	1. Current scientific publications (available via library H-BRS online data bases, e.g. SciFinder) 2. K.P.C. Vollhardt, N.E. Schore, Organische Chemie, Wiley-VCH, 2005. 3. H.R. Christen, F. Vögtle, Organische Chemie (Volume I-III), Verlag Salle-Sauerländer, 2. Auflage 1992 / 1996. 4. R. Brückner, Reaktionsmechanismen, Spektrum Verlag, 3rd Edition, 2004 5. M. Hesse, H. Meier, B. Zeeh, Spektroskopische Methoden in der organischen Chemie, Thieme Verlag, 7th Edition, 2005.

Module:	**Functionalized Materials for Medical Devices**
Semester:	5 semester
Course Leader:	Prof. Dr.-Ing. Dorothee Schroeder-Obst
Lecturer:	Prof. Dr.-Ing. Dorothee Schroeder-Obst
Language:	german
Assignment in Curriculum:	**WPF 5. Sem. Chemie mit Materialwissenschaften** **WPF 5. Sem. Naturwissenschaftliche Forensik** **WPF 5. Sem. Applied Biology**
Course Units/Credit hours:	The course consists of L: 1,5 SWS T: 1,5 SWS Max. 20 Personen
Students workload:	Contact hours Private study L: 22,5 30 T: 22,5 15 sum: 45 45 sum total**: 90 Stunden**
Credits:	3 ECTS
Prerequisites according to examination regulations:	none
Recommendations:	Structure and properties of engineering materials
Learning outcomes:	At the end of the course the students are able to • Practical examples of functionalized Materials for Medical Devices, explain its specific characteristics, application areas, specific advantages and disadvantages
Summary indicative content:	• Definition of Terms "Functionalized Materials" • materials, finishes and manufacturing processes of medical products • Technology to the top and boundary area of medical technology products • Interactions of functionalized materials with endogenous media • Practical examples, such as vascular grafts, patches
Assessment:	The module is non-graded.
Teaching style:	L: charts T: Literature review and presentation on given topics
Indicative Bibliography/Sources:	William D. Callister und David G. Rethwisch: Materialwissenschaften und Werkstofftechnik, Wiley-VCH, Weinheim, 2013, ISBN: 978-3-527-33007-2 Hansgeorg Hofmann und Jürgen Spindler: Verfahren in der Beschichtungs- und Oberflächentechnik, Fachbuchverlag Leipzig im Carl Hanser Verlag, München, Wien, 2010, ISBN: 978-3- 446-42378-7

Module:	**Applied Forensic Genetics**
Semester:	5th semester
Course leader:	Dr Steven Rand
Lecturer:	Dr Steven Rand
Language:	English
Assignment to curriculum:	**Elective course in the 5th semester of Forensic Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 3 lesson hours per week
Student workload:	Contact hours Private study Lecture: 45 45 Total: 45 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Successful participation in Module Forensic Biology
Learning outcomes:	<u>Lectures and exercises:</u> At the end of the lecture, the students will: • understand the basics of forensic DNA testing • understand the statistical analysis and interpretation of forensic results • be familiar with crime scene investigations • be familiar with crime scene reconstruction • be familair with national databses • have an overview on current developments in forensic biology • understand the role of independent forensic consultants
Summary indicative content:	<u>Lectures and tutorials:</u> • Bloodstain distribution and crime scene reconstruction • Forensic DNA testing – interpretation of results • National databases – rationale and effectiveness • The role of independent forensic consultants • Development and history of forensic science • Forensic DNA testing – technologies nuclear DNA • Forensic DNA testing – technologies mitochondrial DNA • Forensic DNA testing – technologies X and Y DNA systems • Recent developments and trends • Statistical analyses in forensic science • Case studies on all aspects • Scene of crime investigations • Adversary versus inquisitorial legal systems • Seminars on topics of (current) interest • Other aspects of forensic biology

Assessment:	Modular examination – ungraded
Teaching style:	Blackboard, computer projector, overhead, written compilation of exercises, current scientific publications
Indicative bibliography/Sources:	Current scientific publications (available via library H-BRS online data bases, e.g. SciFinder) John M. Butler: Fundamentals of Forensic DNA Typing (Elsevier)

Module:	**Troubleshooting in analytical chemistry**
Semester:	5rd semester
Course leader:	PD Dr. Michaela Schmitz
Lecturer:	PD Dr. Michaela Schmitz
Language:	English
Assignment to curriculum:	**Compulsory optional course in the 5rd semester of Forensic Sciences, Chemistry with Material Sciences**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 0.5 lesson hour per week Laboratory course: 2.5 lesson hours per week; max. group size: 20
Student workload:	Contact hours Private study Lecture: 7.5 15 Lab work: 37.5 30 Total : 45 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	Fundamentals in instrumental analytics
Learning outcomes:	Lecture: At the end of the lecture, the students will: • be familiar with the single parts of analytical instruments and with the assembly of them, • be able to solve analytical problems in photometry, DC, GC, HPLC, • be able to adapt sample preparation to each single analytical method. • be able to install a device (e.g. GC) for the measurement of special compounds Laboratory course: The students will: • be able to deepen the knowledge of the lecture by examples in analytics, • be able to install single parts of an analytical device (e.g. column or liner), • be able to find and solve analytical problems in a practical application, • be able to adapt the measuring device for different applications.
Summary indicative content:	Lecture: Photometry, buildup, troubleshooting, methods of optimization, enzymatical/immunological measurement process, microplates; chromatography: DC, GC, HPLC -buildup-, optimization/columns/ detectors/gradients; troubleshooting: how to approach problems in a sytematic manner?

	Practical course: • troubleshooting at different measuring devices • buildup and modification of the devices for special analytical methods • problems in photometry (enzymology and immunology) and troubleshooting • defects in chromatography (DC, GC, HPLC)-and troubleshooting • sample preparation-cause of mistakes
Assessment:	Modular examination – graded Laboratory work (oral examinations and lab reports): 50%; Written final examination: 50% Active participation in the laboratory course is a prerequisite for admission to the final examination. The final examination must be passed independently from the practical part.
Teaching style:	Lecture: Power Point presentation Laboratory course: Conduction of tasks concerning troubleshooting
Indicative bibliography/ Sources:	1) Meyer, V.: Praxis der Hochleistungs-Flüssigkeitschromato-graphie. Wiley-VCH. 2) Meyer, V.R.: Fallstricke und Fehlerquellen der HPLC in Bildern 3) The troubleshooting and maintenance guide for gas chromatography. Wiley VCH 4) Kromidas, St.: HPLC-richtig optimiert. Wiley-VCH. 5) Kromidas, St.: Practical Problem Solving in HPLC 6.) Kromidas, St.: More Practical Problem Solving in HPLC

Module:	**Sensory Evaluation Methods in Quality Control**
Semester:	3rd semester
Course leader:	PD Dr. Michaela Schmitz
Lecturer:	PD Dr. Michaela Schmitz
Language:	English
Assignment to curriculum:	**Compulsory optional course in the 5rd semester of Forensic Sciences, Chemistry with Material Sciences, Biology**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 1 lesson hour per week Laboratory course: 2 lesson hours per week; max. group size: 20
Student workload:	Contact hours Private study Lecture: 15 15 Lab work: 30 30 Total : 45 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	none
Recommendations:	Fundamentals in quality control
Learning outcomes:	Lecture: At the end of the lecture, the students will: • be familiar with sensory perception of humans as a measuring too,l • be familiar with sensory profiles of foods, cosmetics and articles of daily use, • be able to integrate sensory evaluation methods in quality control, • be able to conduct basic sensory evaluation methods and are familiar with different capabilities of each sensory test for each quality control problem. Laboratory course: The students will: • be able to deepen the knowledge of the lecture by experimental methods, • be able to conduct sensory test methods with group of test persons in dependence on DIN standard, • be able to analyse real sensory problems in quality control, and can apply specific test methods for specific problems in quality control.
Summary indicative content:	Lecture: Human observers as good measuring instruments; sensory perception; optical, olfactory, gustatory, haptic and auditive sensory impressions; sensory profiles of foods, cosmetics and articles of daily use; special methods in sensory evaluation: Determination of threshold limit value; discrimination tests; descriptive analysis; hedonic tests; special

	techniques in sensory evaluation: determination of minimum durability, consumer tests and their operating requirements. Practical course: • Development of sensory tests for threshold limit values • Development of discrimination tests • Realization of descriptive tests • Development of hedonic tests
Assessment:	Modular examination – graded Laboratory work (oral examinations and lab reports): 30%; Written final examination: 70% Active participation in the laboratory course is a prerequisite for admission to the final examination. The final examination must be passed independently from the practical part.
Teaching style:	Lecture: Power Point presentation Laboratory course: Description of sensory tests in a power point presentation, realization of the standardized tests (DIN) with test person groups
Indicative bibliography/ Sources:	Lawless, H.T. and Heymann, H. 1998: Sensory evaluation of Food: Principles and Practices. New York: Chapman & Hall. Ney, K.H. 1987: Lebensmittelaromen. Springer Verlag. Frede, W. 2009: Handbuch für Lebensmittelchemiker. Kessler, W. 2007: Multivariate Datenanalyse. Wiley-CH-Verlag. DIN-Normen: DIN 10950-DIN 10970.

Module :	**Cost Accounting**
Semester:	5th semester
Course leader:	MSc, Dipl.-Kauffrau (FH) Simone Fritzen,
Lecturer:	MSc, Dipl.-Kauffrau (FH) Simone Fritzen,
Language:	German
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of lectures, tutorials (exercises) and group work. Lecture: 2 lesson hours per week Tutorial: 1 lesson hour per week, max. group size: max. 30
Student workload:	Contact hours / Private study Lecture: 30 / 25 Tutorial: 15 / 20 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will: • know the tasks and purpose of Cost Accounting, • be able to explain how the Annual Balance Sheet and the Annual Accounts are drawn up and structured, • be able to enter and book basic business transactions, • know the fundamentals of cost and performance accounting as well as special terms relating to costs, • be able to calculate and interpret selected employment levels of machine utilisation, • be able to structure costs according to various criteria, • be able to assign these costs to their cost centres, • be able to apply selected calculation methods, • be able to perform direct costing and process cost calculations. Tutorial: At the end of the tutorial, the students will: • be able to book business transactions and to draw up the Annual Accounts, • be able to calculate and interpret employment levels of machine utilisation • be able to perform a single-level and multi-level division calculation, • be able to apply the methods of direct costing and process cost

	calculation.
Inhalt:	• Tasks and fundamentals of Cost Accounting • Basics of adequate and orderly accounting • Balance Sheet: preparation and structure, valuation in accordance with the Commercial Code (Handelsgesetzbuch - HGB), Profit and Loss Account (Gewinn- und Verlustrechnung – GuV), preparation of the Annual Accounts • Accountancy • Structure and functions of cost and performance accounting, cost accounting systems, cost-type accounting, cost centre accounting (especially preparation of the Cost Distribution Sheet – Betriebsabrechnungsbogen, BAB) • Cost unit accounting
Assessment:	Modular examination - ungraded 3 tests (30%), written final examination (70%) Participation in all of the three tests is a prerequisite for admission to the written examination.
Teaching style:	Lecture: script, overhead, blackboard Tutorial: written compilation of exercises, overhead, blackboard
Indicative bibliography/Sources:	Haberstock, Kostenrechnung I; Heinhold, Kosten- und Erfolgsrechnung in Fallbeispielen Horngren et al., Kostenrechnung

Module:	**Imparting of Scientific Information**
Semester:	5th semester
Course leader:	Dr Klaus Lehmann
Lecturer:	Dr Klaus Lehmann
Language:	German
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS):	The course consists of: Lecture: 1.5 lesson hours per week Tutorial: 1.5 lesson hours per week
Student workload:	Contact hours / Private study Lecture: 22.5 / 30 Tutorial: 22.5 / 15 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits:	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	The students should be willing to reflect on their personal attitudes.
Learning outcomes:	At the end of the course, the students will: • be able to describe the epistemological status of scientific statements, • be able to reflect on the basic problems of integrating scientific information into society, • be able to describe the role played by scientific information from various points of view (e.g. discourse theory/communication psychology/epistemology, ethics of responsibility) • be able to name practical examples of imparting scientific information, to explain their respective special features and to comment on these, weighing the pros and cons (the laboratory as a place of communication, public relations in the chemical industry, scientific museums, findings of forensic medicine in expert reports, newspaper articles, films or others (including an excursion)
Summary indicative content:	• Epistemological fundamentals of experiments (objectivity, inter-subjectivity, falsification principle) • Differentiation between instrumental knowledge and orientation knowledge • Differentiation between true and successful statements • Introduction to the fundamentals of discourse theory, based on the example of the way we talk about "nature" and other examples • Introduction to the basics of the communication psychology of speech (multidimensionality of a message)

	• Introduction to reflections on a scientist's responsibility • Explanations based on examples relating to the degree programme (see above) • Exercises aimed at practising the oral presentation of thoughts and ideas
Assessment:	Modular examination – graded Oral examination (40 minutes - in pairs) Active participation is a prerequisite for participation in the final examination.
Teaching style:	Lecture: notes on the blackboard / transparencies Tutorial: written compilation of exercises/role plays/work in small groups, including presentation of the results/group feedback/excursion
Indicative bibliography/Sources:	A compilation of essays is yet to be compiled. (Authors: Weber, Popper, Böhme, Meyer-Abich, Ströker, Lenk, Schulz von Thun, Lakoff/Johnson, Foucault)

Module:	**Personnel Management**
Semester:	5th semester
Course leader:	MSc, Dipl.-Kauffrau (FH) Simone Fritzen,
Lecturer:	MSc, Dipl.-Kauf (FH) Simone Fritzen,
Language:	German
Assignment to curriculum:	**Elective course in the 5th semester of Chemistry with Material Science** **Elective course in the 5th semester of Forensic Sciences** **Elective course in the 5th semester of Applied Biology**
Course units/Lesson hours per week (SWS)	The course consists of lectures, tutorials (exercises) and group work. Lecture: 2 lesson hours per week Tutorial: 1 lesson hour per week, max. group size: 30
Student workload:	Contact hours / Private study Lecture: 30 / 25 Tutorial: 15 / 20 Total: 45 / 45 **Total (contact hours + private study): 90 hours**
Credits	3 ECTS
Prerequisites according to Examination Regulations:	None
Recommendations:	None
Learning outcomes:	Lecture: At the end of the lecture, the students will: • know the basic forms of organisation and will • be able to discuss their advantages and disadvantages. They will • be able to name methods of personnel requirement planning and acquisition and will • be able to explain the tasks and objectives of personnel development. They will also: • know measures of personnel development, • know about the importance of staff motivation, • be able to name various possibilities of staff motivation, • know various theories of leadership styles and will • be able to assess these theories. They will also • be able to name the steps in the leadership process as well as leadership tasks and will • have acquired basic skills in dealing with bullying and mediation. Exercises: • The students perform exercises in groups to learn how to deal with selected management tasks and typical conflicts in everyday business.
Summary indicative content:	• Line organisation, divisional organisation, matrix organisation • Personnel requirement planning: determination of the gross new personnel requirement, reserve requirements, net new personnel

	requirement • Tasks and objectives of personnel development • Motivation process, classification of motives, basic types of workers (the dependent worker, the economic man, the social man), theories of motivation (content theories, expectation valence theories, balance theories), methods of motivation in professional practice • Typologies of leadership styles (Blake and Mouton, 3D-Model by Reddin, Theory of Contingency by Fiedler) • Steps in the leadership process: setting objectives, planning, decision-making, implementation, supervision • Leadership tasks: management by objectives, delegation, giving instructions, problem-solving, information management, staff control, recognition and criticism, conflict management • Bullying and mediation
Assessment:	Modular examination – ungraded Written examination
Teaching style:	Lecture: script, overhead, blackboard Tutorial: written compilation of exercises, blackboard, group work
Indicative bibliography/ Sources:	Jung, Personalwirtschaft; Eisenführ, Einführung in die Betriebswirtschaftslehre; Olfert, Personalwirtschaft.