Appendix 1 Module descriptions

module no. Phy-Ba-EP-ExI+II	**module name** Experimental Physics I+II – Mechanics, Heat, Electromagnetism, Optics	**responsible lecturer** Prof. Dr. M. Kobel
contents and qualification aims	Students are able to understand basic physics processes and laws of mechanics, thermodynamics, electrodynamics and optics for idealised case studies, to describe them analytically and quantitatively and to interpret them graphically. Students are trained to apply this knowledge to a wide range of phenomena, in particular in the fields • mechanics (kinematics and dynamics of the mass point and of the rigid body; special relativity theory; mechanical properties of solids, liquids and gases; mechanical vibrations and waves) • thermodynamics (laws, cycles, thermal properties of solids, liquids and gases, changes of state and phase diagrams, heat conduction) • electrodynamics (electrostatics and magnetostatics; matter currents and fields; time-variable fields; electromagnetic vibrations and waves; Maxwell's equations; relativistic description) • optics (geometrical optics; reflection, refraction, lenses; optical instruments; photometry).	
types of teaching and learning	8 SWS lectures 4 SWS tutorials self-study	
prerequisites for participation	none	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the modules Phy-Ba-EP-ExIII, Phy-Ba-EP-AM, Phy-Ba-EP-FK and Phy-Ba-EP-TK.	
prerequisites for earning credits	Students earn credits after having passed the module exam. The module examination consists of two written exams that are 180 minutes each.	
credits and grades	Students can earn 12 credit points through the module. The module grade is calculated from the average of the grades earned in the written exams without a weighting factor.	
frequency of the module	The module is offered each winter semester.	
workload	The total workload is 360 hours.	
duration of the module	The module comprises 2 semesters.	

module no. Phy-Ba-EP-ExIII	**module name** Experimental Physics III – Waves and Quanta	**responsible lecturer** Prof. Dr. L. Eng
contents and qualification aims	Students are able to understand basic physics processes and laws of waves and quanta for idealised case studies, to describe them analytically and quantitatively and to interpret them graphically. Students are trained to apply this knowledge to a wide range of phenomena, in particular to such fields as: • physical optics with concepts of coherence, interference and diffraction, and also with applications such as angular resolution of optical instruments and interferometers, • photons, starting from their discovery in the photoelectric effect and Compton scattering and also applications such as photodiodes, solar energy and X-ray tubes, interaction between photons and matter, • mathematical description of waves and wave packets using Fourier series and integrals including Heisenberg uncertainty principle, • matter waves from de Broglie's hypothesis to the first evidence found by Thomson and Davisson/Germer, • Schrödinger's wave mechanics with simple applications to potential steps and barriers, quantum tunnelleing, bound states, zero-point energy and molecular vibrations.	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study	
prerequisites for participation	The competencies covered in module Phy-Ba-EP-ExI+II are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the modules Phy-Ba-EP-AM and Phy-Ba-EP-FK.	
prerequisites for earning credits	Students earn credits after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 6 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each winter semester.	
workload	The total workload is 180 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-EP-AM	**module name** Nuclear and Molecular Physics	**responsible lecturer** Prof. Dr. H. Klauß
contents and qualification aims	Students know the basic properties of atoms and molecules and are able to calculate them for simple applications. Students are trained to apply this knowledge to a wide range of phenomena, in particular to: • structure and properties of atoms, • coarse structure, fine structure, hyperfine structure, • interaction with magnetic and electric fields, • multi-electron atoms, • quantum mechanichal treatment of H_2^+ and H_2, • valence-bond and molecular-orbital model, • rotation and vibration of molecules, • spectroscopy.	
types of teaching and learning	4 SWS lecture 2 SWS tutorial self-study The language used in class is, at least partly, English.	
prerequisites for participation	The competencies covered in modules Phy-Ba-EP-ExI+II and Phy-Ba-EP-ExIII are prerequisite to this module.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students earn credits after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 6 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each summer semester.	
workload	The total workload is 180 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-EP-FK	**module name** Solid-State Physics	**responsible lecturer** Prof. Dr. C. Laubschat
contents and qualification aims	Students master the basic concepts, models, experimental methods and theoretical concepts for the description of condensed matter. They know the crucial phenomena that characterise the behaviour of condensed matter and gain insight into technological applications. Students are trained to apply this knowledge to a wide range of phenomena, in particular to: structure of crystalline and amorphous solids (types of bonding, structure, structure determination, defects), lattice dynamics (lattice vibrations, dispersion curves, state densities, anharmonic properties), conduction electrons (Fermi gas, band model, transport properties, behaviour in magnetic fields), semiconductors (intrinsic and doped semiconductors, simple components and heterostructures), magnetism (dia-, para- and ferromagnetism), dielectric and optical properties (local field, dielectric function, collective excitations), superconductivity (basic properties, Cooper pairs, macroscopic wave function).	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study The language used in class is, at least partly, English.	
prerequisites for participation	The competencies covered in modules Phy-Ba-EP-ExI+II, Phy-Ba-EP-ExIII and Phy-Ba-TP-QI are prerequisite to this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the module Phy-Ba-Vert.	
prerequisites for earning credits	Students can earn credit points after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 6 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each winter semester.	
workload	The total workload is 180 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-EP-TK	**module name** Particle and Nuclear Physics	**responsible lecturer** Prof. Dr. M. Kobel
contents and qualification aims	Students are able to trace back the questions of origin and structure of the matter surrounding us to the question of fundamental particles and their interactions. They know the methods and detection devices of experimental research in particle and nuclear physics. On the basis of symmetry principles and Lagrangian densities they are able to fathom the fundamental vertices of all interactions that are relevant for elementary particles and to discuss the phenomenology of the standard model using Feynman diagrams. They understand that the great similarities in the description of all interactions refer to a common basic principle and lead them to ask questions of cosmological relevance. They are familiar with the setup and interpretation of the essential experiments that are conducted to discover or examine the characteristic properties of the interactions and the elementary particles. They are able to describe the properties of nuclei based on the physics of their constituents. In particular they understand the various models for the description of nucleon binding in nuclei and the resulting consequences for stability and decays of nuclei, and also how energy is released in nuclear transformations.	
types of teaching and learning	4 SWS lecture 2 SWS tutorial self-study The language used in class is, at least partly, English.	
prerequisites for participation	The knowledge of quantum theory covered in module Phy-Ba-TP-QI and also the knowledge of special relativity theory and its covariant formulation covered in modules Phy-Ba-EP-ExI+II, Phy-Ba- TP-RTM and Phy-Ba-TP-ED is essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the module Phy-Ba-Vert.	
prerequisites for earning credits	Students can earn credit points after having passed the module exam. The module examination consists of a first written exam with a total of of 90 minutes and a second written exam with a total of 135 minutes.	
credits and grades	This module carries 6 credit points. The module grade is calculated from the weighted average grade awarded for the two exams. A weighting factor of one is applied to the first written exam, while the factor for the second written exam is three.	
frequency of the module	The module is offered each winter semester.	
workload	The total workload is 180 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-TP-RTM	**module name** Mathematical Methods for Physicists and Theoretical Mechanics	**responsible lecturer** Prof. Dr. R. Ketzmerick
contents and qualification aims	Students get insight into systematic thinking and the formal description of physical theories. They are introduced to the basic computational methods used in physics and understand how theoretical physics analytically deals with problems of mechanics. Students are trained to apply this knowledge to a wide range of phenomena, in particular to: <u>Mathematical Methods for Physicists</u> Vector Algebra differentiation, integration, functions of several variables, Taylor's development, complex numbers, vector analysis: coordinate transformations, nabla operator, integral theorems, ordinary differential equations, method of Green's functions, <u>Theoretical Mechanics</u> kinematics of the mass points, Newton's equation of motion, conservation laws, central force problem, two-body and n-body problem, nonlinear dynamics, Galilean transformation and Lorentz transformation, special relativity theory, covariant formulation, equivalent formulations of theoretical mechanics (Lagrange I+II, Hamilton, Poisson bracket), symmetry, rigid body, top.	
types of teaching and learning	6 SWS lectures 4 SWS tutorials self-study	
prerequisites for participation	none	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the modules Phy-Ba-TP-ED, Phy-Ba-EP-TK and Phy-Ba-TP-QI.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a first written exam with a total of 120 minutes (Mathematical Methods) and a second written exam with a total of 180 minutes (Theoretical Mechanics).	
credits and grades	This module carries 11 credits. The module grade is calculated from the weighted average grade awarded for the exams. A weighting factor of two is applied to the first written exam, while the factor for the second written exam is three.	

frequency of the module	The module is offered each winter semester.
workload	The total workload is 330 hours.
duration of the module	The module comprises 2 semesters.

module no. Phy-Ba-TP-ED	**module name** Theoretical Electrodynamics	**responsible lecturer** Prof. Dr. R. Ketzmerick
contents and qualification aims	Students are trained to understand the physical processes and interrelations using Maxwell's equations, to describe them analytically and quantitatively and to interpret them graphically. Students are enabled to apply their knowledge to a wide range of fields: • basic equations of electrodynamics, • electrostatics, magnetostatics, • electromagnetic waves, • fields of time-dependent charge and current distributions, • covariant formulation, • electromagnetic fields in media.	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study	
prerequisites for participation	The competencies covered in module Phy-Ba-TP-RTM are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the modules Phy-Ba-TP-QI and Phy-Ba-EP-TK.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each winter semester.	
workload	The total workload is 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-TP-Qi	**module name** Quantum Theory I - Basic Concepts	**responsible lecturer** Prof. Dr. R. Ketzmerick
contents and qualification aims	Students are trained to derive basic quantum effects from the postulates of quantum theory, to describe them analytically and quantitatively and to interpret them graphically. Students are enabled to apply their knowledge to a wide range of fields: • quantum mechanical state, quantum mechanical operators, measurements of observables, Hilbert space, • Schrödinger equation, time development, stationary solutions, one-dimensional problems, harmonic oscillator, • angular momentum operators, hydrogen atom, spin • measurement process in quantum theory, • approximation methods (time independent and time dependent perturbation calculation, variation procedures, WKB).	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study The language used in class is, at least partly, English.	
prerequisites for participation	The competencies covered in modules Phy-Ba-TP-RTM and Phy-Ba-TP-ED are prerequisite to this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the modules Phy-Ba-EP-FK, Phy-Ba-EP-TK, Phy-Ba-TP-TS and Phy-Ba-TP-QII.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each summer semester.	
workload	The total workload is 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-TP-TS	**module name** Theoretical Thermodynamics and Statistical Physics	**responsible lecturer** Prof. Dr. R. Ketzmerick
contents and qualification aims	Students are trained to quantitatively describe the thermodynamic properties of classical and quantum mechanical many-particle systems relying on the basic concepts of statistical physics. Students are enabled to apply their knowledge to a wide range of fields: • fundamentals of statistical physics, • mikroscopic description of many-particle systems, • the fundamental laws of thermodynamics, thermodynamic potentials, • ideal quantum gases, Bose and Fermi statistics.	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study The language used in class is, at least partly, English.	
prerequisites for participation	The competencies covered in module Phy-Ba-TP-QI are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the module Phy-Ba-Vert.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each winter semester.	
workload	The total workload is 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-TP-QII	**module name** Quantum Theory II - Advanced Concepts	**responsible lecturer** Prof. Dr. R. Ketzmerick
contents and qualification aims	Students are enabled to apply advanced concepts of quantum theory to a wide range of fields: • identical particles (2nd quantisation), • relativistic quantum theory, • scattering theory.	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study The language used in class is, at least partly, English.	
prerequisites for participation	The competencies covered in module Phy-Ba-TP-QI are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of a written exam of 180 minutes duration.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each summer semester.	
workload	The total workload is 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-MA-LA	**module name** Linear Algebra	**responsible lecturer** director of the Institute of Algebra
contents and qualification aims	Students understand the fundamentals of linear algebra, such as complex numbers, matrices, linear equation systems, linear images in finite-dimensional vector spaces, eigenvalue theory and principal axis transformation and they acquire skills and abilities to use their knowledge to solve mathematical problems, in particular physics-related problems.	
types of teaching and learning	4 SWS lectures 2 SWS tutorials self-study	
prerequisites for participation	none	
usability	The module is a required module in the Bachelor's programme Physics	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of a written exam of 90 minutes. The exam prerequisite is a collection of tasks students work on during the module; the student has successfully passed the exam when s/he earned half of the total of credits.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each summer semester.	
workload	The workload is a total of 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-MA-AnaGrund	**module name** Fundamentals of Analysis	**responsible lecturer** Director of the Institute of Analysis
contents and qualification aims	Students understand the systematics and structure (based on clear definitions and exact evicdence) of analysis. They acquire the skills and abilities to solve mathematical tasks regarding differential and integral calculus of functions with several variables and they are able to apply their knowledge to physics-related problems.	
types of teaching and learning	8 SWS lectures 4 SWS tutorials self-study	
prerequisites for participation	none	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the module Phy-Ba-MA-AnaFort.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of a written exam of 150 minutes. Pre-exam achievements are a written pretest of 90 minutes and also a collection of tasks students work on during the module. The student has successfully passed this exam when s/he earned half of the total of credits.	
credits and grades	Students can earn 14 credits through the module. The module grade is equivalent to the grade given for the written exam.	
frequency of the module	The module is offered each summer semester.	
workload	The workload is a total of 420 hours.	
duration of the module	The module comprises 2 semester.	

module no. {Phy-Ba-MA-AnaFort|	**module name** Advanced Analysis for Physicists	**responsible lecturer** Director of the Institute of Analysis
contents and qualification aims	The goal of this module is to provide students with the mathematical fundamentals required for theoretical physics, in particular for electrodynamics and quantum physics. Students learn the skills of dealing with complex mathematical structures and how to use them to solve physics tasks. They have basic skills for independently working on the issues taught and have advanced analytical skills and a sound understanding of mathematical correlations in the topics listed below: • ordinary differential equations, • partial differential equations including weak solutions and variation methods, • introduction to the theory of distributions with applications to partial differential equations, • functional analysis including Hilbert space operators and spectral theory, • complex analysis (theory of functions of a complex variable), • integration on manifolds and vector analysis.	
types of teaching and learning	8 SWS lectures 4 SWS tutorials self-study	
prerequisites for participation	The competencies covered in module Phy-Ba-MA-AnaGrund are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module exam consists of an oral exam of 30 minutes.	
credits and grades	Students can earn 14 credits through the module. The module grade is equivalent to the grade given for the exam.	
frequency of the module	The module is offered each summer semester.	
workload	The workload is a total of 420 hours.	
duration of the module	The module comprises 2 semester.	

module no. {Phy-Ba-P-EinfProg|	**module name** Introductory Lab Course and Programming	**responsible lecturer** Prof. Dr. A. Straessner
contents and qualification aims	The goal of this module is to provide students with basic experimental skills, with the ability to use important measuring instruments and techniques and to handle measurement uncertainties and calculate errors. Students know one programming language, are able to numerically solve basic tasks (differentiation, integrate, zero determination, statistical data analysis, parameter estimation) and to create simple graphs. They are able to use a computer algebra system.	
types of teaching and learning	3 SWS lecture 1 SWS lab course 2 SWS tutorials self-study	
prerequisites for participation	none	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the modules Phy-Ba-P-GrundI+II, Phy-Ba-P-GrundIII and Phy-Ba-CP.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a lab report. Another prerequisite for passing the exam is the attested creation of a source code portfolio.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the lab report.	
frequency of the module	The module is offered each winter semester.	
workload	The workload is a total of 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. {Phy-Ba-P-GrundI+II|	module name Basic Lab Course I+II - Mechanics, Heat, Electromagnetism, Optics	responsible lecturer Prof. Dr. H.-H. Klauß
contents and qualification aims	Students have a deep and extended basic understanding of experimental physics. They have basic experimental skills in mechanics, thermodynamics, electrodynamics and optics and have a first experience in independent laboratory work.	
types of teaching and learning	10 SWS lab course self-study	
prerequisites for participation	The competencies covered in module Phy-Ba-P-EinfProg are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics. It is a prerequisite for the module Phy-Ba-P-Fort.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a lab report.	
credits and grades	Students can earn 8 credits through the module. The module grade is equivalent to the grade given for the lab report.	
frequency of the module	The module is offered each summer semester.	
workload	The workload is 240 hours.	
duration of the module	The module comprises 2 semester.	

module no. Phy-Ba-P-GrundIII	**module name** Basic Lab Course III - The Structure of Matter	**responsible lecturer** Prof. Dr. H.-H. Klauß
contents and qualification aims	Students have solid basic experimental skills to study the structure of matter and have in-depth experience working in a lab independently. They know advanced statistical evaluation methods. They know how to document and explain experimental procedures, measurement results and evaluation of measured data in academic English.	
types of teaching and learning	6 SWS lab course self-study The language of instruction is, at least in part, English.	
prerequisites for participation	The competencies covered in module Phy-Ba-P-EinfProg and English language requirements at *Abitur* level are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The exam consists of a lab report parts of which are written in English.	
credits and grades	Students can earn 7 credit points through the module. The module grade is equivalent to the grade given for the lab report.	
frequency of the module	The module is offered each summer semester.	
workload	The workload is a total of 210 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-P-Fort	**module name** Advanced Lab Course	**responsible lecturer** Prof. Dr. H.-H. Klauß
contents and qualification aims	Students are taught to use complex measuring systems to conduct modern experiments in all experimental areas of research the Subject Area Physics durchzuführen, and Modern Era Auswertemethoden anzuwenden. They are able to present and critically discuss experimental procedures, measurement results and evaluations of measured data in academic English.	
types of teaching and learning	8 SWS lab course self-study The language of instruction is, at least in part, English.	
prerequisites for participation	The competencies covered in module Phy-Ba-P-GrundI+II and English language requirements at *Abitur* level are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a lab report that is partially written in English and an ungraded oral presentation.	
credits and grades	Students can earn 10 credits through the module. Pursuant to § 10 par. 1 sentence 5 PO the module grade is calculated from the grade given for the lab report or as the arithmetic means of the grade given for the lab report weighted with factor 4 and the grade given for the oral presentation weigthed with factor 1.	
frequency of the module	The module is offered each winter semester.	
workload	The workload is a total of 300 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-CP	**module name** Computational Physics	**responsible lecturer** Prof. Dr. R. {Ketzmerick|
contents and qualification aims	Students are trained to solve and visualise physics tasks in the fields mechanics, electrodynamics, quantum mechanics and statistical physics using numerical methods. Students know which numerical methods to choose and how to critically assess the results. They are able to, your knowledge auf the breite Spektrum Implications Gebieten anzuwenden: • solution of ordinary differential equations, • setting up and solution of eigenvalue problems, • dynamics of wave packets, • Fourier transform, • random numbers, • stochastic processes, • Monte Carlo methods.	
types of teaching and learning	2 SWS lectures 2 SWS tutorials self-study The language of instruction is, at least in part, English.	
prerequisites for participation	The competencies covered in module Phy-Ba-P-EinfProg and English language requirements at *Abitur* level are essential for this module.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a collection of programs.	
credits and grades	Students can earn 5 credit points through the module. The module grade is equivalent to the grade given for the collection of programs.	
frequency of the module	The module is offered each summer semester.	
workload	The workload is a total of 150 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-AQ	**module name** General Qualifications	**responsible lecturer** Prof. Dr. W. Skrotzki
contents and qualification aims	Students have key qualifications in the areas communication skills, in particular foreign languages, interdisciplinarity, project and time management, ability to cooperate and work in a team environment. Students know how to give presentations in English on a physics topic, experimental physics or theoretical physics and critically discuss them with others. They have extended knowledge of one topic of general academic education. Moreover, they have in-depth knowledge or advanced skills in one or more areas of interest (languages, soft skills, committee work, special physics fields, science communication, physical education). Students gratuitously practice science communication by spreading scholarly content to the public, e.g. they support events such as 'Physics on Saturdays', Dresden Researchers' Night etc.	
types of teaching and learning	2 SWS seminar 2 SWS lecture 4 SWS practical further qualification measures self-study The language of instruction is, at least in part, English. Students choose the classes to the indicated extent from the programme catalogue General Qualifications. The catalogue is made public through the usual information channels of the department at the beginning of each semester including the required exams and assessments.	
prerequisites for participation	English language proficiency at Abitur level is prerequisite.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of the assessments announced in the catalogue General Qualifications. Parts of the examination are held in English.	
credits and grades	Students can earn 8 credits through the module. The module is assessed as pass or fail.	
frequency of the module	The module is offered in each semester.	
workload	The workload is a total of 240 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-Vert	**module name** Specialisation Physics	**responsible lecturer** Prof. Dr. M. Kobel
contents and qualification aims	In this module students elect one of six possible physics fields: - applied solid-state physics and photonics, - electronic properties of solids, - soft condensed matter and biological physics, - the structure of condensed matter, - particle and nuclear physics, - theoretical physics. Students have a deep insight into specific research topics of physics. They are able to understand and conduct in-depth work on problems of modern physics.	
types of teaching and learning	Depending on the area of specialisation chosen, the module comprises 4 SWS lectures or 3 SWS lectures and 1 SWS tutorials and also self-study. The language of instruction is, at least in part, English. According to the specialisation area elected, students choose the required elective courses to the stated extent from the catalogue Advanced Physics Course for the Subject Area Physics; the catalogue is made public through the usual information channels of the department at the beginning of the semester including the required language of instruction.	
prerequisites for participation	Depending on the area of specialisation chosen, knowledge of theoretical or experimental physics is prerequisite, analogously as it is obtained for theoretical physics in the module Phy-Ba-TP-TS, for particle and nuclear physics in the module Phy-Ba-EP-TK and for all other areas of specialisation in the module Phy-Ba-EP-FK. Moreover, English language proficiency at Abitur level is prerequisite.	
usability	The module is a required module in the Bachelor's programme Physics.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a problem solution essay in English.	
credits and grades	Students can earn 5 credit points through the module. The module is assessed as pass or fail.	
frequency of the module	The module is offered in each semester.	
workload	The workload is a total of 150 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-NPW-CH	**module name** non-physics required elective module Chemistry	**responsible lecturer** Prof. Dr. Th. Wolff
contents and qualification aims	Students know the fundamentals of chemistry and also the chemistry of the main-group and subgroup elements and their most important inorganic compounds. They are able to connect basic chemical issues and relationships with the corresponding experiments. Students know the elements and important inorganic materials and their chemical and physical properties. They are aware of the importance of occupational safety in the chemical laboratory, the proper handling and disposal of chemicals and environmental protection.	
types of teaching and learning	4 SWS lectures 1 SWS tutorials 3 SWS lab course self-study	
prerequisites for participation	none	
usability	This module is one of four required elective modules in the Bachelor's programme Physics of which students must choose one.	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a written exam with a total of 180 minutes and the lab report.	
credits and grades	Students can earn 8 credits through the module. The module grade is calculated from the weighted average of the two examination components. The written exam has a weighting factor of two, while the lab report has a weighting factor of one.	
frequency of the module	The module is offered each winter semester.	
workload	The workload is a total of 240 hours.	
duration of the module	The module comprises 1 semester.	
references for literature students work on during the module	E. Riedel, C. Janiak: Anorganische Chemie, 7. Aufl., Walter de Gruyter, Berlin, 2007; F. Holleman, E. Wiberg: Lehrbuch der Anorganischen Chemie, 102. Aufl., Walter de Gruyter, Berlin, 2007; G. Jander, J. Strähle: Lehrbuch der analytischen und präparativen anorganischen Chemie, 15th edition, Hirzel, 2002.	

module no. Phy-Ba-NPW-EL	**module name** non-physics required elective module Electronics	**responsible lecturer** Dr. J. Herricht
contents and qualification aims	Students know the fundamentals of electronics. They are familiar with the functions of electronic circuits and devices as the basis for independently working out device specifications and new developments and with numerical analysis. They are able to examine the typical properties of analog and digital integrated circuits and to perform measurements. They know how to set up and examine amplifier circuits and circuits for data acquisition and signal transmission using operational amplifiers and also simple and complex digital circuits relating to applications in physical metrology. They can apply these skills to: linear networks, simple circuit and resistor networks, capacitive, inductive and nonlinear two-poles, electric networks with harmonic excitation, semiconductor components, analog and digital circuits, circuit implementation, interfaces/measured value acquisition.	
types of teaching and learning	4 SWS lectures 2 SWS tutorials 1 SWS lab course self-study	
prerequisites for participation	A prerequisite for attending the lab course is a grade „sufficient“ (4.0) or better for the written exam.	
usability	This module is one of four required elective modules in the Bachelor’s programme Physics, of which students must choose	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a written exam with a total of 180 minutes and the lab report.	
credits and grades	Students can earn 8 credits through the module. The module grade is calculated from the weighted average of the two examination components. The written exam has a weighting factor of two, while the lab report has a weighting factor of one. In addition, the successful completion of the module requires a grade „sufficient“ (4.0) or better for the written exam.	
frequency of the module	The module is offered each winter semester.	
workload	The workload is a total of 240 hours.	
duration of the module	The module comprises 2 semester.	

module no. Phy-Ba-NPW-INF	**module name** non-physics required elective module Computer Science	**responsible lecturer** Prof. Dr. H. Vogler
contents and qualification aims	Students have basic knowledge of imperative programming (syntax diagrams, EBNF, functions, modules, data structures) and apply it to the formulation of algorithms for classical problems (sorting and searching methods, algorithms on trees and graphs). Students know various classes of algorithms (divide-and-conquer, dynamic programming, iterative versus recursive, backtracking) and they are able to analyse algorithms with respect to their runtime behaviour as a first step towards complexity analyses. Students have basic knowledge of issues of computer science and media informatics (selected practical tasks), practical skills in computer science and media informatics, experience in project and team work and skills in giving presentations.	
types of teaching and learning	2 SWS lectures 2 SWS tutorials 4 SWS lab course self-study	
prerequisites for participation	none	
usability	This module is one of four required elective modules in the Bachelor's programme Physics, of which students must choose	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of the following graded coursework: • written exam of 90 minutes duration, • lab report, • oral presentation.	
credits and grades	Students can earn 8 credits through the module. The module grade is calculated from the weighted average of the three examination components. The written exam has a weighting factor of three, the lab report of two and the oral presentation has a weighting factor of one.	
frequency of the module	The module is offered each winter semester.	
workload	The workload is a total of 240 hours.	
duration of the module	The module comprises 1 semester.	

module no. Phy-Ba-NPW-PH	**module name** non-physics required elective module Philosophy	**responsible lecturer** Prof. Dr. G. Schönrich
contents and qualification aims	The module provides an introduction to the subject Philosophy (students may choose between the Fundamentals of Logic or the Introduction to Theoretical Philosophy) and also in-depth introduction to the main currents in the Philosophy of the Natural Sciences and also the General Philosophy of Science and Epistemology (students may choose between the fields metaphysics, ontology, philosophy of the mind, philosophy of the natural sciences, general philosophy of science, epistemology, philosophy of technology, philosophy of nature and also ethics of science and technology). Students have the basic competencies regarding the content and the methods of the subject Philosophy. They have basic knowledge of logic and are familiar with the forms and problems of philosophical argumentation. They have in-depth knowledge to look at the natural sciences and technology and their interrelations and also from the angle of the philosophy of science, epistemology, culture, ecology and social studies.	
types of teaching and learning	The module comprises lectures, tutorials, seminars with a total of 8 SWS and also self-study. Students choose the classes to the indicated extent from the catalogue Minor Recommendation Physics of the Institute for Philosophy. The catalogue is made public through the usual information channels of the department at the beginning of each semester including the required exams and assessments.	
prerequisites for participation	none	
usability	This module is one of four required elective modules in the Bachelor's programme Physics, of which students must choose	
prerequisites for earning credits	Students can earn credits after having passed the module exam. The module examination consists of a written exam of 90 minutes duration and also of an oral exam.	
credits and grades	Students can earn 8 credits through the module. The module grade is calculated from the unweighted average of the examination components.	
frequency of the module	Depending on the introductory course in the subject Philosophy students have chosen, the module is offered each summer or winter semester.	
workload	The workload is a total of 240 hours.	
duration of the module	The module comprises 2 semester.	