Degree Program and Examination Regulations for the Master's Degree Program M.Sc. Physics within the Department of Physics at Freie Universität Berlin

Disclaimer: Please note that only the German version of this document is legally binding. This translation is intended for the convenience of the non-German-reading public and is for informational purposes only.

Preamble

On the basis of Section 14.1.1.2 of Freie Universität Berlin's supplemental rules and regulations *[Teilgrundordnung (Erprobungsmodell)]* from October 27, 1998, published in *FU-Mitteilungen* 24/1998 (the official bulletin of Freie Universität Berlin), the Department Council (*Fachbereichsrat*) of the Department of Physics at Freie Universität Berlin issued the following degree program and examination regulations for the master's degree program M.Sc. Physics within the Department of Physics on January 17, 2024.[1]

Table of Contents

Appendices:

1 The Executive Board of Freie Universität Berlin approved these regulations on April 8, 2024.

Section 1 Scope

These regulations define the objectives, content, and structure of the master's degree program M.Sc. Physics within the Department of Physics at Freie Universität Berlin. These regulations apply in conjunction with Freie Universität Berlin's framework regulations for degree programs and examinations (*Rahmenstudien- und -prüfungsordnung der Freien Universität Berlin*, RSPO) as they outline the requirements and processes necessary to complete coursework and assessments toward completion of a master's degree program.

Section 2 Learning Objectives

(1) Graduates of this degree program possess in-depth knowledge of the field, have a good command of scientific methods of physics, and are familiar with methods from related areas depending on their choice of topics. Graduates possess specialist knowledge in areas of modern experimental and theoretical physics. They can critically assess and select methods that are appropriate to specific tasks or problems and provide sound reasoning for their choice. They are up to date with the latest advances in a modern field of research within physics. Graduates are largely able to solve complex physics problems and interpret the results. They can use simulations and modeling based on fundamental principles of physics, discuss them in the context of current research developments, and present them orally and in writing. As a generalist in the field of science, they have the capacity for scientific thinking and critical appraisal as well as the ability to efficiently work through problems in different areas of science and technology. Students are acquainted with the foundations and basic general principles of academic work and good scientific practice and are able to apply them.

(2) Graduates possess basic skills in scientific research required to carry out scientific research, read and compose texts in English, and present their work. They have a modern understanding of gender and diversity and possess the skills required to work well in a team, communicate effectively, and transfer knowledge. They are able to competently participate in societal discourse on key sustainability issues and play a role in shaping future developments. They also have basic knowledge in project management and project planning in research. They are able to apply these skills to their own work, present their planning in writing, and provide sound reasoning for their choices as well as argue their point when faced with critical inquiries. Graduates are capable of conducting themselves responsibly and have communication and teamwork skills. Graduates of the French-German double master's degree program have additional intercultural, language, and management skills.

(3) Graduates of the master's degree program enjoy a wide array of career options, ranging from fundamental academic research and industrial research to application-oriented development and technical distribution to planning, examination, and management tasks in industry and administration as well as science communication and consulting in governmental and non-governmental organizations. Successful completion of the master's degree program qualifies students to commence a doctoral studies program (depending on the respective admission requirements), especially in areas related to the natural sciences and technology.

Section 3 Curriculum Contents

(1) The master's degree program provides students with in-depth and advanced knowledge in the field of physics and, depending on the student's choice, specialist knowledge in related disciplines. Advanced concepts, scientific research methods, and different ways of interpreting information form part of the curriculum for the master's degree program. During the one-year supervised research phase students carry out supervised academic work in a specialist field of physics, namely the

scientific focus areas covered by the Department of Physics, such as nanophysics and surface physics, biophysics, ultrafast physics, or the physics of complex quantum systems. During this phase, they also explore specific innovative issues, for example, in research laboratories or theoretical working groups. The master's degree program qualifies students to independently conduct research and application-oriented projects, design and carry out suitable experiments or theoretical calculations, categorize research outcomes within the context of a range of physical phenomena, and reach conclusions on this basis in order to contribute to technical developments and advancements in science. Under supervision, students learn to carry out independent research that integrates the basic general principles of scientific work and good scientific practice.

(2) Throughout the supervised research phase of the master's degree program students work on subject-specific and research-related issues independently as well as in international and intercultural groups. This allows students to develop interdisciplinary, linguistic, intercultural, and interpersonal skills, as well as an awareness for gender, diversity, and sustainability issues.

Section 4 General Academic Advising and Departmental Advising

(1) The Center for Academic Advising and Psychological Counseling at Freie Universität Berlin provides general academic advising for students.

(2) All instructors whose main employment is with the Department of Physics at Freie Universität Berlin are responsible for providing departmental advising throughout the degree program and supporting students through subject-specific, individual advising, especially regarding the structure and implementation of their studies and examinations, academic work, specialization options, and plans to participate in the double degree program. A student aid is also available to give additional advising support.

(3) It is highly recommended that students who have yet to complete at least one third of the required credit points upon reaching the mid-way point of the standard study period for this degree program arrange an appointment for departmental advising to ensure that they are adequately supported in successfully continuing their studies.

Section 5 Examination Board

The examination board is appointed by the Department Council of the Department of Physics, Freie Universität Berlin. The board is responsible for organizing examinations and the other tasks stipulated by the framework regulations for degree programs and examinations (RSPO).

Section 6 Standard Time to Degree

The standard time to degree is four semesters.

Section 7 Structure and Components; Distribution of Credit Points

(1) In order to complete the master's degree program, students must earn a total of 120 credit points, consisting of modules totaling 90 credit points and a master's thesis with a corresponding colloquium totaling 30 credit points. The master's degree program comprises a study phase totaling 60 credit points and a supervised research phase totaling 60 credit points.

(2) Students complete the following in the study phase:

1. Required modules: The following required modules must be completed for a total of 15

credit points:
- Module: Advanced Laboratory Course (10 credit points), and
- Module: Selected Topics: Scientific Presentations (5 credit points).

2. Required Elective: Two of the following required elective modules each worth 10 credit points must be completed for a total of 20 credit points. Students must select at least one of the following modules from the field of theoretical physics:

a. Theoretical physics:
- Module: Advanced Quantum Mechanics (10 credit points),
- Module: Statistical Physics and Thermodynamics (10 credit points),
- Module: Advanced Statistical Physics (10 credit points),
- Module: Quantum Field Theory and Many-Body Physics (10 credit points).

b. Experimental physics:
- Module: Advanced Solid State Physics (10 credit points),
- Module: Advanced Atomic and Molecular Physics (10 credit points),
- Module: Advanced Biophysics (10 credit points).

3. Elective modules: Students develop an individualized, subject-specific, interdisciplinary or general professional focus by selecting modules totaling 25 credit points either from those offered by the Department of Physics or other departments. The following modules are offered by the Department of Physics:

a. Research areas within the Department of Physics:
- Module: Theoretical Condensed Matter Physics (10 credit points),
- Module: Nanophysics (5 credit points),
- Module: Magnetism and Spin Electronics (5 credit points),
- Module: Surface Science (5 credit points),
- Module: Theory of Light-Matter Interaction (10 credit points),
- Module: Advanced Optics (10 credit points),
- Module: Ultrafast Spectroscopy and Nonlinear Optics (5 credit points),
- Module: Photobiophysics (5 credit points),
- Module: Special Topics in Molecular Biophysics (5 credit points),
- Module: Advanced Biospectroscopy (5 credit points),
- Module: Semiconductor Physics (5 credit points),
- Module: Advanced Astronomy and Astrophysics (12 credit points),
- Module: Quantum Information Theory (10 credit points),
- Module: Advanced Computational Physics (10 credit points),
- Module: Signal Analysis for Physicists (8 credit points),
- Module: Physics and Chemistry of Sustainability I – Renewable Energy (5 credit points),
- Module: Science Studies in Physics (5 credit points),
- Module: Science Studies Communication (5 credit points),
- Module: Modern Theoretical Physics A (5 credit points),
- Module: Modern Theoretical Physics B (8 credit points),
- Module: Modern Theoretical Physics C (10 credit points),
- Module: Modern Experimental Physics A (5 credit points),
- Module: Modern Experimental Physics B (8 credit points),
- Module: Modern Experimental Physics C (10 credit points),
- Module: Modern Physics: Scientific Presentation (5 credit points).

The aforementioned modules from the research areas within the Department of Physics are not offered every semester. However, at least seven of these modules will be offered per academic year.

b. Interdisciplinary area

Instead of the modules specified here under 3.a, students may also select modules from degree programs specializing in mathematics or the natural sciences at Freie Universität Berlin

that are offered at the Department of Mathematics and Computer Sciences, Department of Biology, Chemistry, Pharmacy, or the Department of Earth Sciences, provided that these departments allow admission to said modules. The examination board produces a list of suitable modules that can be selected without having to request additional permission to enroll as long as enough course places are available. Modules that do not fall into this category can be submitted to the examination board for approval and then selected and completed once said approval has been granted. The modules selected for this area may not be identical to modules that the student completed during their bachelor's degree program.

c. Professional orientation area
Furthermore, after prior consultation and approval by the examination board, students may also complete modules with graded coursework in subjects that are not directly related to mathematics or natural sciences, for example, in subjects such as business administration or philosophy, provided that these departments allow admission to said modules. In such cases the student is required to submit a request stating their reasons for selecting the module to the examination board. The request must include an explanation of how the module relates to the student's overall learning objectives. The relevant examination board is responsible for approving the request.

(3) During the supervised research phase students initially complete the modules "Scientific Specialization" (15 credit points) and "Methodology and Project Planning" (15 credit points) in parallel during the third semester of the master's degree program. Pending the examination board's approval, modules in the supervised research phase may also be completed externally at an appropriate institution, provided that an instructor who is authorized to administer exams for the master's degree program can vouch for the academic supervision. Students subsequently proceed to begin work on a master's thesis worth 30 credit points.

(4) The language of teaching and examination in the master's degree program is English. Pending the examination board's approval, written assessments, reports, examinations, and the master's thesis may also be written in German.

(5) The module descriptions in Appendix 1 provide information on the prerequisites, the contents and learning objectives, the modes of instruction, the workload, the different types of active participation, the various assessments that students must take during the program, information on participation requirements in the different modes of instruction, the standard duration, and how often courses are offered.

(6) Appendix 2.1 is a standard plan for completing the master's degree program.

Section 8 Double Master's Degree Program with the Institut Polytechnique de Paris

(1) Students within the master's degree program have the option of qualifying for the double degree program organized by the Department of Physics at Freie Universität Berlin together with the Institut Polytechnique de Paris, France, with a start date for the double degree program in the winter semester. A joint selection commission shall decide on which applicants will be admitted to the double degree program. Freie Universität Berlin and the Institut Polytechnique de Paris each nominate two members to this joint selection commission. The members nominated by Freie Universität Berlin must be authorized examiners for the master's degree program M.Sc. Physics. The application deadline is April 30 each year. The application phase for the double degree program is usually after the first semester of the master's degree program. Applicants may also submit a preliminary application for the double master's degree program when applying for the master's degree program. A joint selection commission shall decide on which applicants will be admitted

preliminarily to the double degree program. It may issue a preliminary confirmation that is contingent on admission to the master's degree program and specify the coursework to be completed in the first semester of the master's degree program. The relevant criteria will be communicated to the student by the examination board in good time and by suitable means.

(2) The double master's degree program consists of a study phase at Freie Universität Berlin and a supervised study period at Institut Polytechnique de Paris comprising 120 credit points, including a master's thesis with a corresponding colloquium totaling 30 credit points.

(3) During the study phase students complete all required modules pursuant to Section 7.2.1. The required elective module "Statistical Physics and Thermodynamics" (10 credit points) must be selected and completed pursuant to Section 7.2.2 provided that the student did not complete this or an equivalent module in their bachelor's degree program. Please also refer to Section 7.2.2 with regard to the selection and completion of required elective modules. Section 7.2.3 applies to the selection and completion of elective modules.

(4) During the supervised research phase students complete a program from the second year of the master's degree program (M2) at the Institut Polytechnique de Paris, including a master's thesis with a corresponding colloquium, over the course of which an interrelated supervised research phase lasting at least twelve months is completed. The M2 program "Materials Science and Nano-Objects," in which students complete required modules and other modules in this program amounting to 30 credit points, is recommended. Instead of the M2 program "Materials Science and Nano-Objects" students may also select other M2 programs in physics offered by the Institut Polytechnique de Paris.

(5) The module descriptions in Appendix 1 provide information on the prerequisites, the contents and learning objectives, the modes of instruction, the workload, the different types of active participation, the various assessments that students must take during the program, information on participation requirements in the different modes of instruction, the standard duration, and how often courses are offered. The regulations of the Institut Polytechnique de Paris shall apply to the coursework for the modules to be completed during the supervised study period.

(6) Appendix 2.2 is a standard curriculum plan for completing the double master's degree program.

Section 9 Modes of Instruction

(1) The following course types are offered within the master's degree program:

1. Lectures (V) impart to students an overview of an overarching subject area and its methodological/theoretical foundations, as well as knowledge regarding a specific topic and related research questions where applicable. They serve to provide wider context for the subject area and outline its theoretical foundations. The main mode of instruction is a presentation prepared by the respective instructor. Students are also provided with the opportunity for brief interactions and group exercises.

2. Practice sessions (Ü) impart knowledge on practical applications in a clearly defined subject area and the skills required to independently work on a task, present the results, and discuss the subject using critical thinking. The main mode of instruction is solving practice assignments. The instructor leads students in the various activities and evaluates them.

3. Seminars (S) convey knowledge on a clearly defined subject area and teach students the skills of independently researching a topic, presenting the results, and discussing the subject using critical thinking. The main modes of instruction and learning are seminar discussions conducted with the aid of course materials, specialist literature and sources, and group work.

4. Internal internships (P) allow students to independently work on relevant problems and potential

solutions by focusing on selected subjects and using suitable methods, thereby allowing them to acquire practical and analytical skills. Students gain experience in applying their acquired specialist knowledge and methods while under supervision and may test out their own suitability for specific professional fields. The focus of courses that may form part of the internship should focus on the content of internships while also addressing any potential questions and reflecting on experiences from the field.

5. Project modules (PM) aid students in acquiring practical decision-making skills. Over the course of a defined period of time students independently work on an internal or external project. The main mode of instruction is supervision in planning and conducting the project.

(2) The modes of instruction as outlined in Section 9.1 can be implemented through blended learning formats. Blended learning combines on-site education with digital, internet-based media (e-learning). In this context, certain educational activities can be offered through Freie Universität Berlin's central e-learning applications. Students can work on these activities individually or in groups. They can complete them on their own or with the guidance of an instructor. Blended learning can be used both as part of the active learning phase (discussing educational materials, sharing solutions to assignments, vigorous communication between instructors and students) and for follow-up activities (evaluating students' progress, applying and transferring knowledge).

Section 10 Master's Thesis

(1) The master's thesis is intended to demonstrate that a student has the ability to work independently on a research problem from the field of theoretical or experimental physics at an advanced academic level using scientific methods. They should be able to present their findings in a form that is appropriate to the topic and situate them within an academic context, as well as document their findings.

(2) Students will be admitted to work on a master's thesis by submitting a request, provided that they were most recently enrolled in a master's degree program at Freie Universität Berlin. The admission request for the master's thesis should be submitted to the examination board before the modules "Scientific Specialization" (15 credit points) and "Methodology and Project Planning" (15 credit points) are completed. The topic of the master's thesis should overlap with these modules in a logical and coherent manner.

(3) The relevant examination board is responsible for approving the application. The request must be accompanied by written confirmation from an instructor who is an authorized examiner that they are willing and able to act as supervisor for the master's thesis. If the request does not include confirmation from an instructor as described above, the examination board will appoint the student a supervisor. Students have the opportunity to propose topics for their thesis; however, there is no guarantee that their proposed topics will be approved. The function of supervision includes, for example, guiding students toward an understanding of and compliance with the rules of good scientific practice.

(4) The examination board assigns the topic of the master's thesis in coordination with the thesis supervisor, which will cohere with the modules selected during the supervised research phase. The topic and assignment must be designed in such a way as to ensure the work can be completed by the deadline.

(5) Students have six months to complete and submit the master's thesis once they have successfully completed the modules "Scientific Specialization" (15 credit points) and "Methodology and Project Planning" (15 credit points). The master's thesis should be sixty pages in length including footnotes and bibliography.

(6) The work period for the master's thesis begins with the date that the topic is assigned by the examination board. The assignment and compliance with the submission deadline must be documented and kept on file. The topic can be declined once within four weeks of being assigned, in which case it will be deemed not issued. Students must submit their master's thesis as an electronic copy in Portable Document Format (PDF) by the stipulated submission deadline. The PDF file must be machine-readable and digitized. Furthermore, it may not be subject to any rights restrictions. When the student submits their master's thesis, they must include a written statement confirming that they alone are responsible for the content of the thesis and that they only used the sources or references listed in the thesis. A copy of the master's thesis can be submitted to the institute library with the student's consent after they have completed their studies.

(7) The master's thesis is accompanied by a colloquium in which students hold one presentation approximately thirty minutes in length on the progress of their master's thesis.

(8) The master's thesis is to be assessed by two authorized examiners appointed by the examination board, one of whom must be the supervisor of the thesis. At least one of the qualified examiners should be a university lecturer at the Department of Physics at Freie Universität Berlin.

(9) Pending the examination board's approval, the master's thesis can be completed outside of the university at a company/business or at an external research institution, provided an examiner who fulfills the criteria specified in Section 10.8 can vouch for the academic supervision.

(10) The master's theses of students participating in the French-German double degree program with the Institut Polytechnique de Paris are to be assessed by one examiner from Freie Universität Berlin pursuant to Section 8 and one examiner from the Institut Polytechnique de Paris. It is possible to complete the master's thesis within cooperating research groups between the Institut Polytechnique and Freie Universität Berlin if the student chooses a suitable topic.

(11) The master's thesis is considered passed if the overall grade awarded is "sufficient" (4.0) or higher. In the case of a discrepancy of two or more between the two examiners' assigned grades, the master's thesis will be evaluated by a third authorized examiner. The master's thesis is considered passed if the average grade of these three evaluations is "sufficient" (4.0) or higher and at least two of these three evaluations is graded as "sufficient" at a minimum.

(12) A student's work on a master's thesis elsewhere can be recognized/transferred to Freie Universität Berlin. The recognition request should be submitted to the examination board. In order for the master's thesis to be recognized or accredited, the examination conditions and the assignment of the submitted work must not differ substantially in terms of quality, level, learning outcomes, scope, and profile when compared to the examination conditions and the assignment of a master's thesis completed in this master's program, which characterize the type of professional qualification this master's degree program in particular provides.

Section 11 Retaking Exams and Assessments

(1) If a student does not pass their master's thesis, they can attempt the assessment a second time. For all other exams and assessments in the program, they can retake them three times.

(2) In cases where the student receives a grade of "sufficient" (4.0) or higher in a written examination, they are permitted to retake said examination once to improve their grade. The retake must be completed before the end of the subsequent semester. Only the better of the two grades will count toward their final grade. Students cannot attempt to improve their grades by retaking an examination again.

Section 12 Study Abroad

(1) Students are encouraged to study abroad. While studying abroad, students should complete coursework that is transferable to the modules that they would otherwise be working on if they were at Freie Universität Berlin.

(2) Before starting a study abroad program, a learning agreement must be drawn up between the student, the head of the examination board, and the responsible point of contact at the host university. The agreement covers the length of the study abroad period, the coursework to be completed while studying abroad, which must equate to the coursework of the master's degree program, and the credit points allocated to the completed coursework. Coursework completed in accordance with this agreement will be recognized.

(3) The second semester in the program lends itself well to study abroad, and students are encouraged to study abroad then.

(4) Students in the master's degree program have the option of applying for the double master's degree program carried out in cooperation with the Institut Polytechnique de Paris pursuant to Section 8.

(5) The coordinator of the master's degree program is responsible for supporting students in planning and preparing for the study abroad period. They provide students with information on their financial options for covering their travel and accommodation costs.

Section 13 Degree Completion

(1) In order to graduate, students must complete the coursework and assessments outlined in Sections 7 and 10, or in the case of the double degree program, the coursework and assessments outlined in Sections 8 and 10.

(2) A student is not eligible for graduation if they have definitively failed some coursework or assessment or are involved in a pending examination procedure at another university in the same course of study or in a module that is identical or comparable to one of the modules to be completed in the master's degree program here and that will be taken into account when determining their overall grade.

(3) The application request for the award of a degree must be accompanied by documentation showing the student has completed the requirements mentioned in Section 12.1 as well as a guarantee that the applicant is not subject to any of the eligibility restrictions mentioned in Section 12.2. The relevant examination board is responsible for approving the application.

(4) The grades for assessments completed at the partner university within the double degree program pursuant to Section 8 will be communicated by the responsible body at the respective institution to the examination committee at Freie Universität Berlin in the form of an average grade and a grade for the master's thesis. The following conversion table applies:

Institut Polytechnique de Paris grading scale	Freie Universität Berlin grading scale
16, 17, 18, 19, 20	1.0
15	1.3
14	1.7
13	2.0
12.5	2.3

12	2.7
11.5	3.0
11	3.3
10.5	3.7
10	4.0
< 10	>4.0 (insufficient / fail)

The final grade is calculated as the arithmetical mean of the final grade of the coursework totaling 60 credit points completed at Freie Universität Berlin and the final grade of the coursework totaling 60 credit points completed at the Institut Polytechnique de Paris.

(5) Upon successful completion of the assessment, the student will receive a Master of Science (M.Sc.) university degree. Students receive a certificate of academic record and a degree certificate (Appendices 3 and 4) in addition to a diploma supplement (English and German versions). A degree certificate supplement with details of the individual modules and their components (transcript) is also prepared. Additional English versions of the academic record and degree certificate may be issued upon request.

(6) Having completed and passed their assessments within the double degree program, pursuant to Section 8, the student receives:

1. A certificate of academic record and degree certificate from the partner university Institut Polytechnique de Paris;
2. A certificate of academic record and degree certificate from Freie Universität Berlin (Appendices 5 and 6), and
3. A joint diploma supplement in English, German, and French. Please also refer to Section 5.

Section 14 Entry into Force and Interim Regulations

(1) These regulations enter into force on the day following their publication in *FU-Mitteilungen* (the official bulletin of Freie Universität Berlin).

(2) The degree program and examination regulations for the master's degree program from February 12, 2020 (*FU-Mitteilungen* 17/2020, p. 316), therefore lapse once the new regulations come into force.

(3) These regulations apply to students who are enrolled in the master's degree program at Freie Universität Berlin after the regulations enter into force. Students who were enrolled in the master's degree program at Freie Universität Berlin before the regulations' entry into force shall study and complete coursework on the basis of the degree program and examination regulations pursuant to Section 14.2, provided that they do not submit a request to the examination board to continue their degree program and complete coursework pursuant to the new regulations outlined here. Should this request be granted, the examination board shall decide on the extent to which modules that the student has already begun or completed at the point in time at which the request was submitted shall be recognized and to what extent they can be accredited under the requirements of the currently valid regulations, whereby the requirements of the right to confidentiality and equal treatment shall be taken into account. The decision concerning the student's entitlement to continue their degree program pursuant to the currently valid regulations will apply from the beginning of the teaching period of the following semester onward. It is not possible to revise this decision.

(4) Students are entitled to complete their degree on the basis of the degree program and examination regulations pursuant to Section 14.2 up until the 2027 summer semester.

Appendix 1: Module Descriptions

Explanatory notes:

These module descriptions address the following aspects for each module in the master's degree program, unless otherwise noted that another set of regulations applies:

- The name of the module
- The person responsible for the module (module coordinator)
- The prerequisites needed in order to take a particular module
- The module's content and learning objectives
- Modes of instruction used in the module
- The amount of work required by students to successfully complete a module
- Types of active participation
- Types of assessments
- Whether or not regular attendance is required
- Credits awarded for the module
- Standard duration of the module
- Frequency
- Applicability

The information provided on student workload takes the following factors into account:

- Active participation during class sessions
- Time needed to complete small assignments during class sessions
- Time spent attending class
- Students' preparations before class and follow-up work
- Work on study units in online learning sections
- Preparation time required specifically for assessments
- The time needed for the assessment itself

The amount of time indicated for independent study (including preparing for class, follow-up work, preparing for an exam) are only approximations meant to help students organize their time when planning their workload for modules. The information on the workload corresponds to the number of credit points assigned to the respective module, which serves as a unit of measurement for the amount of work required to successfully complete the module. One credit point equals 30 hours.

If regular attendance is required for the specific type of instruction, then regular attendance, along with active participation in the instruction and successful completion of assessments, is necessary in order to receive credit points for the specific module. Regular attendance means that a student has attended at least 85% of the instruction in the module. If regular attendance is not required in a module, students are still strongly encouraged to attend classes regularly. Instructors teaching courses in which regular attendance is merely encouraged cannot decide that attendance should be required.

To complete each module, the student must complete the module assessment for that module if the module has one. In order to complete a graded module, only one assessment (module assessment) must be completed. The module assessment is based on the module's learning objectives and serves as a way to test whether the objectives have been achieved. The scope of the assessment covers the components necessary to this end. For modules that include alternative assessment forms, the type of assessment for the respective semester must be determined by the responsible instructor before or on the first day of class. Active and regular participation in the instruction and successful completion of assessments are necessary in order to receive credit points for the specific module.

1. Required Modules

Module: Advanced Laboratory Course				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students have mastered more complex issues in physics. They are familiar with and can apply the more advanced experimental methods used in current physics research to solve these issues. They are able to master a new field of work in a short time from current specialist literature and to communicate it comprehensibly in presentations.				
Content: Literature review as introduction to a new field; close study of physics issues, modern experimental methods and measurement technologies; documentation of experimental process; critical evaluation and discussion of findings; written presentation of issues, evaluation and findings; presentation and explanation of experimental methods, their possibilities and limitations. Topic fields: solid state physics (magnetism, surface physics, superconductivity), atomic and molecular physics, nuclear physics, biophysics				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Internal lab project/internship	6	Carrying out and documenting lab experiments	Class attendance (internal lab project/internship) Preparation, before and after (internal lab project/internship)	90 150
Seminar	2	Presentation, participation in discussions	Class attendance (seminar) Preparation, before and after (seminar)	30 30
Module assessment		None		
Language		English (and German, where applicable)		
Regular attendance required		Yes		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Every semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Selected Topics: Scientific Presentations				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students have a deeper knowledge of a topic in physics and are able to prepare it for a scientific presentation and transfer their knowledge to others through a scientific lecture and chairing a scientific discussion. They are able to adapt a scientific presentation to suit the audience's level of knowledge. They are able to reflect on the literature and to answer critical questions in detail on the basis of their reading.				
Content: Guided by their lecturers, the students work on, present and discuss topics from a variety of fields relating to current issues and methods of modern physics on the basis of specialist literature.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Seminar	2	Presentation, participation in discussions	Class attendance (seminar) Preparation, before and after (seminar)	30 120
Module assessment		none		
Language		English (and German, where applicable)		
Regular attendance required		Yes		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Every semester		
Applicability		Master's degree program M.Sc. Physics		

2. Required Elective

Module: Advanced Quantum Mechanics
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics
Module coordinator: Module instructors
Prerequisites: None
Learning objectives: The students deepen their knowledge of quantum mechanics. They understand the concepts and methods of advanced quantum mechanics and can describe these verbally and in mathematical terms and apply them

confidently to fundamental issues in physics.				
Content: Advanced concepts of quantum mechanics are explored in depth in the module. The content includes a selection from the following topics: many-particle systems, second quantisation formalism, approximation methods, Bose and Fermi statistics, field quantisation, correlation functions, relativistic quantum theory and Dirac equations, scattering theory, current issues and methods of quantum theory (e.g. path integral formulation, quantum information).				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Statistical Physics and Thermodynamics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students are able to name and describe the principle concepts and theorems of statistical physics and thermodynamics. They are also capable of applying the methods they have learnt to existing problems and to solve them. The students have also advanced knowledge of calculation methods necessary for dealing with statistical physics and thermodynamics and are able to apply them.				
Content: Elementary statistics and the laws of large numbers, equilibrium ensembles, the principle of maximum entropy, main theorems of thermodynamics, thermodynamic potentials, thermodynamic processes, phase transition, ideal quantum gases, interactive systems				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Advanced Statistical Physics	
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics	
Module coordinator: Module instructors	

Prerequisites: None				
Learning objectives: The students have profound knowledge of the fundamental concepts and theorems of statistical physics. They can name, describe and apply them and apply the methods they have learnt to existing problems to solve them. The students have extended their knowledge of methods and calculation methods in the field of statistical physics and are now able to apply these to more complex issues. Using the methods they have learnt, they are also able to derive and analyse microscopic physical processes / laws at the macroscopic level.				
Content: A selection of the following advanced topics of statistical physics: non-equilibrium thermodynamics (entropy production, Onsager relations), linear response theory and fluctuation-dissipation theorem, stochastic processes (Markov processes, master equation, Langevin equation and Fokker-Planck equation), kinetic theory, phase transition (Landau theory, Gauss fluctuations, correlation functions, renorming groups), theory of liquids, hydrodynamics and elasticity, statistical quantum mechanics, exactly solvable models.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Quantum Field Theory and Many-Body Physics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students understand the concepts and methods of quantum field theory with the focus on many-body physics. They can reproduce these in terms of language, present them mathematically and apply them to issues of many-body physics.				
Content: Green's functions, diagrammatic perturbation theory and Feynman diagrams, non-perturbative methods, selected applications in condensed matter or relativistic field theory				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Advanced Solid State Physics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students have a detailed, critical understanding of specific areas of solid state physics and of the most up-to-date commonly used experimental methods. Students can apply their knowledge to concrete problems.				
Content: This module deepens the students' knowledge of fundamental concepts of solid state physics (describing the geometrical structure, electronic and vibronic conditions, elementary excitations, collective phenomena) on the basis of one or more relevant areas of solid state physics (semiconductor physics, physics of interfaces and nanostructures, photonics, superconductivity, magnetism, ferroelectricity).				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Advanced Atomic and Molecular Physics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students have a detailed and critical understanding of specific areas of atomic and molecular physics and of modern spectroscopic methods. They can apply their knowledge to concrete problems.				
Content: The module deepens the students' knowledge of the fundamental concepts of atomic and molecular physics (quantum mechanical description of atoms and molecules, the interaction of atoms and molecules with electromagnetic fields) on the basis of one or more relevant areas of atomic and molecular physics (e.g. single atoms and molecules in traps, spectroscopy of atomic clusters, biomolecules, single molecule experiments in the condensed phase).				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		

Applicability	Master's degree program M.Sc. Physics

Module: Advanced Biophysics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students have a detailed and critical understanding of specific areas of molecular biophysics and of modern spectroscopic methods. They can apply their knowledge to concrete issues.				
Content: In this module, a range of biophysical concepts and methods are introduced or covered in more detail. The module focuses particularly on the application of selected methods of spectroscopy and diffraction to biologically relevant systems such as proteins, nucleic acids and membranes. The experimental approaches discussed include a selection of the methods listed below: absorption spectroscopy in the visible range, UV and IR, fluorescence spectroscopy, time-resolved emission and absorption spectroscopy, spectroscopy with linearly and circularly polarized light, vibrational spectroscopy: Fourier transform infrared spectroscopy, resonance Raman spectroscopy; x-ray and neutron diffraction, magnetic resonance and x-ray spectroscopy.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 90
Practice session	4	Participation in practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	60 30 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Practice session: yes, Lecture: attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

3. Elective Modules: (*At least seven elective modules will be offered per academic year)

Module: Quantum Information Theory				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students understand basic concepts, methods and application of quantum information theory. They can reproduce them in terms of language as well as mathematically and apply them to problems of quantum communication, simulations and quantum computing.				
Content: Quantum systems promise new modes of information processing with applications particularly in quantum communication, quantum simulation and quantum computing. This course provides a comprehensive introduction to the research field of quantum information. It clarifies the conceptual foundations of quantum states and channels and identifies entanglement as an important resource. The second part of the course builds on these foundations and examines in some detail practical applications in secure communication, in the simulation of strongly correlated quantum systems and in quantum computing. The latter idea is given particular attention when discussing computational models, algorithms and methods of quantum error correction. Proximity to current research issues is maintained at all times.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60 30

Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Advanced Computational Physics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students are able to understand and develop algorithms for solving typical problems in statistical mechanics and quantum mechanics of many-body systems. They can implement these algorithms in a computer program and analyze the numerical results.				
Content: Numerical methods are necessary in all areas of physics in order to predict the properties of complex systems. The module introduces the most important algorithmic methods to describe classical and quantum mechanical many-body systems. These are: Particle-based methods, such as molecular dynamics simulations and stochastic simulations, lattice-based methods for solving hydrodynamic equations, Monte Carlo methods for spin systems, Fourier lattice methods, propagator methods and path integral methods for solving the time-dependent Schrödinger equation. Coarse-graining and machine-learning methods are also covered. Principal component analysis, cluster analysis and Markov state models are introduced for the evaluation of numerical calculations. Further applications discussed include optimal quantum control problems and encryption. In the lecture the applications are demonstrated with practical programme examples, in the practice sessions algorithms are implemented as programme codes.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Theoretical Condensed Matter Physics	
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics	
Module coordinator: Module instructors	
Prerequisites: None	

Learning objectives: The students learn theoretical approaches and concepts of condensed matter theory. They can present these in terms of language and mathematically and apply them to current problems in solid state physics.				
Content: Theoretical description of systems (liquids, quasi –and liquid crystals) with effective (Landau theory, hydrodynamic) and microscopic description (), phase transitions, low-dimensional and mesoscopic systems, correlated electron systems, condensed matter in nonequilibrium.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Theory of Light–Matter Interaction				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students understand the concepts and methods used to describe light-matter interactions. They are able to describe these in terms of language and mathematically and apply them to current problems in atomic and molecular physics, quantum optics and solid state physics.				
Content: Fundamental concepts of classical, theoretical optics and light-matter interactions are taught. These include the optical Bloch equations, the electric dipole approximation, the principle of minimal coupling and the principle of the rotating wave approximation. Elementary concepts of ultrafast spectroscopy and their applications are discussed. Concepts of non-linear spectroscopy (Feynman diagram for non-linear reactions, phase alignment, etc.) and quantum optics (Jaynes-Cummings model, quantum state of radiation, quantisation of the electromagnetic field) are taught.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Modern Theoretical Physics A				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The module enables the students to select the field they wish to concentrate on. Students master selected methods applied in current theoretical research and are able to apply them independently.				
Content: The module covers a selection of the following topics: group theory and symmetries in physics, density functional theory, path integral formulation, density matrix theory, quantum optics, field theory, equilibrium and nonequilibrium theory.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	 30 45
Practice session	1	Participation in class discussions	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	15 30 30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Modern Theoretical Physics B				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The module enables the students to select the field they wish to concentrate on. Students master selected methods applied in current theoretical research and are able to analyze concrete problems independently and to solve them using the methods they have learnt.				
Content: The module covers a selection of the following topics: group theory and symmetries in physics, density functional theory, path integral formulation, density matrix theory, quantum optics, field theory, equilibrium and nonequilibrium theory.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	 30 45
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 75 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		240 hours		8 credit points
Duration		One semester		

Frequency	Irregular*
Applicability	Master's degree program M.Sc. Physics

Module: Modern Theoretical Physics C				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The module enables the students to select the field they wish to concentrate on. Students master a wide range of methods applied in current theoretical research and are able to analyze concrete problems, to select appropriate methods to solve them and to apply these methods successfully.				
Content: The module covers a selection of the following topics: group theory and symmetries in physics, density functional theory, path integral formulation, density matrix theory, quantum optics, field theory, equilibrium and nonequilibrium theory.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Nanophysics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students are familiar with the current state of research and the future challenges in the modern, interdisciplinary research field of nanophysics. They are able to interpret and evaluate experimental and theoretical findings				
Content: The module uses examples to introduce the principles of nanophysical systems, important investigation methods and possible applications. The teaching unit may be oriented on particular nanosystems, groups of physics topics or investigation methods. Alongside textbooks, original literature is also used to discuss the current state of research.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 45
Practice session	1	Participation in class discussions	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	15 30 30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points

Duration	One semester
Frequency	Irregular*
Applicability	Master's degree program M.Sc. Physics

Module: Surface Science				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students are familiar with the current state of research and the current challenges in the research field of surface and interface physics. They are able to interpret and critically assess experimental and theoretical results.				
Content: The basics of surface and interface physics, important experimental methods and possible applications are demonstrated using examples. The course focuses on selected physical topics and investigation methods, including an understanding of the structure and electronic properties of surfaces and interfaces, as well as their investigation using diffraction methods and microscopic imaging techniques. Advanced topics may focus on molecules and self-organisation on surfaces, production and manipulation of nanostructures, magnetism of thin films and charge carrier dynamics at surfaces. In addition to textbooks, original literature is used to discuss the current state of research. Simple data will also be analyzed in the exercises.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 45
Practice session	1	Data analysis and discussion	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	15 30 30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Magnetism and Spin Electronics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students are familiar with current research issues in the field of magnetism and spin electronics as well as currently used methods and their possibilities. They are able to interpret and critically evaluate findings in relation to the current state of knowledge.				
Content: On the basis of selected examples, the module identifies the principles and applications, the current state of research and the possibilities and limitations of modern experimental methods in the field of research into magnetism. Topics covered may include: magnetic nanostructures, new magnetic materials, magneto-transport phenomena/spin electronics, magnetisation dynamics, magnetic coupling phenomena/magnetic interfaces, micromagnetism/magnetic domains, molecular magnetism.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 45
Practice session	1	Participation in class discussions	Class attendance (practice session) Preparation, before and after (practice session)	15 30 30

			Exam preparation and exam	
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Advanced Optics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students are able to analyze basic optical systems with the help of wave-optical tools.				
Content: The module provides an introduction to the fundamentals and applications of modern linear and non-linear wave optics. Important aspects include the optical wave equation (Helmholtz equation), light-matter interaction, light scattering, plane waves (reflection, refraction, polarization), plane-wave representation of light fields, diffraction effects, surface plasmons, Fourier optics, Gaussian beams, nonlinear optics and ultrafast spectroscopy. Students work on exercises analytically, numerically and also in the laboratory. In the exercises, these topics are deepened by working on practical problems analytically, numerically with the help of a software package (e.g. Python or Matlab) and also experimentally in the laboratory.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Preparation of numeric models and completion of practice assignments, documentation of results	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Practice session: yes, Lecture: attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Ultrafast Spectroscopy and Nonlinear Optics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students gain fundamental knowledge in the field of nonlinear optics and the dynamics of elementary optically induced processes. They have an overview of modern methods of ultrafast spectroscopy and nonlinear optics and how to apply them to particular problems.				
Content: Principles of the interaction of light and matter, wave packet dynamics, electron dynamics and elementary scattering processes, collective excitations in solids. Experimental methods of ultrafast spectroscopy and selected applications, e.g. femtochemistry, coherent control, photoelectron spectroscopy, attosecond physics, diffraction methods, structural dynamics.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture)	30
Practice session	1	Participation in class discussions	Preparation, before and after (lecture) Class attendance (practice	45 15 30

			session) Preparation, before and after (practice session) Exam preparation and exam	30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Photobiophysics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: On the basis of selected examples, students are familiar with current issues of biophysics research in the field of photobiophysics. They know the new methods and the possibilities they offer and are able to interpret and critically evaluate findings in relation to the current state of knowledge.				
Content: The conversion and utilization of light in biological systems is of fundamental importance for life on earth. Topics are: photophysical principles of light absorption, fluorescence emission and energy transfer, light-driven processes in co-factor protein complexes, selected methods of photobiophysics, time-resolved spectroscopy of biological systems, signal transduction, light-driven proton and electron transfer.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture)	
Practice session	1	Carrying out and documenting lab experiments with follow-up discussion *or* Participation in practice assignments	Preparation, before and after (lecture) Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 30 15 15 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Special Topics in Molecular Biophysics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students are familiar with current research issues in the field of molecular biophysics and with new methods and the possibilities they offer. They are able to interpret and critically evaluate findings in relation to the current state of knowledge.				
Content: On the basis of selected examples, the module identifies the principles and applications, the current state of research and the possibilities and limitations of modern concepts and methods in the field of molecular biophysics. Topics covered are oriented on the main current research directions in biophysics in the faculty and may include: advanced approaches in vibrational, x-ray or electron spin resonance spectroscopy into biomolecules; biomolecules on surfaces or in membranes; tracing the function of photoreceptors or biocatalysts at the atomic level.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture)	
Practice session	1	Participation in class discussions	Preparation, before and after (lecture) Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 45 15 30 30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		

Total workload	150 hours	5 credit points
Duration	One semester	
Frequency	Irregular*	
Applicability	Master's degree program M.Sc. Physics	

Module: Advanced Biospectroscopy				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students have a detailed, critical understanding of some areas of linear and multidimensional spectroscopy and aspects of their application. They are able to apply their knowledge to specific problems.				
Content: The module deepens the understanding of basic concepts of linear and multidimensional spectroscopic methods and their application to biologically relevant molecules and presents different methods for the characterisation of molecules. Examples are: Spectroscopy of spins, of electronic transitions and vibrational transitions, as well as the combination of methods. Application examples illustrate the variety of information that can be obtained about molecules.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture)	30
Practice session	1	Preparation of numeric models and completion of practice assignments, documentation of results	Preparation, before and after (lecture) Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 15 15 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Semiconductor Physics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students have a detailed, critical understanding of some areas of semiconductor physics and aspects of their application. They are able to apply their knowledge to concrete problems.				
Content: The module covers in depth the fundamental concepts of electronic states in semiconductors and their realization with inorganic or organic materials, of charge carriers transport in semiconductors and contact systems and of the influence of structural dimensions on the properties of semiconductors. Special aspects in the application of semiconductors and selected characterization methods for the properties of semiconductors and semiconductor interfaces are examined.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture)	30
Practice session	1	Participation in class discussions	Preparation, before and after (lecture) Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	45 15 30 30

Module assessment	Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)	
Language	English (and German, where applicable)	
Regular attendance required	attendance recommended	
Total workload	150 hours	5 credit points
Duration	One semester	
Frequency	Irregular*	
Applicability	Master's degree program M.Sc. Physics	

Module: Signal Analysis for Physicists

University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics

Module coordinator: Module instructors

Prerequisites: None

Learning objectives: Students are able to identify and analyze linear translation-invariant (LTI) systems. They use tools like convolution, Fourier and Laplace transforms analytically and numerically. The students are familiar with applications like signal deconvolution, the efficient solving of LTI differential equations, feedback, modulation, reconstruction of sampled signals and correlation functions.

Content: The lecture introduces basic knowledge of signal and system analysis, which is relevant for all scientific disciplines quantitatively measuring and analyzing signals. The module covers the following topics using illustrative examples from fields such as optics, acoustics and electronics: signals and systems, linear translation-invariant (LTI) systems and convolution operations, Fourier and Laplace transforms, signal deconvolution, solving LTI differential equations, systems with feedback, signal modulation, signal sampling and reconstruction, correlation functions and multidimensional signals. In the practice sessions, these topics are deepend by working on practical problems analytically and numerically, using the Python software package.

Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture)	30
			Preparation, before and after (lecture)	45
Practice session	2	Preparation of numeric models and completion of practice assignments, documentation of results	Class attendance (practice session)	30
			Preparation, before and after (practice session)	75
			Exam preparation and exam	60

Module assessment	Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)	
Language	English (and German, where applicable)	
Regular attendance required	Attendance recommended	
Total workload	240 hours	8 credit points
Duration	One semester	
Frequency	Irregular*	
Applicability	Master's degree program M.Sc. Physics	

Module: Physics and Chemistry of Sustainability I – Renewable Energy

University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics

Module coordinator: Module instructors

Prerequisites: None

Learning objectives: Students are familiar with current issues from research in the field of renewable energies as well as new methods and their capabilities. They are able to interpret and critically discuss results with regard to the current state of knowledge.

Content: Selected examples are used to acquire knowledge of fundamentals and applications, the current state of research as well as possibilities and limitations of research on conversion and storage of renewable energies. The selection of focal points is based on topicality and scientific and technological relevance. Focus topics can be: Solar energy, photovoltaics, chemical energy storage, new energy materials (solid state, molecular, biological), photo- and electrocatalysis, artificial photosynthesis, role in global cycles and future energy systems. The module is supplemented by a module offered in the Master's degree programme in Chemistry on other selected sustainability topics (Physics and Chemistry of Sustainability II).

Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)

Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 30
Practice session	1	Participation in the discussion, participation in practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	15 15 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Advanced Astronomy and Astrophysics				
University/department/teaching unit: Technische Universität Berlin/Mathematics and Natural Sciences/Astronomy and Astrophysics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The module conveys profound knowledge in modern areas of astronomy and astrophysics through alternating wide-ranging lectures. In the laboratory work, students acquire practical skills relating to astronomic observation methods and learn numerical methods applicable to astrophysical issues.				
Content: The lectures cover various specialized topics from astronomy and astrophysics (e.g. relativistic astrophysics, cosmology, physics of stellar atmospheres, cosmic electrodynamics, ISM, astronomical observation methods, planetary physics, stellar structure and stellar development). Practical tasks from astronomy are worked on (e.g. astrometry, stellar spectroscopy, determining distances, galactic rotation, observations with the center's own telescopes). Numerical methods are used for solving astrophysical problems.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture 1	2	–	Class attendance (lecture 1) Preparation, before and after (lecture 1)	30 45
Lecture 2	2	–	Class attendance (lecture 2) Preparation, before and after (lecture 2)	30 45
Internal lab project/internship	4	Carrying out practical experiments, documenting and evaluating results in writing	Class attendance (internal lab project/internship) Preparation, before and after (internal lab project/internship) Exam preparation and exam	60 120 30
Module assessment		Oral examination (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Internal lab project/internship: yes, Lectures 1 and 2: attendance recommended		
Total workload		360 hours		12 credit points
Duration		One or two semesters		
Frequency		At least every second semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Modern Experimental Physics A
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics
Module coordinator: Module instructors
Prerequisites: None
Learning objectives: The module enables the students to select the field they wish to concentrate on. Students gain an overview of questions that are relevant in current experimental research and are able to independently assess the

advantages and disadvantages of methods for answering a given question.				
Content: Topics covered can come from the fields of solid state research, physics of surfaces or nanostructures, ultrafast physics, biophysics or other areas of current research.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 45
Practice session	1	Participation in class discussions	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	15 30 30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Modern Experimental Physics B				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The module enables the students to select the field they wish to concentrate on. Students gain an overview of the questions that are relevant in current experimental research and are able to independently assess the advantages and disadvantages of methods for answering a given question. They are able to reconstruct concrete problems independently, formulate hypotheses and interpret and critically examine measurement results.				
Content: Topics covered can come from the fields of solid state research, physics of surfaces or nanostructures, ultrafast physics, biophysics or other areas of current research.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 45
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 75 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		240 hours		8 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Modern Experimental Physics C	
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics	
Module coordinator: Module instructors	
Prerequisites: None	
Learning objectives: The module enables the students to select the field they wish to concentrate on. Students gain a	

broad overview of a wide range of questions that are relevant in current experimental research and are able to independently assess the advantages and disadvantages of a variety of methods for answering a given question. They are able to reconstruct concrete problems independently, formulate hypotheses and interpret and critically examine measurement results				
Content: Topics covered can come from the fields of solid state research, physics of surfaces or nanostructures, ultrafast physics, biophysics or other areas of current research.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	4	–	Class attendance (lecture) Preparation, before and after (lecture)	60 60
Practice session	2	Completing practice assignments	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 90 60
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		300 hours		10 credit points
Duration		One semester		
Frequency		Irregular*		
Applicability		Master's degree program M.Sc. Physics		

Module: Modern Physics: Scientific Presentation				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students set an individual focus on the specific subject area of the module. By actively participating in presentations and discussions in a coordinated series of student lectures, students have in-depth knowledge of a physical subject area. They are able to adapt a scientific presentation to suit the audience's level of knowledge and the desired progress in knowledge in the subject area of the module. They are able to answer critical questions in detail on the basis of sound knowledge of their presentation topic.				
Content: Guided by their lecturers, the students work on, present and discuss topics from a variety of fields relating to current questions and methods of modern physics on the basis of specialist literature.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Seminar	2	Participation in class discussions, participation in group presentations	Class attendance (seminar) Preparation, before and after (seminar)	30 120
Module assessment		Scientific presentation (approx. 30 minutes) with follow-up discussion (approx. 20 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Yes		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular		
Applicability		Master's degree program M.Sc. Physics		

Module: Science Studies in Physics				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: The students have knowledge of the basic concepts and approaches of science studies, history of science as well as gender and diversity research in the natural sciences as well as their various research orientations. They have an overview of different perspectives in science studies, history of science and gender and diversity research, in particular those related to physics topics, and know the current state of research in each area. They are able to identify future challenges in the field of research.				

Content: The module introduces different research directions in science studies, gender and diversity research and history of science, each with focus on physics research. This includes overarching introductions to science and technology studies, gender and diversity studies in the natural sciences, history of physics and sociological perspectives on physics.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Lecture	2	–	Class attendance (lecture) Preparation, before and after (lecture)	30 45
Seminar	1	Participation in class discussions	Class attendance (seminar) Preparation, before and after (seminar) Exam preparation and exam	15 30 30
Module assessment		Written examination (90 minutes) or oral examination (approx. 30 minutes) or term paper (approx. 15 pages)		
Language		English (and German, where applicable)		
Regular attendance required		Attendance recommended		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular		
Applicability		Master's degree program M.Sc. Physics		

Module: Science Studies Communication				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: None				
Learning objectives: Students can reproduce and scientifically discuss different research approaches, methods and aims in the fields of science studies, gender & diversity studies and history of science. They gain an overview of the current state of the art in the specific field. They are able to identify future challenges in the research area at the center of the respective course and to shape relevant research questions. The students have the ability to prepare a scientific presentation based on current research from the research area, to communicate it to others with the help of a scientific presentation and the moderation of a scientific discussion. They have the ability to adapt a scientific presentation to the knowledge of the audience and to lead into a critical discussion.				
Content: Guided by their lecturers, the students work on, present and discuss topics from science studies, gender and diversity research in natural sciences and history of science with reference to physics on the basis of specialist literature.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Seminar	2	Participation in class discussions	Class attendance (seminar) Preparation, before and after (seminar) Exam preparation	30 90 30
Module assessment		Presentation (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Yes		
Total workload		150 hours		5 credit points
Duration		One semester		
Frequency		Irregular		
Applicability		Master's degree program M.Sc. Physics		

4. Supervised Research Phase

Module: Scientific Specialization
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics
Module coordinator: Module instructors
Prerequisites: Successful completion of the module "Advanced Laboratory Course" (10 credit points) and an additional required elective module in the field of theoretical physics totaling 10 credit points, as well as successful completion of additional modules from the master's degree program totaling at least 25 credit points
Learning objectives: Students are familiar with the current state of scientific knowledge in this field and are able to assess the advantages and disadvantages of various approaches to a particular current issue and to argue for these in discussion, giving reasons. Students know the rules and general principles of scientific work and good scientific practice and can take these into account.
Content: In this module, the students familiarize themselves in detail with a modern field of research prescribed by their

research phase supervisor on the basis of original literature (scientific journals and monographs). The focus is on the scientific content, the critical evaluation of literature, scientifically correct presentation and the rules of good scientific practice. On the basis of the literature studies, open questions are defined and the investigations necessary to answer them are discussed and planned. The skills of expert presentation and critical discussion are practiced in the seminar.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Project module	4	Documenting and analyzing original literature, performing calculations	Class attendance (project module) Preparation, before and after (project module)	60 180
Seminar	2	Participation in class discussions	Class attendance (seminar) Preparation, before and after (seminar) Exam preparation and exam	30 30 150
Module assessment		Scientific presentation (approx. 30 minutes) with follow-up discussion (approx. 30 minutes)		
Language		English (and German, where applicable)		
Regular attendance required		Yes		
Total workload		450 hours		15 credit points
Duration		One semester		
Frequency		Every semester		
Applicability		Master's degree program M.Sc. Physics		

Module: Methodology and Project Planning				
University/department/teaching unit: Freie Universität Berlin/Department of Physics/Physics				
Module coordinator: Module instructors				
Prerequisites: Successful completion of the module "Advanced Laboratory Course" (10 credit points) and an additional required elective module in the field of theoretical physics totaling 10 credit points, as well as successful completion of additional modules from the master's degree program totaling at least 25 credit points				
Learning objectives: Students are familiar with the particular physics-specific methods and skills and can apply them in practice. They are able to plan a research project, to present the planning in written form giving reasons and to defend it in the face of critical questions. Students know the rules and general principles of scientific work and good scientific practice and can take these into account.				
Content: In this module, students learn selected theoretical and/or experimental methods and skills necessary to complete their Master's thesis under expert guidance. Depending on whether the work is experimental or theoretical in orientation, the focus is on the confident and precise use of measurement apparatus, algorithms, programs and aids and the reliable application of the necessary skills. Building on the mastery of these methods, the planning of a sample scientific project is drawn up and presented in written form.				
Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Project module	4	Presentation of a project plan, participation in the discussion	Class attendance (project module) Preparation, before and after (project module)	60 180
Internal lab project/internship (experimental or theoretical)	7	Performing experiments and preparing a written paper (approx. 20 pages) presenting and evaluating the results	Attendance (internship) Preparation, before and after (internship)	105 105
Module assessment		none		
Language		English (and German, where applicable)		
Regular attendance required		Yes		
Total workload		450 hours		15 credit points
Duration		One semester		
Frequency		Every semester		
Applicability		Master's degree program M.Sc. Physics		

Appendix 2: Standard Curriculum Plans

2.1. Standard Curriculum Plan for the Master's Degree Program M.Sc. Physics

The modules in the first and second semester can be taken in any order. It is recommended that students distribute their workload equally across these two semesters.

<table>
<tr><th>First semester
30 credit points</th><th>Second semester
30 credit points</th><th>Third semester
30 credit points</th><th>Fourth semester
30 credit points</th></tr>
<tr><td colspan="2">Study Phase</td><td colspan="2">Supervised Research Phase</td></tr>
<tr><td>Module
Advanced Laboratory Course
10 credit points</td><td>Module
Selected Topics:
Scientific Presentations
5 credit points</td><td>Required Module
Scientific Specialization
15 credit points</td><td rowspan="3">Master's Thesis
with Accompanying Colloquium
30 credit points</td></tr>
<tr><td colspan="2">Required Elective Modules
20 credit points
At least one module from Theoretical Physics
10 credit points</td><td rowspan="2">Required Module
Methodology and Project Planning
15 credit points</td></tr>
<tr><td>Module(s)
Electives
10 credit points</td><td>Module(s)
Electives
15 credit points</td></tr>
</table>

2.2. Standard Curriculum Plan for the Double Master's Degree Program M.Sc. Physics

<table>
<tr><th>First semester
30 credit points</th><th>Second semester
30 credit points</th><th>Third semester
30 credit points</th><th>Fourth semester
30 credit points</th></tr>
<tr><td colspan="2">Study Phase</td><td colspan="2">Supervised Research Phase
Institut Polytechnique de Paris</td></tr>
<tr><td>Module
Advanced Laboratory Course
10 credit points</td><td>Module
Selected Topics:
Scientific Presentations
5 credit points</td><td rowspan="3">e.g.,
Program M2 "Nanoscience"
30 credit points</td><td rowspan="3">Master's Thesis
with Accompanying Colloquium
30 credit points</td></tr>
<tr><td>Module
Statistical Physics and Thermodynamics
10 credit points</td><td>Required Elective Modules
10 credit points</td></tr>
<tr><td>Module(s)
Electives
10 credit points</td><td>Module(s)
Electives
15 credit points</td></tr>
</table>

Appendix 3: Certificate of Academic Record (template)

Freie Universität Berlin
DEPARTMENT OF PHYSICS

Certificate of Academic Record

[First name/Last name]

born on [Month DD, YYYY], in [City of Birth, Country],

has successfully completed the master's degree program in

Physics

in accordance with the Examination Regulations of January 17, 2024, published in *FU-Mitteilungen* [XX]/[Year] with the final grade

[Grade as number and text]

The grade was calculated based on the following:

Areas of study	Credit points	Grade
Study phase modules	60 (…)	
Supervised research phase modules	30 (15)	
Master's thesis	30 (30)	

The topic of the master's thesis was: [XX]

Berlin, [Day/Month/Year] (Seal)

Dean Chair of the Examination Board

Grading scale: 1.0 – 1.5 very good; 1.6 – 2.5 good; 2.6 – 3.5 satisfactory; 3.6 – 4.0 sufficient; 4.1 – 5.0 insufficient / fail
Non-graded achievements: BE = pass; NB = fail
Credit points correspond to the European Credit Transfer and Accumulation System (ECTS).
Some coursework is ungraded; the amount of credit points in parentheses denotes those credit points that have been graded and have an effect on the cumulative grade.

Appendix 4: Degree Certificate **(template)**

Freie Universität Berlin
DEPARTMENT OF PHYSICS

D e g r e e C e r t i f i c a t e

[First name/Last name]

born on [Month DD, YYYY], in [City of Birth, Country],

has successfully completed the master's degree program in

Physics

In accordance with the Examination Regulations of January 17, 2024, published in *FU-Mitteilungen* No. [XX]/[Year],

the Degree of

Master of Science (M. Sc.)

is hereby awarded.

Berlin, [Day/Month/Year] (Seal)

Dean Chair of the Examination Board

Appendix 5: Certificate of Academic Record
(template, double master's degree program)

Freie Universität Berlin
DEPARTMENT OF PHYSICS

Certificate of Academic Record

[First name/Last name]

born on [Month DD, YYYY], in [City of Birth, Country],

has successfully completed the double master's degree program between Freie Universität Berlin, Germany, and the Institut Polytechnique de Paris, France, in

Physics

in accordance with the Examination Regulations of January 17, 2024, published in *FU-Mitteilungen* [XX]/[Year] with the final grade

[Grade as number and text]

The grade was calculated based on the following:

Areas of study	Credit points	Grade
Study phase modules	60 (…)	
Supervised research phase modules at the Institut Polytechnique de Paris	30 (30)	
Master's thesis	30 (30)	

The topic of the master's thesis was: [XX]

Berlin, [Day/Month/Year] (Seal)

Dean Chair of the Examination Board

Grading scale: 1.0 – 1.5 very good; 1.6 – 2.5 good; 2.6 – 3.5 satisfactory; 3.6 – 4.0 sufficient; 4.1 – 5.0 insufficient / fail
Non-graded achievements: BE = pass; NB = fail
Credit points correspond to the European Credit Transfer and Accumulation System (ECTS).
Some coursework is ungraded; the amount of credit points in parentheses denotes those credit points that have been graded and have an effect on the cumulative grade.

Appendix 6: Degree Certificate
(template, double master's degree program)

Freie Universität Berlin
DEPARTMENT OF PHYSICS

D e g r e e C e r t i f i c a t e

[First name/Last name]

born on [Month DD, YYYY], in [City of Birth, Country],

has successfully completed the double master's degree program
between Freie Universität Berlin, Germany, and the Institut Polytechnique de Paris, France,
in

Physics

In accordance with the Examination Regulations of January 17, 2024, published in *FU-Mitteilungen* No. [XX]/Year],

the Degree of

Master of Science (M. Sc.)

is hereby awarded.

Berlin, [Day/Month/Year] (Seal)

Dean Chair of the Examination Board