Humboldt University of Berlin
Faculty of Mathematics and Natural Sciences
Institute of Physics

Course Schedule and List of Modules of the Master program in Optical Sciences

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Translation of the German original

Course Schedule

In this table, you can find the apportionment of the modules across different semesters for a sample curriculum (which is not mandatory). This particular curriculum is only possible if you enroll in the winter semester.

Nr. of Module/ Name	1. Semester	2. Semester	3. Semester	4. Semester
Mandatory Modules	P30: Fundamentals of Optical Sciences 12 ECTS credits	P32: Advanced Optical Sciences 12 ECTS credits		
	P31: Optical Sciences Laboratory 8 ECTS credits			
			P33: Advanced Optical Sciences Laboratory 15 ECTS credits	
			P34: Introduction to Independent Scientific Research 15 ECTS credits	
				Master Thesis 30 ECTS credits
Elective Subject[1]	P.35.x.b 6 ECTS credits	P.35.x.a, P.35.x.c 6 ECTS credits each		
General Electives[2]	General Elective Module I 5 ECTS credits	General Elective Module II 5 ECTS credits		
ECTS credits per semester	31	29	30	30

Notes:

[1]: You have to choose one of four possible elective subjects: *Quantum Optics* (P35.1), *Nonlinear Photonics* (P35.2), *Theoretical Optics* (P35.3), or *Short-Wavelength Optics* (P35.4). For each elective subject, there is one mandatory module (P35.x.a) and two further modules can be chosen from a variety of modules. Note that several modules can be counted towards more than one elective subject. For instance, while the mandatory modules for *Nonlinear Photonics* and *Theoretical Optics* are, respectively, "Physics of Ultrafast Processes" (P35.2.a) and "Computational Photonics" (P35.3.a), the module "Nonlinear Dynamics in Photonics" can be counted towards both elective subjects, i.e., as P35.2.b/c or P35.3.b/c.

[2]: General elective modules can be chosen from all modules offered at HU Berlin, e.g., German language modules (depending on your level of proficiency), scientific writing, philosophy, neuroscience, advanced quantum mechanics etc.

Descriptions of Modules

Below, you can find a detailed description of the modules listed in the above Course Schedule.

<table>
<tr><td colspan="4">Nr. P30, Fundamentals of Optical Sciences ECTS credits: 12</td></tr>
<tr><td colspan="4">Educational and qualification objectives: The students are able to systematize the fundamentals and the theoretical concpets of optics and can apply them towards the solution of corresponding problems.</td></tr>
<tr><td colspan="4">Prerequisites for participation in the module or specific courses within the module:
None</td></tr>
<tr><td>Type of course</td><td>Time of attendance, Workload in hours</td><td>ECTS credits and requirements for their issuance</td><td>Topics, Content</td></tr>
<tr><td>Lecture</td><td><u>6 hours/week</u>

<u>180 hours</u>
70 hours attend-ance,
110 hours
pre- and post-processing of the course</td><td>6 credits</td><td>• Fundamentals of modern optics (Electro-dynamics & Special Relativity, Quantum mechanics, Atom and Solid-State Physics)
• Wave optics and light propagation (Reso-nators, Photonic Crystals and Metamateri-als)
• Light-matter interaction (semi-classical description)
• Optical amplification and Laser
• Types of Lasers and other coherent radia-tion sources
• Applications (Frequency conversion, Laser spectroscopy, ultrafast processes)
• Nano-optics und plasmonics
• Quantization of the electromagnetic field (Fock-, thermal and coherent states, properties of coherence)
• Quantum mechanical light-matter interac-tion (Jaynes-Cummings model)</td></tr>
<tr><td>Exercises</td><td><u>2 hours/week</u>

<u>120 hours</u>
25 hours attend-ance,
95 hours
pre- and post-processing of the course</td><td>4 credits, participation</td><td>Content of the lecture</td></tr>
<tr><td>Module exam</td><td><u>30 hours</u>
Written exam, 120 minutes or
oral examination, 30 minutes, and preparation</td><td>2 credits, pass</td><td></td></tr>
<tr><td>Duration of module</td><td colspan="3">☒ 1 Semester ☐ 2 Semester</td></tr>
<tr><td>Begin of module</td><td colspan="3">☒ Winter semester ☐ Summer semester</td></tr>
</table>

Nr. P31, Optical Sciences Laboratory			ECTS credits: *8*
Educational and qualification objectives: The students solve complex experimental problems of modern optics via largely independent practical activities. They are able to assess the usage of experimental principles, techniques, and devices and are able to appraise and document their results.			
Prerequisites for participation in the module or specific courses within the module: None			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Seminar	*<u>1 hour/week</u>* *<u>30 hours</u>* *15 hours attend-ance, 15 hours pre- and post-processing of the course*	*1 credit, participation*	Introduction into the different experiments including safety training
Laboratory	*<u>8 hours/week</u>* *<u>150 hours</u>* *90 hours attend-ance,* *60 hours* *pre- and post-processing of the course*	*5 credits, participation*	*Experiments from the following areas of optics:* • *Spectroscopy* • *Microscopy* • *Nano-Optics* • *Quantum Optics* • *Further areas of optics* Programming exercises for the evaluation of data from or the simulation/design of experi-ments
Module exam	*<u>60 hours</u>* *Portfolio of labora-tory reports for every experiment, about 10 pages each*	*2 credits, pass*	The laboratory reports will be appraised by way of a point-based scheme. The final mod-ule grade is determined by the total number of points obtained.
Duration of module	☒ 1 Semester		☐ 2 Semester
Begin of module	☒ Winter semester		☒ Summer semester

Nr. P32, Advanced Optical Sciences			ECTS credits: *12*
Educational and qualification objectives: The students acquire advanced knowledge regarding important theoretical developments and key experiments of modern optics. They are further able, to apply this knowledge towards the solution of corresponding problems.			
Prerequisites for participation in the module or specific courses within the module: None			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	• *Key experiments of modern optics (e.g., Works that have led to Nobel prizes with direct reference to optics).* • *Theoretical foundations of these key experiments*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Seminar	*<u>2 hours/week</u>* *<u>180 hours</u>* *25 hours attend-ance,* *155 hours pre- and post-processing of the course*	*6 credits, Participation and talk with sub-sequent dis-cussion, about 45 minutes*	• *Independent compilation of scientific talks on current topics of optics under the supervision of a faculty member* • *Acquisition and critical evaluation of scientific presentation skills* • *Constructive participation in scientific discussions*
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☐ Winter semester	☒ Summer semester	

Nr. P33, Advanced Optical Sciences Laboratory			ECTS credits: *15*
Educational and qualification objectives: The students are acquainted with independent research. The module serves as an orientation phase regarding the Master Thesis and can thus be completed within the periphery of the future Master Thesis.			
Prerequisites for participation in the module or specific courses within the module: None			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Seminar	*<u>2 hours/week</u>* *<u>60 hours</u>* *25 hours attend-ance,* *65 hours pre- and post-processing of the course*	*2 credits, participation*	*Current research topics of the research group*
Laboratory	*<u>7 hours/week</u>* *<u>300 hours</u>* *80 hours attend-ance,* *220 hours pre- and post-processing of the course*	*10 credits, participation*	*Research topics in preparation of the Master Thesis*
Module exam	*<u>90 hours</u>* *Term paper in report form (about 10 pages) or oral examination in form of talk in the research seminar of the research group with subsequent discussion, about 45 minutes*	*3 credits, pass*	*Compilation of the current state-of-the-art of research in a topics, preferably the topic of the Master Thesis, within the research seminar of the research group*
Duration of module	☒ 1 Semester		☐ 2 Semester
Begin of module	☒ Winter semester		☒ Summer semester

Nr. P34, Introduction into Independent Scientific Research			ECTS credits: *15*
Educational and qualification objectives: The students will acquire the skills required for the successful independent handing of the topic of the Master Thesis. This module serves as a preparation for the Master Thesis.			
Prerequisites for participation in the module or specific courses within the module: None			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Seminar	*<u>2 hours/week</u>* *<u>60 hours</u>* *25 hours attendance,* *65 hours pre- and post-processing of the course*	*2 credits, participation*	*Current research topics of the research group*
Laboratory	*<u>7 hours/week</u>* *<u>300 hours</u>* *80 hours attendance,* *220 hours pre- and post-processing of the course*	*10 credits, participation*	*Independent execution of research work in immediate preparation of the Master Thesis under the supervision of a faculty member*
Module exam	*<u>90 hours</u>* *Term paper in report form (about 10 pages) or oral examination in form of talk in the research seminar of the research group with subsequent discussion, about 45 minutes*	*3 credits, participation*	*Acquisition of scientific methods, their demonstration and the presentation of scientific results in the form of a talk or a report (about 10 pages)*
Duration of module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☒ Winter semester	☒ Summer semester	

Nr. P35.1.a, Quantum Optics			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals and the theoretical description of quantum optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attendance,* *25 hours pre- and post-processing of the course*	*2 credits*	• *Fundamentals of quantum optics* • *Quantum-optical 3-level systems (electromagnetically induced transparency, slow light etc.)* • *Quasi-probability distributions (Wigner, Husimi, Glauber-Sudarshan)* • *System-reservoir interaction (Markov approximation, Wigner-Weisskopf theory, fluctuation-dissipation theorem)* • *Cavity Quantum Electrodynamics* • *Laser theory (semi-classical and fully quantized)* • *Quantum optical tests of quantum mechanics* • *Fundamentals of atom optics (matter waves)*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attendance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester		☐ 2 Semester
Begin of module	☐ Winter semester		☒ Summer semester

Nr. P35.1.b, Quantum Optics Specialization I			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of quantum optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of quantum optics. Among others, lectures with the following topics are regularly offered:* • *Quantum Information* • *Quantum Dynamics in Strong Laser Fields* • *Laser Cooling* • *Nano Optics* • *Fluctuation-Induced Phenomena*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☒ Winter semester	☐ Summer semester	

Nr. P35.1.c, Quantum Optics Specialization II			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of quantum optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of quantum optics. Among others, lectures with the following topics are regularly offered:* • *Quantum Information* • *Quantum Dynamics in Strong Laser Fields* • *Laser Cooling* • *Nano Optics* • *Fluctuation-Induced Phenomena*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☐ Winter semester	☒ Summer semester	

Nr. P35.2.a, Physics of Ultrafast Processes			ECTS credits: *6*
Educational and qualification objectives: Introduction in the generation of ultrashort light pulses, measurement processes of short pulse spectroscopy, and the physics of ultrafast light-induces processes in atoms, molecules and solids.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	• *Generation of ultrashort light pulses* • *Frequency conversion of ultrashort pulses* • *Temporal beam shaping* • *Measurement processes of short pulse spectroscopy* • *Ultrafast processes in isolated systems* • *Ultrafast dynamics of molecular systems in the condensed phase* • *Dynamics of elementary excitations in solids* • *Ultrafast structural changes*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of Module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☐ Winter semester	☒ Summer semester	

Nr. P35.2.b, Nonlinear Photonics Specialization I			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of nonlinear photonics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of nonlinear photonics. Among others, lectures with the following topics are regularly offered:* • *Nonlinear Optics* • *Nonlinear Dynamics in Photonics* • *THz Spectroscopy* • *Quantum Dynamics in Strong Laser Fields* • *Physics of Ultrafast Processes*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of Module	☒ 1 Semester		☐ 2 Semester
Begin of module	☒ Winter semester		☐ Summer semester

Nr. P35.2.c, Nonlinear Photonics Specialization II			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of nonlinear photonics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of nonlinear photonics. Among others, lectures with the following topics are regularly offered:* • *Nonlinear Optics* • *Nonlinear Dynamics in Photonics* • *THz Spectroscopy* • *Quantum Dynamics in Strong Laser Fields* • *Physics of Ultrafast Processes*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester		☐ 2 Semester
Begin of module	☐ Winter semester		☒ Summer semester

Nr. P35.3.a, Computational Photonics			ECTS credits: *6*
Educational and qualification objectives: The students acquire the fundamentals of computational photonics, i.e., the current research areas, the methodologies and techniques, and the open scientific questions. The students are further able to apply this knowledge towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	• *Finite-difference techniques* • *Treatment of dispersive materials via auxiliary differential equations* • *Treatment of open systems via perfectly matched layers (PMLs)* • *Beam propagation method* • *Photonic band structure computations* • *Rigorous Coupled Wave Analysis* • *Advanced time-stepping approaches (Operator exponentials etc.)* • *Advanced spatial discretization (Finite element methods)*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of Module	☒ 1 Semester		☐ 2 Semester
Begin of module	☐ Winter semester		☒ Summer semester

Nr. P35.3.b, Theoretical Optics Specialization I			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of theoretical optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of theoretical optics. Among others, lectures with the following topics are regularly offered:* • *Quantum Optics* • *Fluctuation-induced Phenomena* • *Quantum Information* • *Quantum Dynamics in Strong Laser Fields* • *Nonlinear Dynamics in Photonics*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of Module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☒ Winter semester	☐ Summer semester	

Nr. P35.3.c, Theoretical Optics Specialization II			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of theoretical optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of theoretical optics. Among others, lectures with the following topics are regularly offered:* • *Quantum Optics* • *Fluctuation-induced Phenomena* • *Quantum Information* • *Quantum Dynamics in Strong Laser Fields* • *Nonlinear Dynamics in Photonics*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☐ Winter semester	☒ Summer semester	

Nr. P35.4.a, Fourier Optics and X-Ray Microscopy			ECTS credits: *6*
Educational and qualification objectives: The students acquire the fundamentals of microscopy with X-rays, i.e., the current research topics, the methodologies and techniques, and the open scientific questions. They are further able to apply this knowledge towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	• *Introduction to X-ray optics* • *Composition of microscopes* • *X-ray sources* • *Contrast mechanisms* • *Applications in material science and the life sciences*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of Module	☒ 1 Semester		☐ 2 Semester
Begin of module	☐ Winter semester		☒ Summer semester

Nr. P35.4.b, Short-Wavelength Optics Specialization I			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of short-wavelength optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*<u>3 hours/week</u>* *<u>60 hours</u>* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of short-wavelength optics. Among others, lectures with the following topics are regularly offered:* • *Modern X-Ray Optics* • *Introduction to Electron Microscopy* • *Synchrotron Radiation* • *Physics of Ultrafast Processes*
Exercises	*<u>1 hours/week</u>* *<u>60 hours</u>* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*<u>60 hours</u>* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of Module	☒ 1 Semester		☐ 2 Semester
Begin of module	☒ Winter semester		☐ Summer semester

Nr. P35.4.c, Short-Wavelength Optics Specialization II			ECTS credits: *6*
Educational and qualification objectives: The students are able to systematize the fundamentals of current topics of short-wavelength optics and are further able to apply them towards the solution of pertinent problems.			
Prerequisites for participation in the module or specific courses within the module: Knowledge of optics, quantum mechanics, and laser physics			
Type of course	Time of attendance, Workload in hours	ECTS credits and requirements for their issuance	Topics, Content
Lecture	*3 hours/week* *60 hours* *35 hours attend-ance,* *25 hours pre- and post-processing of the course*	*2 credits*	*Semester-wise varying lectures with varying topics of short-wavelength optics. Among others, lectures with the following topics are regularly offered:* • *Modern X-Ray Optics* • *Introduction to Electron Microscopy* • *Synchrotron Radiation* • *Physics of Ultrafast Processes*
Exercises	*1 hours/week* *60 hours* *15 hours attend-ance,* *45 hours pre- and post-processing of the course*	*2 credits, participation*	Content of the lecture
Module exam	*60 hours* *Written exam, 120 minutes, or oral exam, 30 minutes, and preparations*	*2 credits, pass*	
Duration of module	☒ 1 Semester	☐ 2 Semester	
Begin of module	☐ Winter semester	☒ Summer semester	