university of groningen / faculty of science and engineering / physics

Appendices to the Teaching and Examination Regulations

2022-2023

Master's degree programme in Physics

Appendix I Teaching outcomes of the degree programme (art. 3.1)

1. **Knowledge and understanding**
   The master graduate in Physics
   - 1.1. understands the advanced concepts of physics, including the necessary mathematics and computer science, at a level which permits admission to a PhD programme;
   - 1.2. is familiar with the advanced quantitative character of physics and with the relevant research methods;
   - 1.3. [Advanced Materials track] has a thorough understanding of the current state of the art in materials science, more specifically of the structure, functional properties and characterisation of advanced materials;
   - 1.4. [Quantum Universe track] has a thorough understanding of the main fields and presently active topics in theoretical physics, more specifically in the fields of general relativity, statistical mechanics, quantum mechanics, particle physics and radiation processes
   - 1.5. [Science, Business and Policy track] has operational knowledge of, and insight into, the present functioning of companies and administrations, as well as the relevant legislation, in relation to physics oriented working areas;

2. **Application of knowledge and understanding**
   The master graduate in Physics
   - 2.1. is capable of carrying out research, aimed at the understanding of physical phenomena and their description in scientific terms;
   - 2.2. is capable of analyzing a (new) complex physical problem, and to use modelling skills to develop a structured and well-planned research approach;
   - 2.3. is capable of applying acquired specific knowledge and mathematical, experimental, and computer skills to solve physical problems in the relevant subject area, as well as related subject areas and fields;
   - 2.4. is capable of collaborating in a (multi-disciplinary) team;

3. **Assessment**
   The master graduate in Physics
   - 3.1. is capable of obtaining relevant information using modern information channels, and to interpret this information critically;
   - 3.2. is capable of managing and assessing personal and others' actions within a highly scientific and professional context, taking societal and ethical aspects into account;
   - 3.3. is able to draw conclusions on the basis of limited or incomplete information, and is able to realize and formulate the limitations of such conclusions;

4. **Communication skills**
   The master graduate in Physics
   - 4.1. is capable of communicating clearly in English, both verbally and in writing, on the subject and relevant applications, at a level which is understandable to experts and non-experts, and using modern communication tools;

5. **Learning skills**
   The master graduate in Physics
   - 5.1. is capable of addressing issues on new developments (using e.g. literature research) inside as well as outside the main subject area, therefore and thereby gaining new, updated knowledge and skills.

Appendix II Tracks of the degree programme (art. 3.6)

The Master's degree programme in Physics offers the following tracks:

- Advanced Materials
- Quantum Universe
- Science, Business and Policy

Appendix III Content of the degree programme (art. 3.8)

The assessment method(s) of the courses below can be found in the assessment plan of the degree programme and on Ocasys.

3.1 Track Advanced Materials

Course unit (course code)	ECTS	Practical	Entry Requirements
Advanced Quantum Mechanics (WMPH032-05)	5		
Computational Physics (WMPH007-05)	5	X	
Mathematical Methods of Physics (WMPH016-05)	5		
Statistical Mechanics (WMPH029-05)	5		
Choice [*] - Characterisation of Materials (WMPH021-05) - Cross-disciplinary Materials Science (WMPH049-05) - Functional Properties (WMPH015-05) - Structure at Macro, Meso and Nano Scale (WMPH020-05) - Supramolecular Chemistry (WMCH020-05)	20		
Optional Courses in Advanced Materials	20	See app. IV	See appendix IV
Physics Master Research Project (WMPH902-60)	60	X	Passed 45 ECTS of the masters's degree programme

[*] Four out of five courses should be chosen

3.2 Track Quantum Universe

Course unit (course code)	ECTS	Practical	Entry Requirements
Advanced Quantum Mechanics (WMPH032-05)	5		
Computational Physics (WMPH007-05)	5	X	
Electrodynamics of Radiation Processes (WMAS008-05)	5		
General Relativity (WMPH009-05)	5		
Mathematical Methods of Physics (WMPH016-05)	5		
Particle Physics Phenomenology (WMPH026-05)	5		
Statistical Mechanics (WMPH029-05)	5		
Student Seminar Quantum Universe (WMPH039-05)	5		
Optional Courses in Quantum Universe	20	See app. IV	See appendix IV
Physics Master Research Project (WMPH902-60)	60	X	Passed 45 ECTS of the masters's degree programme

3.3 Track Science, Business and Policy

Course unit (course code)	ECTS	Practical	Entry Requirements
Computational Physics (WMPH007-05)	5	X	
Mathematical Methods of Physics (WMPH016-05)	5		
Four course units to be selected from either the track Quantum Universe or the track Advanced Materials.	20	See app. III or IV for the corresponding programme	See app. III or IV for the corresponding programme
Introduction Science and Business (WMSE001-10)	10		
Introduction Science and Policy (WMSE002-10)	10		
Work placement Business & Policy (WMSE902-40)	40	X	
Physics Master Research Project (SBP) (WMPH005-30)	30	X	

3.4 Double master's degree in Mathematics and Physics

If a student desires to obtain a master's degree in Mathematics and a master's degree in Physics at the same time, the student has the possibility to follow a specific double master's programme. The student has to fulfil the requirements of the Mathematics as well as the Physics degree programme with some adaptations.

A complete overview of all obligations and modifications within both programmes is provided in the Teaching and Examination Regulations of the Master's degree programme in Mathematics.

Appendix IV Electives (art. 3.9.1)

The assessment method(s) of the courses below can be found in the assessment plan of the degree programme and on Ocasys.

4.1 Optional Courses in Advanced Materials

Course unit (course code)	ECTS	Practical	Entry Requirements
Atomic and (bio-)molecular Interactions (WMPH046-05)	5		
Basics of Teaching (TEM0105)	5		
Bioinspired designer materials (WMCH009-05)	5		
Biophysical imaging & manipulation techniques (WMPH047-05)	5	X	
Internship in secondary education 1 TE (TEM0205)	5	X	
Many-particle systems (WMPH036-05)	5		
Mechanical Properties (WMPH023-05)	5		
Mesoscopic Physics (WMPH037-05)	5		
Non-linear Optics (WMPH024-05)	5		
Physics of Lasers (WMPH027-05)	5	X	
Surfaces and Interfaces (WMPH014-05)	5		
Theoretical Condensed Matter Physics (WMPH031-05)	5		
Ultrafast Time-resolved Spectroscopy (WMPH040-05)	5	X	

4.2 Optional Courses in Quantum Universe

Course unit (course code)	ECTS	Practical	Entry Requirements
Basics of Teaching (TEM0105)	5		
Collider Experiments (WMPH033-05)	5		
Elementary Particles (WMPH034-05)	5		
Formation and Evolution of Galaxies (WMAS005-05)	5		
Fundamental Constants (WMPH008-05)	5		
Hamiltonian Mechanics (WMMA019-05)	5		
Internship in secondary education 1 TE (TEM0205)	5	X	
Introduction to Plasma Physics (WMPH035-05)	5		
Lie groups in Physics (WMPH011-05)	5		
Nuclear Astrophysics (WMPH038-05)	5		
Quantum Experiments (WMPH017-05)	5		
Quantum Field Theory (WMPH018-05)	5		
Statistical Methods in Physics (WMPH030-05)	5		
Biennial courses, offered in 2022-2023			
Cosmic Structure Formation (WMAS004-05)	5		
Geometry & Differential Equations (WMMA017-05)	5		
Gravitational Waves (WMPH022-05)	5		
High-energy astrophysics (WMAS006-05)	5		
Star and Planet Formation (WMAS017-05)	5		
Biennial courses, offered in 2023-2024			
Dynamics of Galaxies (WMAS014-05)	5		
Geometry and Topology (WMMA018-05)	5		
Particle Cosmology (WMPH025-05)	5		
Stars, Nucleosynthesis, and Chemical Evolution (WMAS010-05)	5		

Appendix V Entry requirements and compulsory order of examinations (art. 4.4)

For students admitted to the degree programme the conditional entry requirements for individual modules and order of examinations are listed in Ocasys.

Appendix VI Admission to the degree programme and different tracks (art. 2.1A.1 + 2.1B.1)

Graduates of the following Bachelor's degree programmes of the University of Groningen are considered to have adequate knowledge and skills to be admissible into the Master's degree programme in Physics:

- BSc Physics
- BSc Applied Physics

A dedicated 60 ECTS programme is composed for graduates of the Bachelor's degree programme in Life Science & Technology (LST) of the University of Groningen and consists of the following course units:

- Bachelor Research Project Physics (WBPH903-15; 15 ECTS)
- Solid State Physics 1 (WBPH030-05; 5 ECTS)
- Mechanics and Relativity 2 (WBPH021-05; 5 ECTS)
- Waves and Optics (WBPH032-05; 5 ECTS)
- Electricity and Magnetism (WBPH033-10; 10 ECTS)
- Structure of Matter (WBPH034-10; 10 ECTS)
- Calculus II (WBMA029-05; 5 ECTS)
- Quantum Physics 2 (WBPH052-05; 5 ECTS)

Bachelor Life Science & Technology graduates who successfully completed the mandatory programme of the first two years and followed the courses listed above in their third year are considered admissible into the Master's degree programme of Physics.

Students with a background in a physics or related bachelor's degree programme and interested in pursuing a master's degree programme in Physics are encouraged to apply through the Admissions Office of the Faculty of Science and Engineering. The Board of Admissions of Physics and Applied Physics will then assess the application and decides whether the applicant has sufficient background to register for the programme, possibly after following a bridging pre-master's programme.

Appendix VII Transitional provisions (art. 7.1)

There are no transitional provisions for Physics students.

Appendix VIII Additional Requirements Open degree Programmes (Art. 3.10)

Students wishing to pursue an open degree programme may file a request with the Board of Examiners of Physics and Applied Physics. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme.

Appendix IX Admission

Application and decision deadlines for admission (art. 2.7.1 and 2.7.3)

Programmes starting on 1 September 2022

Programme	Deadline of Application	Deadline of decision
Behavioural and Cognitive Neurosciences	1 May 2022	1 June 2022
Biology	1 May 2022	1 June 2022
Biomedical Engineering	1 May 2022	1 June 2022
Biomedical Sciences	1 May 2022	1 June 2022
Biomolecular Sciences	1 May 2022	1 June 2022
Ecology and Evolution	1 May 2022	1 June 2022
Energy and Environmental Sciences	1 May 2022	1 June 2022
Human-Machine Communication	1 May 2022	1 June 2022
Marine Biology	1 May 2022	1 June 2022
Mechanical Engineering	1 May 2022	1 June 2022
Medical Pharmaceutical Sciences	1 May 2022	1 June 2022
Nanoscience: for non-EU/EEA students	1 February 2022	1 June 2022
Nanoscience: for EU/EEA students	1 May 2022	1 June 2022
Science Education and Communication	1 May 2022	1 June 2022

Programmes starting on 1 September 2022 and 1 February 2023

Programme	Deadline of Application for 1 September	Deadline of decision for 1 September	Deadline of Application for 1 February	Deadline of decision for 1 February
Applied Mathematics	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Applied Physics	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Artificial Intelligence	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Astronomy	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Chemical Engineering	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Chemistry	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Computing Science	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Farmacie	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Industrial Engineering and Management	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Mathematics	1 May 2022	1 June 2022	15 October 2022	15 November 2022
Physics	1 May 2022	1 June 2022	15 October 2022	15 November 2022