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# **Appendices to the Teaching and Examination Regulations**

**2020-2021**

**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 his/her specific knowledge and mathematical, experimental, and computer skills to solve physical problems in his/her own and related fields;
- 2.4. is capable of collaborating in a (multi-disciplinary) team;

### 3. Judgement

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 judging his/her 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 his/her 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 his/her main subject area, therefore and thereby gaining new, updated knowledge and skills.



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## **Appendix II Tracks of the degree programme (art. 3.5)**

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. 3.6)

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

#### Track Advanced Materials

Course unit	ECTS	Practical	Entry Requirements
Cross-disciplinary Materials Science	5		
<i>Choice</i> * Characterisation of Materials Functional Properties Structure at Macro, Meso and Nano Scale Supramolecular Chemistry	15		
Advanced Quantum Mechanics	5		
Computational Physics	5	X	
Mathematical Methods of Physics	5		
Statistical Mechanics	5		
Optional Courses in Advanced Materials	20	See app. IV	See appendix IV
Master's Research Project (Advanced Materials)	60	X	Passed 45 ECTS of the masters's degree programme

\* Three out of four courses should be chosen

#### Track Quantum Universe

Course unit	ECTS	Practical	Entry Requirements
Advanced Quantum Mechanics	5		
Computational Physics	5	X	
Electrodynamics of Radiation Processes	5		
General Relativity	5		
Mathematical Methods of Physics	5		
Particle Physics Phenomenology	5		
Statistical Mechanics	5		
Student Seminar Quantum Universe	5		
Optional Courses in Quantum Universe	20	See app. IV	See appendix IV
Master's Research Project (Quantum Universe)	60	X	Passed 45 ECTS of the masters's degree programme



**Track Science, Business and Policy**

<b>Course unit</b>	<b>ECTS</b>	<b>Practical</b>	<b>Entry Requirements</b>
Advanced Quantum Mechanics	5		
Computational Physics	5	X	
Mathematical Methods of Physics	5		
Statistical Mechanics	5		
Four course units which all have to be selected from either the track Quantum Universe or the track Advanced Materials.	20		
Introduction Science and Business	10		
Introduction Science and Policy	10		
Internship Science, Business and Policy	40	X	
Master's Research Project (Science, Business and Policy)	30	X	



## Appendix IV Electives (art. 3.7)

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

### Optional Courses in Advanced Materials

Course unit	ECTS	Practical	Entry Requirements
Surfaces and Interfaces	5		
Theoretical Condensed Matter Physics	5		
Physics of Lasers	5	X	
Non-linear Optics	5		
Mesoscopic Physics	5		
Many-particle systems	5		
Atomic and (bio-)molecular Interactions	5		
Bioinspired designer materials	5		
Mechanical Properties	5		
Biophysical imaging & manipulation techniques	5	X	
Basiscursus Master Lerarenopleiding	5		
Masterstage 1 Lerarenopleiding	5	X	
The student is allowed to choose courses in Applied Physics or Quantum Universe, on individual approval of the Board of Examiners (max. 10 ECTS)		See app. III or IV of the corresponding programme	See app. III or IV of the corresponding programme



**Optional Courses in Quantum Universe**

<b>Course unit</b>	<b>ECTS</b>	<b>Practical</b>	<b>Entry Requirements</b>
Collider Experiments	5		
Elementary Particles	5		
Formation and Evolution of Galaxies	5		
Fundamental Constants	5		
Gravitational Waves	5		
Introduction to Plasma Physics	5		
Hamiltonian Mechanics	5		
Lie groups in Physics	5		
Nuclear Astrophysics	5		
Quantum Experiments	5		
Quantum Field Theory	5		
Statistical Methods in Physics	5		
Basiscursus Master Lerarenopleiding	5		
Masterstage 1	5	X	
The student is allowed to choose courses in Applied Physics, Astronomy or Advanced Materials, on individual approval by the Board of Examiners (max. 10 ECTS)		See app. III or IV of the corresponding programme	See app. III or IV of the corresponding programme
<b><i>Biennial courses, offered in 2020-2021</i></b>			
Cosmic Structure Formation	5		
High-energy astrophysics	5		
Star and Planet Formation	5		
Geometry & Differential Equations	5		
<b><i>Biennial courses, offered in 2021-2022</i></b>			
Dynamics of Galaxies	5		
Geometry and Topology	5		
Stars, Nucleosynthesis, and Chemical Evolution	5		



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## **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. 2.1.1 + art. 2.2)**

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
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- A dedicated 15 ECTS pre-master programme is composed for graduates of the Bachelor's degree programme in Astronomy of the University of Groningen and consists of the following three course units:
    - Electronics and Signal Processing
    - Structure of Matter 2
    - Physics Laboratory 3 *or* Physics Laboratory 4

Bachelor Astronomy graduates who successfully complete this programme are considered admissible into the Master's degree programme in Physics.



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## **Appendix VII Transitional provisions (art. 7.1)**

There are no transitional provisions for Physics students.



## Appendix VIII Admission

### Application deadlines for admission (art. 2.6.1)

<b>Deadline of Application</b>	<b>Non-EU students</b>	<b>EU students</b>
Physics	May 1st 2020	May 1st 2020

### Decision deadlines (art. 2.6.3)

<b>Deadline of Decision</b>	<b>Non-EU students</b>	<b>EU students</b>
Physics	June 1st 2020	June 1st 2020