university of groningen / faculty of science and engineering / physics

Appendices to the Teaching and Examination Regulations

2022-2023

Bachelor's degree programme in Physics

Appendix I Learning outcomes of the Bachelor's degree programme (Article 3.1.1)

A. Generic learning outcomes – Knowledge

A1. Bachelor's graduates have general knowledge of the foundations and history of mathematics, natural sciences and technology, in particular those of Physics.

A2. Bachelor's graduates have mastered the basic concepts of Physics (see Appendix 1.1 for further specification) and are familiar with the interrelationships of these concepts within their own discipline as well as with other disciplines.

A3. Bachelor's graduates have in-depth knowledge of several contemporary topics within Physics.

A4. Bachelor's graduates are familiar with the quantitative character of the fields of mathematics and natural sciences and have an understanding of the methods used in these fields, and particularly within Physics, including computer-aided methods.

A5. Bachelor's graduates have sufficient knowledge and understanding of mathematics and natural sciences to successfully complete a follow-up Master's degree programme in Physics.

A6. Bachelor's graduates are aware of the societal, ethical and social aspects involved in the fields of mathematics and natural sciences, and act accordingly.

B. Generic learning outcomes – Skills

B1. (Research) Bachelor's graduates are able to draw up a research question, design, plan and conduct research and report on it independently with an appropriate degree of supervision. Bachelor's graduates are able to evaluate the value and limitations of their research and assess its applicability outside their own field.

B2. (Designing and Modeling) Bachelor's graduates are able to translate a physics problem into a plan of approach and – taking into account practical boundary conditions – find a solution.

B3. (Gathering information) Bachelor's graduates are able to gather relevant information using modern means of communication and to critically interpret this information.

B4. (Collaborating) Bachelor's graduates are able to collaborate in teams on technical-scientific problems.

B5. (Communicating) Bachelor's graduates are able to communicate orally and in writing in academic and professional contexts, with both colleagues and others. They are familiar with the relevant means of communication.

B6. (Reflecting) Bachelor's graduates are able to assess their own actions and those of others in a natural sciences context, bearing in mind the social/societal and ethical aspects.

B7. (Learning skills) Bachelor's graduates are able to apply learning skills that enable them to pursue a follow-up degree and acquire knowledge in new fields with a high level of autonomy.

B8. Additional subject-specific skills are listed in Appendix 1.2.

1.1 Degree programme-specific learning outcomes – Basic Knowledge

The Bachelor's graduate in Physics has:

1.1.1 knowledge of the most important subjects in the field of:

a. Classical and Relativistic Mechanics
b. Electromagnetism
c. Quantum Physics
d. Thermodynamics
e. Statistical Physics
f. Wave phenomena, Oscillations and Optics
g. Materials: structure and interactions
h. Calculus and Linear Algebra

1.1.2 knowledge of topics in at least one of the following research fields:

i. Biophysics and Medical Physics
j. Energy and Environmental Physics
k. Nanophysics
l. Particle Physics

1.1.3 achieved in the Minor, a deeper knowledge of subjects within their own discipline or a broad general knowledge of a different discipline.

1.2 Degree programme-specific learning outcomes – Skills

The Bachelor's graduate in Physics is able to:

1.2.1 estimate the orders of magnitude of various physical processes;
1.2.2 use specific software, such as a programming language or a (symbolical) software package;
1.2.3 setup and carry out an experiment, while taking into account the safety and environmental issues;
1.2.4 gain insight in the fundamental workings of nature through the analysis of experimental constructs and/or experimental data.

Appendix II Majors and Minors of the degree programme (Article 3.6.4)

The degree programme is build up by the Physics major (165 ECTS) and a free minor (15 ECTS).

The Physics major consists of a core programme, mandatory for all Physics students, and a specific track programme which provides different lines of specialization.

Major(s):

1. The Bachelor's degree programme of Physics offers the following four tracks within the major:
   - Biophysics & Medical Physics (BMP)
   - Energy & Environmental Physics (EEP)
   - Nanophysics (NP)
   - Particle Physics (PP)

Minor(s):

2. The Bachelor's degree programme of Physics offers the following deepening minor:
   - Quantum Materials & Radiation (15 ECTS)

3. The Bachelor's degree programme of Physics offers the following university minor:
   - Einstein's physics: Space-time and Parallel Worlds (15 ECTS)

Appendix III Course units in the propaedeutic phase

- **List of course units; Article 4.1.1**
- **Compulsory order of examinations; Article 9.3**

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

3.1 Physics major programme

Course unit (course code)	ECTS	Practical	Remarks
Calculus 1 (*TBA*)	5	X	
Calculus 2 (*TBA*)	5		
Electricity and Magnetism (WBPH033-10)	10	X	
Python for Physics (WBPH044-05)	5	X	
Mathematical Physics (WBPH049-05)	5		
Physics Laboratory 2 (WBPH050-05)	5	X	
Linear Algebra (WBPH054-05)	5		
Physics Laboratory 1 (WBPH013-05)	5	X	
Mechanics and Relativity (WBPH001-10)	10		
Choice: - Introduction to Astronomy (WBAS007-05) - Introduction to Energy & Environment (WBPH019-05) - Physics of Modern Technology - (WBPH027-05) - Medical Physics & Biophysics (WBPH022-05) - Introduction to Nanophysics (WBPH055-05) - Physics of the Quantum Universe (WBPH028-05)	5		

3.2 Propaedeutic phase double bachelor's degree in Mathematics and Physics

If a student desires to obtain a Bachelor's degree in Mathematics and a Bachelor's degree in Physics at the same time, 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 the propaedeutic phase of both programmes is provided in the Teaching and Examination Regulations of the Bachelor's degree programme in Mathematics.

Appendix IV Course units in the post-propaedeutic phase

- **List of course units; Article 7.1.1**
- **Compulsory order of examinations; Article 9.3**

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

4.1 Physics major programme

To follow the Education minor (30 ECTS) track specific courses may be substituted, as indicated below.

Course unit (course code)	ECTS	Practical	Remarks
Computational Methods in Science and Technology (WBPH005-05)	5	X	
Electronics and signal processing (WBPH038-05)	5	X	
Physics Laboratory 3 (WBPH051-05)	5	X	
Physics, Astronomy & Society: Ethical and Professional Aspects (WBPH053-05)	5		
Quantum Physics 1 (WBPH014-05)	5		
Statistical Physics (WMPH030-05)	5		
Structure of Matter (WBPH034-10)	10		
Thermal Physics (WBPH002-10)	10		
Waves and optics (WBPH032-05)	5	X	
Track specific courses in: - Biophysics & Medical Physics - Energy & Environmental Physics - Nanophysics - Particle Physics	40[1]		
Minor	15[2]		
Bachelor Research Project (Physics) (WBPH903-15)	15[3]	X	Requires 150 ECTS of the Bachelor's degree programme completed.

[1] In case of Education minor this is 25 ECTS.
[2] In case of Education minor this is 30 ECTS.
[3] In case of a double degree Physics and Mathematics a combined research of 20 ECTS has to be done.

4.2 Track: Biophysics & Medical Physics (BMP)

Course unit (course code)	ECTS	Practical	Remarks
Year 2			
Biomaterials 1 (WBBE007-05)	5		
Molecular Biophysics (WBPH023-05)	5		
Year 3			
Cellular Chemistry (WBCH021-05)	5	X	
Imaging Techniques in Radiology (WBBE012-05)	5	X	
Modelling Life (WBBY024-05)	5	X	Not with Education minor
Physics Laboratory 4 (WBPH026-05)	5	X	Not with Education minor
Physics of Fluids (WBPH042-05)	5		
Choice: - Nanophysics and Nanotechnology (WBPH025-05) - Principles of Measurement Systems (WBPH029-05) - Introduction to Science Communication (WBEC001-05) [4] - Oriëntatie op Onderwijs in de Bètawetenschappen(WBEC002-05) [5]	5		Not with Education minor

4.3 Track: Energy & Environmental Physics (EEP)

Course unit (course code)	ECTS	Practical	Remarks
Year 2			
Climate System and Atmosphere (WBPH048-05)	5		
Geo-energy (WBPH018-05)	5	X	
Year 3			
Air Pollution (WBPH035-05)	5		Not with Education minor
Energy from Gas (WBPH039-05)	5		
Molecular Spectra and Structure	5		
Physics Laboratory 4 (WBPH026-05)	5	X	Not with Education minor
Physics of Fluids (WBPH042-05)	5		
Choice: - Principles of Measurement Systems (WBPH029-05) - Introduction to Science Communication (WBEC001-05) [6] - Oriëntatie op Onderwijs in de Bètawetenschappen(WBEC002-05) [7]	5		Not with Education minor

[4] Additional programme specific requirements apply.
[5] Additional programme specific requirements apply.
[6] Additional programme specific requirements apply.
[7] Additional programme specific requirements apply.

4.4 Track: Nanophysics (NP)

Course unit (course code)	ECTS	Practical	Remarks
Year 2			
Complex Analysis (*TBA*)	5		
Quantum Physics 2 (WBPH052-05)	5		
Year 3			
Device Physics (WBPH037-05)	5		
Materials Design: Theoretical Methods (WBCH024-05)	5		
Nanophysics and Nanotechnology (WBPH025-05)	5		Not with Education minor
Nano-probing and Nano-fabrication (WBPH041-05)	5		
Solid State Physics 1 (WBPH030-05)	5		Not with Education minor
Choice: - Physics Laboratory 4 (WBPH026-05) - Principles of Measurement Systems (WBPH029-05) - Introduction to Science Communication (WBEC001-05) [8] - Oriëntatie op Onderwijs in de Bètawetenschappen(WBEC002-05) [9]	5		Not with Education minor

4.5 Track: Particle Physics (PP)

Course unit (course code)	ECTS	Practical	Remarks
Year 2			
Complex Analysis (WBMA018-05)	5		
Quantum Physics 2 (WBPH052-05)	5		
Year 3			
Astroparticle physics (WBPH036-05)	5		
Symmetry in Physics (WBPH047-05)	5		
Subatomic Physics (WBPH031-05)	5		Not with Education minor
Choice - Relativistic Quantum Mechanics (WBPH045-05) - Experimental Particle Physics (WBPH040-05)	5		
Choice - Physics Laboratory 4 (WBPH026-05) - Advanced Mechanics (WBPH017-05)	5		Not with Education minor
Choice - Principles of Measurement Systems (WBPH029-05) - Project Chaos Theory (WBMA025-05) - Introduction to Science Communication (WBEC001-05) [10] - Oriëntatie op Onderwijs in de Bètawetenschappen(WBEC002-05) [11]	5		Not with Education minor

[8] Additional programme specific requirements apply.
[9] Additional programme specific requirements apply.
[10] Additional programme specific requirements apply.
[11] Additional programme specific requirements apply.

4.6 Minor: Quantum Materials & Radiation

The minor comprises a choice of 15 ECTS from the list below and is a coherent and deepening package of course units.

Course unit (course code)	ECTS	Practical	Remarks
Atoms and Molecules (WBPH003-05)	5		
Cosmology (WBAS001-05)	5		
Nuclear Energy (WBPH010-05)	5		
Nuclear Physics (WBPH011-05)	5		
Physical and Chemical Kinetics (WBPH012-05)	5		
Solid Mechanics (WBPH015-05)	5		

4.7 Post-propaedeutic phase double bachelor's degree in Mathematics and Physics

In case of a double degree Physics and Mathematics a combined research of 20 ECTS. A complete overview of all additional obligations and modifications within the post-propaedeutic phase of the Mathematics and Physics degree programmes is provided in the Teaching and Examination Regulations of the Bachelor's degree programme in Mathematics.

Appendix V Admission to the post-propaedeutic phase (Article 6.1.1)

The following candidates will be admitted to the post-propaedeutic phase:

a. Students who have been issued a positive study advice from the degree programme in question;
b. Students who have been issued a positive study advice from one of the degree programmes:
    - Applied Physics

Appendix VI Contact hours propaedeutic and post-propaedeutic phase (Article 3.5.3)

Bachelor's year 1	
Structure contact hours	**Contact hours per year**
Lectures	319
Tutorial/practicals	371
Projects	38
Tutoring	8
Examinations	45
Other structured hours	24

Bachelor's year 2	
Structure contact hours	**Contact hours per year**
Lectures	305
Tutorial/practicals	247
Projects	51
Tutoring	0
Examinations	40
Other structured hours	20

Bachelor's year 3	
Structure contact hours	**Contact hours per year**
Lectures	184
Tutorial/practicals	151
Projects	560
Tutoring	0
Examinations	40
Other structured hours	20

Appendix VII Additional Requirements Open degree Programmes (Art. 7.3)

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 VIII Transitional arrangement (article 12.1)

Discontinued course units				**Substitute course units**				
Course unit code	*Course unit name*	*ECTS*	*Final exam*	*Course unit code*	*Course unit name*	*ECTS*	*Explanation*	*Equivalent Yes/No*
WBPH007-05	Ionizing Radiation in Medicine	5	*22/23*	--	--	--	--	--