university of groningen / faculty of science and engineering / physics

Appendices to the Teaching and Examination Regulations for the

Bachelor's degree programme in Physics

2026-2027

Appendix I. Learning outcomes of the Bachelor's degree programme (Art. 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 investigate 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 gained within in the Minor:

- a deeper knowledge of subjects within one of the following fields of physics:
  a. Biophysics and Medical Physics
  b. Energy and Environmental Physics
  c. Nanophysics
  d. Particle Physics
  e. Education in Physics
- broad general knowledge within 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 analyse experimental constructs and/or experimental data to gain insight in the fundamental workings of nature.

Appendix II. Majors and Minors of the Bachelor's degree programme (Art. 3.7.4 and 7.1.3)

The degree programme consists of the Physics major (150 ECTS) and a free minor (30 ECTS).

Majors:
The Physics major of 150 ECTS is mandatory for all Physics students.

Minors:
1. The Bachelor's degree programme of Physics offers the following deepening minors:
   - Biophysics & Medical Physics (30 ECTS)
   - Energy & Environmental Physics (30 ECTS)
   - Nanophysics (30 ECTS)
   - Particle Physics (30 ECTS)

   These deepening minors are offered for students in the Bachelor's degree programme of Physics.

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

   This university minor is offered university wide and as such not available for students from the bachelor degree programmes Physics, Applied Physics, and Astronomy.

Double bachelor's degree in Mathematics and Physics

A student who desires to obtain two Bachelor's degrees in both Mathematics and Physics has to be enrolled in both degree programmes. The learning outcomes of both programmes are met by combining a predetermined set of courses with a total workload of 250 ECTS. See the document "Appendix for the double Bachelor's degree programme in Mathematics and Physics" for further details.

Appendix III. Course units in the first year of the degree programme

- **List of course units (Art. 4.1.1 and 9.4.3)**
- **Compulsory order of examinations (Art. 9.3)**

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

Physics major programme

Course unit (course code)	ECTS	Remarks
Calculus 1 (for Physics) (WBPH057-05)	5	
Calculus 2 (for Physics) (WBPH058-05)	5	
Computational Methods 1 (WBPH064-05)	5	
Differential Equations (for Physics) (WBPH089-05)	5	
Electricity and Magnetism (WBPH033-10)	10	
Linear Algebra (for Physics) (WBPH054-05)	5	
Mechanics and Relativity (WBPH001-10)	10	
Physics Lab: Research Project (WBPH076-05)	5	
Physics Lab: Skills (WBPH077-05)	5	
Choice: - Introduction to Astronomy (WBAS007-05) - Introduction to Energy & Environment (WBPH019-05) - Introduction to Nanophysics (WBPH055-05) - Medical Physics & Biophysics (WBPH022-05) - Physics of Modern Technology (WBPH027-05) - Physics of the Quantum Universe (WBPH028-05)	5	

Appendix IV. Course units second and third years of the degree programme

- **List of course units (Art. 4.1.1 and 9.4.3)**
- **Compulsory order of examinations (Art. 9.3)**

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

4.1 Physics major programme

Course unit (course code)	ECTS	Remarks
Year 2		
Physics Lab: Advanced Experiments 1 (WBPH074-05)	5	
Computational Methods 2 (WBPH065-05)	5	
Fundamentals of Electronics (WBPH070-05)	5	
Subatomic physics: concepts and experiments (WBPH088-05)	5	
Quantum Physics 1 (WBPH014-05)	5	
Quantum Physics 2 (WBPH052-05)	5	
From Atoms to Solids (WBPH085-10)	10	
Thermal Physics (WBPH002-10)	10	
Waves and optics (WBPH032-05)	5	
Choice: - Biomaterials 1 (WBBE007-05) - Complex Analysis (for Physics) (WBPH059-05) - Geo-Energy (WBPH018-05)	5	
Year 3		
Physics & Society: Ethical and Professional Aspects (WBPH083-05)	5	
Choice: - Nanophysics and Nanotechnology (WBPH025-05) - Physics Lab: Advanced Experiments 2 (WBPH073-05) - Statistics for modern physics (WBPH080-05)	5	
Choice: - Advanced Electrodynamics (WBPH079-05) - Physics of Fluids (WBPH042-05)	5	
Minor	30	Depending on the minor
Bachelor Research Project (Physics) (WBPH903-15)	15[1]	Requires 150 ECTS of the Bachelor's degree programme completed. Additionally, third-year BSc Physics students who have obtained 135 ECTS of the degree programme within the first three years of registration are also allowed to start the Bachelor Research Project.

[1] In case of a double degree Physics and Mathematics a combined research of 20 ECTS has to be done.

4.2 Minor: Biophysics & Medical Physics (BMP)

Course unit (course code)	ECTS	Remarks
Choice: - Chemistry of Materials for Physicists (WBPH073-05) - Ionizing Radiation in Medicine (WBPH007-05) - Modelling Life (WBBY024-05) - Molecular Biophysics (WBPH023-05) - Optical Spectroscopy (WBPH078-05) - Principles of Measurement Systems (WBPH029-05) - Introduction to Science Communication (WBEC001-05) * - Introduction to Science Education (WBEC002-05) * - Tailored Project Course in Physics (WBPH091-05) * - Teach like a scientist (WBEC004-05) *	30	Additional course specific entry requirements may apply regarding WBEC001-05, WBEC002-05, and WBEC004-05.

* Only one out of four can be chosen as part of this minor.

4.3 Minor: Energy & Environmental Physics (EEP)

Course unit (course code)	ECTS	Remarks
Air Pollution (WBPH035-05)	5	
Introduction to Energy Systems (WBPH084-05)	5	
Climate System and Atmosphere (WBPH048-05)	5	
Nuclear Energy (WBPH010-05)	5	
Solar Cells (WBCH018-05)	5	
Choice: - Introduction to Science Communication (WBEC001-05) - Introduction to Science Education (WBEC002-05) - Principles of Measurement Systems (WBPH029-05) - Teach like a scientist (WBEC004-05)	5	Additional course specific entry requirements may apply regarding WBEC001-05, WBEC002-05, and WBEC004-05.

4.4 Minor: Nanophysics (NP)

Course unit (course code)	ECTS	Remarks
Device Physics (WBPH037-05)	5	
Nanophysics and Nanotechnology (WBPH025-05)	5	
Solid State Physics (WBPH068-05)	5	
Choice: - Atoms and Molecules (WBPH003-05) - Chemistry of Materials for Physicists (WBPH073-05) - Optical Spectroscopy (WBPH078-05) - Principles of Measurement Systems (WBPH029-05) - Solar Cells (WBCH018-05) - Solid Mechanics (WBIE055-05) - Introduction to Science Communication (WBEC001-05) * - Introduction to Science Education (WBEC002-05) * - Tailored Project Course in Physics (WBPH091-05) * - Teach like a scientist (WBEC004-05) *	15	Additional course specific entry requirements may apply regarding WBEC001-05, WBEC002-05, and WBEC004-05.

* Only one out of four can be chosen as part of this minor.

4.5 Minor: Particle Physics (PP)

Course unit (course code)	ECTS	Remarks
Choice: - Advanced Mechanics (WBPH017-05) - Atoms and Molecules (WBPH003-05) - Cosmology (WBAS001-05) - Experimental Particle Physics (WBPH040-05) - Nuclear Physics (WBPH011-05) - Particle Physics (WBPH081-05) - Relativistic Quantum Mechanics (WBPH045-05) - Symmetry in Physics (WBPH047-05) - Introduction to Science Communication (WBEC001-05) * - Introduction to Science Education (WBEC002-05) * - Tailored Project Course in Physics (WBPH091-05) * - Teach like a scientist (WBEC004-05) *	30	Additional course specific entry requirements may apply regarding WBEC001-05, WBEC002-05, and WBEC004-05.

* Only one out of four can be chosen as part of this minor.

Appendix V. Contact hours (Art. 3.6)

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	90
Tutorial/practicals	140
Projects	500
Tutoring	0
Examinations	20
Other structured hours	30

Appendix VI. 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. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme.

Appendix VII. Transitional provisions (Art. 12.1)

8.1 Transitional arrangement 2026-2027

Discontinued course units				**Substitute course units**				
Course code	*Course name*	*ECTS*	*Final exam*	*Course code*	*Course name*	*ECTS*	*Explanation*	*Equivalent Yes/No*
WBPH012-10	Physical and Chemical Kinetics	5	26/27	WBPH073-10	Chemistry of Materials	5	Substituting course in NP and BMP *	Yes
WBPH012-10	Physical and Chemical Kinetics	5	26/27	WBPH048-10	Climate System and Atmosphere	5	Substituting course in EEP **	Yes

* For minors Nanophysics (NP) and Biophysics & Medical Physics (BMP).
** For minor Energy & Environmental Physics (EEP)

8.2 Transitional arrangement 2025-2026

Discontinued course units				**Substitute course units**				
Course code	*Course name*	*ECTS*	*Final exam*	*Course code*	*Course name*	*ECTS*	*Explanation*	*Equivalent Yes/No*
WBPH049-10	Mathematical Physics	5	24/25	WBPH089-05	Differential Equations (for Physics)	5	Substituting course	Yes
WBPH015-05	Solid Mechanics	5	24/25	WBIE055-05	Solid Mechanics	5	Substituting course	Yes

8.3 Transitional arrangement 2024-2025

Discontinued course units				**Substitute course units**				
Course code	*Course name*	*ECTS*	*Final exam*	*Course code*	*Course name*	*ECTS*	*Explanation*	*Equivalent Yes/No*
WBPH034-10	Structure of Matter	10	24/25	WBPH085-10	From Atoms to Solids	10	Substituting course	Yes
WBPH031-05	Subatomic Physics	5	23/24	WBPH081-05	Particle Physics	5	Substituting course	Yes
WBPH026-05	Physics Laboratory 4	5	23/24	WBPH073-05	Physics Lab: Advanced Experiments 2	5	Name change	Yes
WBPH053-05	Physics, Astronomy & Society: Ethical and Professional Aspects	5	23/24	WBPH083-05	Physics & Society: Ethical & Professional Aspects	5	Substituting course	Yes *

* The course "Physics, Astronomy & Society: Ethical & Professional Aspects" has been changed into three dedicated versions for Physics, Applied Physics and Astronomy, which will be given in different years in the curricula of the three programmes. For Physics students, the new course, entitled "Physics & Society: Ethical & Professional Aspects", will be offered in the third year as of academic year 2025/2026.

Older-year students, in their third year or higher (i.e. cohorts 2022/2023 and earlier), who still need to pass "Physics, Astronomy & Society: Ethical & Professional Aspects" and prefer not to

wait until the new third-year course, are also allowed to follow the new versions for either Applied Physics (WBPH082-05) or Astronomy (WBAS019-05), already given during academic year 2024/2025.

8.4 Transitional arrangement 2023-2024

Discontinued course units				**Substitute course units**				
Course code	*Course name*	*ECTS*	*Final exam*	*Course code*	*Course name*	*ECTS*	*Explanation*	*Equivalent Yes/No*
WBPH013-05	Physics Laboratory 1	5	23/24	WBPH077-05	Physics Lab: Skills	5	Name change	Yes
WBPH050-05	Physics Laboratory 2	5	23/24	WBPH076-05	Physics Lab: Research Project	5	Name change	Yes
WBPH051-05	Physics Laboratory 3	5	23/24	WBPH074-05	Physics Lab: Advanced Experiments 1	5	Name change	Yes
WBPH030-05	Solid State Physics 1	5	23/24	WBPH068-05	Solid State Physics	5	Name change	Yes
WBPH005-05	Computational Methods in Science and Technology	5	23/24	WBPH064-05	Computational methods 2	5	Name change	Yes
WBPH038-05	Electronics and Signal Processing	5	23/24	WBPH070-05	Fundamentals of Electronics	5	Name change	Yes
WBPH036-05	Astroparticle Physics	5	24/25	WBPH079-05	Advanced Electrodynamics	5	Substituting course	Yes

8.5 Transitional arrangement 2022-2023

Discontinued course units				**Substitute course units**				
Course code	*Course name*	*ECTS*	*Final exam*	*Course code*	*Course name*	*ECTS*	*Explanation*	*Equivalent Yes/No*
WBMA003-05	Calculus 1	5	N/A	WBPH057-05	Calculus 1 (for Physics)	5	Substituting course	Yes
WBMA029-05	Calculus 2	5	N/A	WBPH058-05	Calculus 2 (for Physics)	5	Substituting course	Yes
WBMA018-05	Complex Analysis	5	N/A	WBPH059-05	Complex Analysis (for Physics)	5	Substituting course	Yes
WBPH044-05	Python for Physicists	5	23/24	WBPH063-05	Computational methods 1	5	Name change	Yes