Appendices Bachelor's degree programme Applied Physics

Appendix I Learning outcomes of the degree programme (article 1.3)

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 their own discipline.

A2. Bachelor's graduates have mastered the basic concepts of their own discipline (see Appendix 1 for further specification) to a certain extent 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 current topics within their own discipline.

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 their own discipline, 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 their own discipline.

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

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 a certain 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 Modelling) Bachelor's graduates are able to translate a problem, in particular a design problem, into a plan of approach and – taking into account the requirements of the client and/or technical preconditions – 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 (including multidisciplinary 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 2.

Appendix 1 Degree programme-specific learning outcomes – Basic Knowledge

The Bachelor's graduate in Applied Physics has:

1.1. Knowledge of the most important subjects in the field of
- a) Classical Mechanics / Mechanics
- b) Electromagnetism
- c) Quantum Physics
- d) Thermodynamics
- e) Statistical Physics
- f) Wave phenomena, Oscillations and Optics
- g) Structure and Properties of Materials
- h) Calculus, Linear Algebra and Numerical Mathematics

1.2. Knowledge of
- a) Principles of design
- b) Continuum Mechanics

Appendix 2 Degree programme-specific learning outcomes – Skills

The Bachelor's graduate in Applied Physics is able to:

2.1. estimate the orders of magnitude of various physical processes,
2.2. use specific software, such as a programming language or a (symbolic) software package,
2.3. measure mechanical, electric, magnetic and optical properties of materials, while taking into account the safety and environmental issues,
2.4. calculate with models / mathematical models with design as a purpose.

Appendix II Follow-on Master's degree programmes (Article 1.5)

The Bachelor's degree programme will grant unconditional admission to the following Master's degree programmes at the University of Groningen:

- Applied Physics
- Education and Communication in Mathematics and Natural Sciences
- Energy and Environmental Sciences

Appendix III Majors and Minors in the degree programme (Article 2.1.2)

1) The programme consists of the Major Applied Physics
2) The programme consists of a deepening Minor Applied Physics

Appendix IV Course units in the propaedeutic phase

- **List of course units; Article 3.1.1**
- **Course units with one or more practicals; Article 3.2**
- **Form of examinations; Article 7.4**

Course unit	ECTS	Assessment method	Practical
Calculus 1	5	Written exam , test	x
Physics Laboratory 1	5	Written exam, practical assessment (preparation, experimental skills, lab journal, reports, discussion of results)	x
Choice: ▪ Kaleidoscope Modern Physics ▪ Molecules: Structure, Reactivity, and Function ▪ Introduction to Mathematics	5	▪ Written exam ▪ Written exam, practical assessment, discussion of results ▪ Written exam	x
Thermodynamics	5	Written exam	
Mechanics and Relativity 1	5	Written exam	
Linear Algebra 1	5	Written exam, practical assessment	x
Mechanics and Relativity 2	5	Written exam, practical assessment	x
Calculus 2	5	Written exam	
Choice: ▪ Introduction Astronomy ▪ Physics of Modern Technology ▪ Bachelor Tracks ▪ Introduction NExT ▪ Introduction to Energy and Environment ▪ Physics of Life	5	▪ Homework, mid-exam, written exam, report, mandatory attendance Introduction Research ▪ Written exam, presentation, essay, mandatory attendance Introduction Research ▪ Written exam, presentation, mandatory attendance Introduction Research ▪ Written exam, mandatory attendance Introduction Research ▪ Written exam, mandatory attendance Introduction Research ▪ Oral exam, mandatory attendance Introduction Research	
Calculus 3	5	Written exam	
Electricity and Magnetism I	5	Written exam, practical assessment	x
Physics Laboratory 2	5	Practical assessment (presentation schedule, presentation of results, report, poster presentation)	x

Appendix V Course units in the post-propaedeutic phase

- **List of course units; Article 6.1**
- **Course units with one or more practicals; Article 6.2**
- **Compulsory order of examinations; Article 7.2**
- **Form of examinations; Article 7.4**

Course unit	ECTS	Assessment method	Practical	Prerequisites
Introduction to Programming and Numerical Methods	5	Written exam, practical assessment	x	
Electricity and Magnetism II	5	Written exam		
Quantum Physics 1	5	Written exam		
Materials Science	5	Written exam, assignments	x	
Waves and optics	5	Written exam, practical assessment	x	
Statistical Physics	5	Written exam		
Electronics and Signal Processing	5	Written exam, practical assessment	x	
Structure of Matter 1	5	Written exam		
Science and Society	5	Written exam, performance, essay, presentation, mandatory attendance		
Structure of Matter 2	5	Written exam		
Physics Laboratory 3	5	Practical assessment (preparation, experimental skills, lab journal, report, discussion of results)	x	
Numerical Mathematics 1	5	Written exam	x	
Physics Laboratory 4	5	Practical assessment (preparation, experimental skills, lab journal, report, discussion of results)	x	
Solid State Physics 1	5	Written exam		
Control Engineering	5	Written exam, practical assessment	x	
Choice: ▪ Nanophysics and Nanotechnology ▪ Imaging Techniques in Radiology	5	 ▪ Written exam ▪ Written exam, report, presentation	 x	
Solid Mechanics	5	Written exam, homework, practical report	x	
Principles of Measurement Systems	5	Written exam, homework assignments		
Physics of Fluids	5	Written exam		
Product Design by the FEM	5	Assignments	x	
Device Physics	5	Written exam, case studies		
Bachelor's Research Project	15	Performance, presentation, report	x	Passed 150 ECTS of the Bachelor's degree programme

Appendix VIII Admission to the post-propaedeutic phase

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

- Holders of a propaedeutic certificate of the degree programmes in Physics or Applied Physics