

# **Appendices Bachelor's degree programme Astronomy**

## **Appendix I Learning outcomes of the degree programme (artikel 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) 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 Astronomy

1. has some knowledge of the historical development of the astronomical worldview
2. is familiar with the principles of positional astronomy,
3. masters the basic astrophysics of planets, stars and galaxies, interstellar medium and cosmology,
4. knows the basic principles concerning conducting astronomical observations in different wavelength regimes and processing the obtained observational data,
5. has a thorough knowledge of theoretical astrophysics,
6. has a thorough knowledge of general mathematics (calculus, linear algebra, complex analysis, error analysis, and statistics).
7. has a thorough knowledge of general physics (classical mechanics, electromagnetism, quantum physics, thermodynamics, statistical physics, wave phenomena, oscillations and optics, matter: structure and interactions)
8. (minor) has a deeper knowledge of subjects within their own discipline or a broad general knowledge of a different discipline.

## Appendix 2 Degree programme-specific learning outcomes – Skills

The bachelor's graduate in Astronomy

1. is on an elementary level able to obtain, analyse, and presents observations in different wavelength regimes of objects like stars, galaxies, and star forming regions,
2. is able to conduct basic astronomical observations with an optical telescope,
3. is familiar with the use of computers and computing in astronomy research:
  - has experience in working with astronomical observations and/or astronomical simulations
  - is able to write software in a common programming language.

## **Bijlage II Doorstroommasteropleidingen (artikel 1.5)**

De bacheloropleiding geeft recht op onvoorwaardelijke toegang tot de volgende masteropleidingen van de Rijksuniversiteit Groningen:

- o Astronomy
- o Educatie en Communicatie in de Wiskunde en Natuurwetenschappen
- o Energy and Environmental Sciences

## **Bijlage III Majoren en minoren van de opleiding (artikel 2.1, lid 2)**

The programme consists of the major Astronomy (90 ects) and a minor (30 ects).

The student can participate in either the minor Astronomy or the minor Instrumentation & Informatics or a Faculty or University Minor.

**Bijlage IV Studieonderdelen van de propedeutische fase**  
**- Lijst met studieonderdelen; artikel 3.1.1**  
**- Vakken met een of meerdere practica; artikel 3.2**  
**- Vorm van de tentamens; artikel 7.4**

Module	ECTS	Assessment method	practical
Calculus 1	5	Written exam, test mathematical skills	x
Physics Laboratory 1	5	Written exam, practical assessment (preparation, experimental skills, lab journal, reports, discussion of results)	x
Choice: <ul style="list-style-type: none"> <li>▪ Kaleidoscope Modern Physics</li> <li>▪ Molecules: structure, reactivity and function</li> <li>▪ Introduction Mathematics</li> </ul>	5	<ul style="list-style-type: none"> <li>▪ Written exam</li> <li>▪ Assignments, written exam, practical assessment</li> <li>▪ Written exam</li> </ul>	x
Thermodynamics	5	Assignments, written exam	
Mechanics and Relativity 1	5	Written exam	
Linear Algebra 1	5	Assignments, written exam	x
Mechanics and Relativity 2	5	Assignments, written exam, practical assessment	x
Calculus 2	5	Assignments, written exam	
Choice: <ul style="list-style-type: none"> <li>▪ Introduction Astronomy</li> <li>▪ Physics of Modern Technology</li> <li>▪ Introduction NEXT</li> <li>▪ Introduction to Energy and Environment</li> <li>▪ Physics of Life</li> </ul>	5	<ul style="list-style-type: none"> <li>▪ Assignments, mid-exam, written exam, report, mandatory attendance Introduction Research</li> <li>▪ Written exam, presentation, essay, mandatory attendance Introduction Research</li> <li>▪ Assignments, written exam, presentation, mandatory attendance Introduction Research</li> <li>▪ Written exam, presentation, mandatory attendance Introduction Research</li> <li>▪ Assignments, written exam, presentation, mandatory attendance Introduction Research</li> </ul>	x x x x x
Calculus 3	5	Assignments, written exam	
Electricity and Magnetism 1	5	Written exam,	
Introduction to programming and numerical methods	5	Assignments, reports, poster presentation	x

**Bijlage V Studieonderdelen van de post-propedeutische fase**

- **Lijst met studieonderdelen; artikel 6.1**
- **Vakken met een of meerdere practica; artikel 6.2**
- **Verplichte volgorde tentamens; artikel 7.2**
- **Vorm van de tentamens; artikel 7.4**

Module	ECTS	Assessment method	practical	prerequisites
Observational Astronomy	5	Assignments, presentation, practical assessment	x	
Electricity and Magnetism 2	5	Written exam		
Quantum Physics 1	5	Written exam		
Statistical Physics	5	Assignments, written exam		
Waves and Optics	5	Written exam		
Complex Analysis	5	Written exam		
Structure of Matter 1	5	Written exam		
Science and Society	5	Written exam, performance, essay, presentation, compulsory attendance		
Statistical and Numerical Methods	5	Assignments, written exam	x	
Physics of Stars	5	Written exam, mid-term exam		
Quantum Physics 2	5	Assignments, written exam		
Physics of Galaxies	5	Written exam		
Minor	30	Depending on the minor	Depending on the minor	Depending on the minor
Astroparticle physics	5	Written exam		
Interstellar Medium	5	Written exam		
Astrophysical Hydrodynamics	5	Written exam		
Bachelor Research Project	15	Performance, presentation, report	x	Passed 135 ECTS of the bachelor's degree programme

## Minor Astronomy

The minor comprises 30 ECTS and is a coherent and deepening package of modules

Module	ECTS	Assessment method	practical	Prerequisites
Cosmology	5	Written exam, homework, assignments		
Radio Astronomy	5	Written exam, homework, assignments	x	
Choice: <ul style="list-style-type: none"> <li>▪ Basic Detection Techniques (biennial, 2015/16)</li> <li>▪ Stellar Structure and Evolution (biennial, 2014/15)</li> <li>▪ High Energy Astrophysics (biennial, 2015/16)</li> </ul>	5	<ul style="list-style-type: none"> <li>▪ Assignments</li> <li>▪ Written exam</li> <li>▪ Assignments, written exam</li> </ul>	<ul style="list-style-type: none"> <li>x</li> <li></li> <li>x</li> </ul>	
Choice from the bachelor's degree programme (Applied) Physics	5	See Appendix IV and V of the teaching and examination regulations (TER) of the relevant programme	See Appendix IV and V of the TER of the relevant programme	See Appendix IV and V of the TER of the relevant programme
Choice: <ul style="list-style-type: none"> <li>▪ Cosmic structure formation (biennial, 2014/15)</li> <li>▪ Dynamics of Galaxies (biennial, 2015/16)</li> <li>▪ Statistical signal processing</li> <li>▪ Space Mission Technology (biennial, 2015/16)</li> </ul>	5	<ul style="list-style-type: none"> <li>▪ Written exam</li> <li>▪ Assignments, written exam</li> <li>▪ Assignments, written exam</li> <li>▪ Written exam</li> </ul>		
Electromagnetics and radiative processes	5	Written exam		
Advanced Mechanics	5	Assignments, written exam	x	

## Minor Instrumentation and Informatics

Module	ECTS	Assessment method	practical	prerequisites
Basic Detection Techniques (biennial, 2015/16)	5	Assignments, report about experiments	x	
Materials Science and Design	5	Written exam, assignments	x	
Control Engineering	5	Written exam, reports	x	
Space Mission Technology (biennial, 2015/16)	5	Written exam		
Principles of Measurement Systems	5	Assignments, written exam		
Choice (2014/15): <ul style="list-style-type: none"> <li>• Radio Astronomy</li> <li>• Cosmology</li> </ul>	5	<ul style="list-style-type: none"> <li>• Written exam, homework, assignments</li> <li>• Written exam, homework, assignments</li> </ul>	x	
Statistical Signal Processing	5	Assignments, written exam		

## **Bijlage VI Vooropleidingseisen**

## **Bijlage VII Clustering bacheloropleidingen**

## **Bijlage VIII Toelating post-propedeutische fase**

Toelaatbaar tot de postpropedeutische fase, is

- de bezitter van het propedeutisch getuigschrift van de opleiding Sterrenkunde;

## **Bijlage IX Aard contacturen propedeutische fase**

<b>Bachelor jaar 1</b>	
<b>Contacttijd</b>	<b>Aantal contacturen per jaar</b>
Hoorcolleges	335
Werkcolleges	290
Practica	100
Stagebegeleiding	0
Toetsen/tentamens/examens	45 ??
Studieloopbaanbegeleiding	8 ??
Overige gestructureerde uren	50