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

**2019-2020**

**Bachelor's degree programme in Astronomy**



## **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 their own discipline.

A2. Bachelor's graduates have mastered the basic concepts of their own discipline (see Appendix 1.1 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 contemporary 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, 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 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) Bachelor's graduates are able to translate an astronomy problem, in particular a design problem, into a plan of approach and – taking into account the 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 in English, both 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.



### **Degree programme-specific learning outcomes - Basic Knowledge**

1. The bachelor's graduate in Astronomy
  - 1.1. has some knowledge of the historical development of the astronomical worldview;
  - 1.2. is familiar with the principles of positional astronomy;
  - 1.3. masters the basic astrophysics of planets, stars and galaxies, interstellar medium and cosmology;
  - 1.4. knows the basic principles concerning conducting astronomical observations in different wavelength regimes and processing the obtained observational data;
  - 1.5. has a thorough knowledge of theoretical astrophysics;
  - 1.6. has a thorough knowledge of general mathematics (calculus, linear algebra, complex analysis, error analysis, and statistics);
  - 1.7. has a thorough knowledge of general physics (classical mechanics, electromagnetism, quantum physics, thermodynamics, statistical physics, wave phenomena, oscillations and optics, matter: structure and interactions);
  - 1.8. (minor) has a deeper knowledge of subjects within their own discipline or a broad general knowledge of a different discipline.

### **Degree programme-specific learning outcomes – Skills**

2. The bachelor's graduate in Astronomy
  - 2.1. 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;
  - 2.2. is able to conduct basic astronomical observations with an optical telescope;
  - 2.3. 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.



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## **Appendix II Majors and Minors of the degree programme (Article 3.7.4)**

The programme consists of the major Astronomy (90 ects) and a minor (30 ects). The student can participate in either the minor Astronomy, the minor Instrumentation & Informatics or a Faculty or University Minor.



### Appendix III Course units in the propaedeutic phase

- **List of course units; Article 4.1.1**
- **Compulsory order of examinations; Article 9.2**

The assessment method of the courses can be found in the assessment plan of the degree programme and on Ocasys

Course unit name	ECTS	Practical	Entry requirements
Mechanics and Relativity	10	X	
Physics Laboratory 1	5	X	
Calculus 1	5	X	
Choice: <ul style="list-style-type: none"><li>- Introduction to Astronomy</li><li>- Introduction to Energy &amp; Environment</li><li>- Medical Physics &amp; Biophysics</li><li>- Nanophysics</li><li>- Physics of Modern Technology</li><li>- Physics of the Quantum Universe</li></ul>	5		
Linear Algebra 1	5	X	
Electricity and Magnetism	10	X	
Calculus 2	5		
Introduction to Programming	5	X	
Mathematical Physics	5		
Observational Astronomy	5	X	



## Appendix IV Course units in the post-propaedeutic phase

- **List of course units; Article 7.1.1**
- **Compulsory order of examinations; Article 9.2**

The assessment method of the courses can be found in the assessment plan of the degree programme and on Ocasys

<b>Course unit name</b>	<b>ECTS</b>	<b>Practical</b>	<b>Entry requirements</b>
Thermal Physics	10		
Quantum Physics 1	5		
Complex Analysis	5		
Statistics for Astronomy	5	X	
Waves and Optics	5	X	
Science, Ethics, Technology, and Society	5		
Numerical Methods	5	X	
Structure of Matter 1	5		
Physics of Galaxies	5		
Physics of Stars	5		
Quantum Physics 2	5		
Minor	30	Depending on the minor	Depending on the minor
Astrophysical Hydrodynamics	5		
Astroparticle Physics	5		
Interstellar Medium	5		
Bachelor Research Project (Astronomy)	15	X	Passed 135 ECTS of the Bachelor's degree programme



### Minor Astronomy

The Minor comprises of 30 ECTS and is a coherent and deepening package of course units.

Course unit name	ECTS	Practical	Entry requirements
Cosmology	5		
Planetary Systems	5		
Choice: - Atoms and Molecules - Nuclear Physics - Space Mission Technology	5		
Choice: - Advanced Mechanics - Radio Astronomy - Statistical Signal Processing - Introduction to Science Communication - Oriëntatie op Onderwijs in de Bètawetenschappen	15	X	See the programme-specific appendices IV and V of the Teaching and Examination Regulation.

### Minor Instrumentation and Informatics

The Minor comprises of 30 ECTS and is a coherent and deepening package of course units.

Course unit name	ECTS	Practical	Entry requirements
Control Engineering	5	X	
Materials Science and Engineering	5	X	
Principles of Measurement Systems	5		
Statistical Signal Processing	5		
Choice: - Radio Astronomy - Cosmology - Space Mission Technology - Introduction to Science Communication - Oriëntatie op Onderwijs in de Bètawetenschappen	10	X	See the programme-specific appendices IV and V of the Teaching and Examination Regulation



## Appendix V Entry requirements (Article 2.1, article 2.2)

### A. Deficient VWO-diploma

- The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

<b>Bacheloropleiding</b> <i>Bachelor's degree programme</i>	<b>N+T</b>	<b>N+G</b>	<b>E+M</b>	<b>C+M</b>
<b>Biologie</b> <i>Biology</i>	Biologie	Natuurkunde	Wiskunde A of B Natuurkunde Scheikunde Biologie	Wiskunde A of B Natuurkunde Scheikunde Biologie
<b>Farmacie</b> <i>Pharmacy</i>	V	Natuurkunde	Natuurkunde Scheikunde	Wiskunde A of B Natuurkunde Scheikunde
<b>Life Science and Technology</b>  <b>Scheikunde</b> <i>Chemistry</i> <b>Scheikundige Technologie</b> <i>Chemical Engineering</i>	V	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde Scheikunde	Wiskunde B Natuurkunde Scheikunde
<b>Biomedische Technologie (in oprichting)</b> <i>Biomedical Engineering</i>	V	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde
<b>Informatica</b> <i>Computing Science</i> <b>Technische Bedrijfskunde</b> <i>Industrial Engineering and Management</i> <b>(Technische) Wiskunde</b> <i>(Applied) Mathematics</i>	V	Wiskunde B	Wiskunde B	Wiskunde B
<b>Kunstmatige Intelligentie</b> <i>Artificial Intelligence</i>	V	V	V	Wiskunde A of B
<b>(Technische) Natuurkunde</b> <i>(Applied) Physics</i> <b>Sterrenkunde</b> <i>Astronomy</i>	V	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde	Wiskunde B Natuurkunde





- The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

**B. HBO (university of applied sciences) or academic propaedeutic certificate**

- The following requirements apply to the entrance examination as defined in Article 7.28.3 of the Act:

<b>Bachelor's degree programme</b>	<b>Subjects at VWO (pre-university) level</b>
B Biology	wia or wib + na+sk+bio
B Pharmacy	wia or wib + na+sk
B Life Science and Technology	wib+na+sk
B Biomedical Engineering	wib + na
B Computing Science	wib
B Artificial Intelligence	wia or wib
B Physics	wib+na
B Chemistry	wib+na+sk
B Astronomy	wib+na
B Mathematics	wib
B Chemical Engineering	wib+na+sk
B Industrial Engineering and Management Science	wib
B Applied Physics	wib+na
B Applied Mathematics	wib

wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology

- In addition, candidates are required to be competent in English:

<b>Score -&gt;</b>	<b>Overall</b>	<b>Reading</b>	<b>Listening</b>	<b>Speaking</b>	<b>Writing</b>
<b>Test</b>					
<b>IELTS (Academic)</b>	6.5	6.5	6.5	6.5	6.5
<b>TOEFL IBT (internet-based)</b>	90	21	21	21	24
<b>Cambridge English</b>	CAE or CPE Certificate with a minimum score of 180				
<b>English language test – TC UG</b>	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.



3. The Admissions Board Bachelor programmes FSE will determine whether deficiencies have been compensated satisfactorily.

**C. Foreign qualifications (EEA)**

1. Any certificate that grants access to a university in a European country will also grant access to Dutch universities.
2. In the entrance examination, as referred to in art. 7.28, paragraph 3 of the Act, per country and educational institution specific training conditions are mentioned. These are standardized. The entrance examination is, in accordance with the Admissions Board Bachelor’s programmes FSE, carried out by the Admissions Office. If for a specific diploma no standardisation has taken place then the requirements as formulated for candidates with a HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).
3. In addition, candidates are required to be competent in English:

Score ->	Overall	Reading	Listening	Speaking	Writing
<b>Test</b>					
<b>IELTS (Academic)</b>	6.5	6.5	6.5	6.5	6.5
<b>TOEFL IBT (internet-based)</b>	90	21	21	21	24
<b>Cambridge English</b>	CAE or CPE Certificate with a minimum score of 180				
<b>English language test – TC UG</b>	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

4. The Admissions Board Bachelor’s programmes FSE will determine whether deficiencies have been compensated satisfactorily.

**D. Foreign qualifications (non-EEA)**

1. A non-European certificate that according to NUFFIC and/or NARIC standards is equivalent to a Dutch VWO certificate will grant access to university in the Netherlands.
2. In the entrance examination, as referred to in art. 7.28, paragraph 3 of the Act, per country and educational institution specific training conditions are mentioned. These are standardized. The entrance examination is, in accordance with the Admissions Board Bachelor’s programmes FSE, carried out by the Admissions Office. If for a specific diploma no standardisation has taken place then the requirements as formulated for candidates with a HBO (university of applied science) propaedeutic certificate will apply to these candidates in the entrance examination as defined in Article 7.28.3 of the Act (see A).



3. In addition, candidates are required to be competent in English:

Score ->	Overall	Reading	Listening	Speaking	Writing
<b>Test</b>					
<b>IELTS (Academic)</b>	6.5	6.5	6.5	6.5	6.5
<b>TOEFL IBT (internet-based)</b>	90	21	21	21	24
<b>Cambridge English</b>	CAE or CPE Certificate with a minimum score of 180				
<b>English language test – TC UG</b>	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

4. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.

### E. Entrance examination (Colloquium Doctum)

1. The following requirements apply to the entrance examination as defined in Article 7.29 of the Act:

Degree programme	Nature and Health VWO level	or	Nature and Technology VWO level
B Biology	en, wia or b, sk, bio, na		en, wib, na, sk, bio
B Pharmacy	en, wia or b, sk, bio, na		en, wib, na, sk
B Life Science and Technology	en, wib, sk, bio, na		en, wib, na, sk
B Computing Science	en, wib, sk, bio		en, wib, na, sk
B Artificial Intelligence	en, wia or b, sk, bio		en, wib, na, sk
B Physics	en, wib, sk, bio, na		en, wib, na, sk
B Chemistry	en, wib, sk, bio, na		en, wib, na, sk
B Astronomy	en, wib, sk, bio, na		en, wib, na, sk
B Mathematics	en, wib, sk, bio		en, wib, na, sk
B Chemical Engineering	en, wib, sk, bio, na		en, wib, na, sk
B Industrial Engineering and Management Science	en, wib, sk, bio		en, wib, na, sk
B Applied Physics	en, wib, sk, bio, na		en, wib, na, sk
B Applied Mathematics	en, wib, sk, bio		en, wib, na, sk

en = English; wia = Mathematics A; wib = Mathematics B; na = Physics; sk = Chemistry; bio = Biology



2. In addition, candidates are required to be competent in English:

<b>Score -&gt;</b>	<b>Overall</b>	<b>Reading</b>	<b>Listening</b>	<b>Speaking</b>	<b>Writing</b>
<b>Test</b>					
<b>IELTS (Academic)</b>	6.5	6.5	6.5	6.5	6.5
<b>TOEFL IBT (internet- based)</b>	90	21	21	21	24
<b>Cambridge English</b>	CAE or CPE Certificate with a minimum score of 180				
<b>English language test – TC UG</b>	n/a	B2	B2	B2	C1

Applicants with a Dutch VWO or equivalent diploma are exempt for an English language test as are native English speakers.

3. The Admissions Board Bachelor's programmes FSE will determine whether deficiencies have been compensated satisfactorily.



**Appendix VI Clustering of Bachelor's degree programmes**  
**Article 4.3.4, Article 4.6.1**

<b>Degree programme CROHO code</b>	<b>Name of degree programme</b>	<b>Clustered with CROHO code</b>	<b>Name of degree programme</b>
56286	B Life Science and Technology	56860 56157	B Biology B Pharmacy
56860	B Biology	56286 56157	B Life Science and Technology B Pharmacy
56157	B Pharmacy	56860 56286	B Biology B Life Science and Technology
56980	B Mathematics	56965 50206 56962 50205	B Applied Mathematics B Physics B Applied Physics B Astronomy
56965	B Applied Mathematics	56980 50206 56962 50205	B Mathematics B Physics B Applied Physics B Astronomy
50206	B Physics	56962 50205 56965 56980	B Applied Physics B Astronomy B Applied Mathematics B Mathematics
56962	B Applied Physics	50206 50205 56965 56980	B Physics B Astronomy B Applied Mathematics B Mathematics
50205	B Astronomy	56962 56965 50206 56980	B Applied Physics B Applied Mathematics B Physics B Mathematics
56857	B Chemistry	56960	B Chemical Engineering
56960	B Chemical Engineering	56857	B Chemistry



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## **Appendix VII Admission to the post-propaedeutic phase (Article 5.2.1)**

Only students who have been issued a positive study advice from the degree programme in Astronomy will be admitted to the post-propaedeutic phase.



**Appendix VIII Contact hours propaedeutic phase  
 (Article 3.6)**

<b>Bachelor's year 1</b>	
<b>Structure contact hours</b>	<b>Contact hours per year</b>
Lectures	346
Tutorial	288
Practicals	140
Tutoring	8
Supervision during an internship	0
Examinations	45
Other structured hours	50



## Appendix IX University Minors of the faculty of Science and Engineering (Article 8.5.1)

1. Neurosciences Minor (taught in English):
  - Neuroscience (15 ECTS)
  - Behavioural Neuroscience (15 ECTS)

*Future Planet Innovation (taught in English): (not offered in the academic year 2019-2020)*

- *Global Challenges (10 ECTS)*
- *Sustainability in perspective (5 ECTS)*
- *Sustainable contributions to society (15 ECTS)*

Astronomy through Space and Time Minor (taught in English):

- The Evolving Universe (5 ECTS)
- Cosmic Origins (5 ECTS)
- Astrobiology (5 ECTS)

Einstein's physics: Space-time and Parallel Worlds (taught in English):

- Einstein's Universe (5 ECTS)
- Quantum World (5 ECTS)
- Building blocks of matter (5 ECTS)

2. The Programme Committee for the Bachelor's degree programmes in Biology and Life Science & Technology also has authority in the field of the Minor "Neurosciences" and/or its course units.

The Programme Committee for the Master's degree programme in Energy & Environmental Sciences also has authority in the field of the Minor "People, Planet, Profit" and/or its course units.

The Programme Committee for the Bachelor's degree programme in Astronomy also has authority in the field of the Minor "Astronomy through Space and Time" and/or its course units.

The Programme Committee for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Minor "Einstein's physics: Space-time and parallel worlds" and/or its course units.

3. The Board of Examiners for the Bachelor's degree programmes in Biology and Life Science & Technology and the Master's degree programmes in Biology, Ecology & Evolution, Marine Biology and Molecular Biology & Biotechnology also has authority in the field of the Neurosciences Minor and/or its course units.

The Board of Examiners for the Master's degree programme in Energy & Environmental Sciences also has authority in the field of the People, Planet, Profit Minor and/or its course units.

The Board of Examiners for the Bachelor's degree programme in Astronomy also has authority in the field of the Astronomy through Space and Time Minor and/or its course units.

The Board of Examiners for the Bachelor's degree programmes in Physics and Applied Physics also has authority in the field of the Physics Minor "Einstein's physics: Space-time and parallel worlds" and/or its course units.





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4. These Teaching and Examination Regulations also apply in their entirety to the Minors in Neurosciences, People, Planet, Profit, Astronomy through Space and Time and Einstein's physics: Space-time and parallel worlds and/or their course units.



## Appendix X Transitional arrangement (article 12.1)

There are no discontinued courses.

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
WBPH17004	Thermodynamics & Statistical Physics	10	--	TBA	Thermal Physics	10	New name for the course	Yes
WPPH16004	Medical Physics	5	TBA	-	-	-	-	-
WPPH16002	Introduction to Energy and Environment 1	5	TBA	-	-	-	-	-