Assessment plan
Bachelor's degree programme Astronomy
2022-2023

June 2022

Introduction

This assessment plan is a systematic description of the type of assessment used in the various modules of the Bachelors's program Astronomy. This assessment plan fits within the assessment policy of the Faculty of Science and Engineering [1], and the protocol used by the Board of Examiners of the degree program [2].

The assessment plan is based on:

- the learning outcomes of the degree program (appendix 1);
- the Teaching and Examination regulations of the degree program;
- the description of the various modules of the degree program in the digital course catalogue *Ocasys*, including:
    - Objective of the module;
    - Course content;
    - Lecturers and examiners;
    - Assessment method used;
    - Lecture format.

Assessment plan 2022-2023

The assessment plan contains two parts:

1. An overview of examiners and assessment type used for all modules in the Astronomy bachelors's program. The following types of assessments are distinguished in this scheme:
    - Written examination (WE);
    - Oral examination (OR);
    - Assignment, including homework, written report, and presentation (AST);
    - Assessment of Practical work, including laboratory and computer work (PR);
    - Presentation (P);
    - Midterm test (IT).

    In case of just one examiner, a deputy examiner [3] is given. The coordinator of the module is underlined, in case more examiners are involved in teaching.

2. A matrix describing the relation between the various modules of the program and the specified learning outcomes of the degree program. The specified learning outcomes are defined in the program's Teaching and Examination Regulation and have been included in the Appendix.

[1] FSE Quality Assurance Manual 2016-2017, chapter 6: Assessment policy

[2] FSE Manual for Board of Examiners (version: 2019); Chapter 4: Duties of the Board of Examiners

[3] FSE Quality Assurance Manual 2016-2017, paragraph 6.3: Practical matters

Examiners and assessment methods of modules in the degree programme

First year (core program)

Module	First examiner	Assessment method	Second examiner and other teachers
Calculus 1 (for Physics) (WBPH057-05)	P.M.J. Tibboel	AST, WE, IT	R.W.C.P. Verstappen
Calculus 2 (for Physics) (WBPH058-05)	T.F. Görbe	AST, WE, IT	H. Waalkens
Electricity and Magnetism (WBPH033-10)	M.S. Pchenitchnikov	PR, WE, IT	S. Hoekstra
Introduction to Astronomy (WBAS007-05)	J. Noel-Storr	AST, WE, IT	M.A.M. van de Weijgaert
Introduction to Energy and Environment (WBPH019-05)	H.A.J. Meijer	AST, WE	H. Chen
Introduction to Programming and Computational Methods	M.G.R. Vogelaar	AST, IT	J. Noel-Storr
Linear Algebra (for Physics) (WBPH054-05)	M. Mendez	AST, WE, IT	D. Boer
Mathematical Physics (WBPH049-05)	G. Palasantzas	AST, WE, IT	H. Waalkens
Mechanics and Relativity (WBPH001-10)	P.D. Meerburg	AST, WE, IT	M.H. Lee
Medical Physics & Biophysics (WBPH022-05)	R. Vlijm	AST, WE	T. Schlathölter
Introduction to Nanophysics (WBPH055-05)	P. Rudolf	WE, IT, P	B. Noheda Pinuaga
Observational Astronomy (WBAS015-05)	J. Noel-Storr	AST, PR, P	S.C. Trager
Physics Laboratory 1 (WBPH013-05)	J.S. Blijleven	PR, WE	R.J.H. Klein-Douwel
Physics of Modern Technology (WBPH027-05)	C.H. van der Wal	WE, P	M.H. Diniz Guimaraes, A. Giuntoli
Physics of the Quantum Universe	K.A.M. de Bruyn	AST, WE	D. Roest

Second year (core program)

Module	First examiner	Assessment method	Second examiner and other teachers
Complex Analysis (for Physics) (WBPH059-05)	T.F. Görbe	AST, WE, IT	K. Efstathiou
Numerical Methods (WBAS014-05)	R.F. Peletier	AST, WE	L. Wang
Physics of Galaxies (WBAS016-05)	E. Starkenburg	WE	S.C. Trager
Physics of Stars (WBAS017-05)	E. Tolstoy	WE, AST, PR, IT	M.A.W. Verheijen
Physics, Astronomy & Society: Ethical & Professional Aspects (WBPH053-05)	B. Piersma	AST, WE, P	J. Zevenberg, H.J. van der Windt, dr. H.A.J. Mulder
Quantum Physics 1 (WBPH014-05)	D. Roest	WE	A. Mazumdar
Quantum Physics 2 (WBPH052-05)	A. Mazumdar	AST, WE	D. Boer
Statistics for Astronomy (WBAS004-05)	A.R. Offringa	AST, WE, PR, P	S.C. Trager
Structure of Matter 1 (WBPH046-05)	R.A. Hoekstra	WE	T.A. Schlathölter
Thermal Physics (WBPH002-10)	T.A. Schlathölter	WE, IT	A. Borschevsky
Waves and Optics (WBPH032-05)	S. Hoekstra	WE, IT	A.K. Biegun

Third year (core program)

Module	First examiner	Assessment method	Second examiner and other teachers
Astroparticle Physics (WBPH036-05)	M. Vecchi	AST, WE	A.M. van den Berg
Astrophysical Hydrodynamics (WBAS011-05)	F. Fraternali	AST, WE	M.A.M. van de Weijgaert
Interstellar Medium (WBAS012-05)	K. Caputi	AST, WE	I.E.E. Kamp
Bachelor Research Project (WBAS901-15)	S.C. Trager, *see list examiners research projects below*	AST, P	

Third year (Minor Astronomy)

Module	First examiner	Assessment method	Second examiner and other teachers
Advanced Mechanics (WBPH017-05)	E. Dimastrogiovanni	AST, WE	E. van der Giessen
Cosmology (WBAS001-05)	S. Zaroubi	AST, WE	M.A.M. van de Weijgaert
Introduction to Science Communication (WBEC001-05)	L.T.J. Kraan	AST	H.A.J. Mulder, F.H.C.E. van der Graaf
Nuclear Physics (WBPH011-05)	J. Even	AST, WE	J.G. Messchendorp
Oriëntatie op Onderwijs in de Bètawetenschappen (WBEC002-05)	J.E. van der Laan	OR, AST	G. Roorda, S. Tuenter
Planetary Systems (WBAS002-05)	I.E.E. Kamp	AST, WE	F.F.S. van der Tak
Introduction to Radio Astronomy (WBAS008-05)	J.P. McKean	AST, WE, IT	M.W. Verheyen
Space Mission Technology (WBAS003-05)	G. de Lange	WE	A.M. Baryshev
Statistical Signal Processing (WBAS009-05)	L.V.E. Koopmans	AST, WE	R.F. Peletier

Third year (Minor Instrumentation and Informatics)

Module	First examiner	Assessment method	Second examiner and other teachers
Control Engineering for BME (WMBE024-05)	R. Reyes Báez	AST, WE	C. De Persis
Cosmology (WBAS001-05)	S. Zaroubi	AST, WE	M.A.M. van de Weijgaert
Introduction to Science Communication (WBEC001-05)	L.T.J. Kraan	AST	H.A.J. Mulder, F.H.C.E. van der Graaf
Oriëntatie op Onderwijs in de Bètawetenschappen (WBEC002-05)	J.E. van der Laan	OR, AST	G. Roorda, S. Tuenter
Principles of Measurement Systems (WBPH029-05)	A.K. Biegun	WE	J.S. Blijleven
Introduction to Radio Astronomy (WBAS008-05)	J.P. McKean	AST, WE, IT	M.W. Verheyen
Space Mission Technology (WBAS003-05)	G. de Lange	WE	A.M. Baryshev
Statistical Signal Processing (WBAS009-05)	L.V.E. Koopmans	AST, WE	R.F. Peletier

University Minor

Astronomy through space and time

Module	First examiner	Assessment method	Second examiner and other teachers
Astrobiology (WBAS005-05)	P. Dayal	OR, P, AST	*TBD*
Cosmic Origins (WBAS006-05)	M.A.M. van de Weijgaert	WE, P	*TBD*
The Evolving Universe (WBAS010-05)	M.A.W. Verheijen	WE, AST	M.A.M. van de Weijgaert

Astronomy examiners for Bachelors Research projects

For the Bachelor Research project of Astronomy all scientific staff members of the Kapteyn Astronomical Institute can act as both first and second examiner. Selected staff members from other institutes may act as second examiner.

Kapteyn Astronomical Institute:

- Dr. Betsey Adams [B.]
- Prof. dr. Andrey Baryshev [A.]
- Prof. dr. Ad van den Berg [A.M.]
- Dr. Erwin de Blok [W.J.G.]
- Prof. dr. Karina Caputi [K.I.]
- Prof. dr. Pratika Dayal [P.]
- Prof. dr. Filippo Fraternali [F.]
- Prof. dr. Amina Helmi [A.]
- Dr. ir. Willem Jellema [W.]
- Prof. dr. Inga Kamp [I.E.E.]
- Prof. dr. Léon Koopmans [L.V.E.]
- Dr. Gert de Lange [G.]
- Dr. Tim Lichtenberg [T.]
- Prof. dr. John McKean [J.P.]
- Prof. dr. Mariano Méndez [R.M.]
- Prof. dr. Raffaella Morganti [R.]
- Dr. J. Noel-Storr [J.]
- Dr. André Offringa [A.R.]
- Prof. dr. Tom Oosterloo [T.A.]
- Prof. dr. Reynier Peletier [R.F.]
- Dr. Peter Roelfsema [P.R.]
- Prof. dr. Olaf Scholten [O.]
- Dr. Russell F. Shipman [R.F.]
- Dr. Else Starkenburg [E.]
- Prof. dr. Floris van der Tak [F.F.S.]
- Prof. dr. Eline Tolstoy [E.]
- Prof. dr. Scott Trager [S.C.]
- Dr. Manuela Vecchi [M.]
- Dr. Gijs Verdoes Kleijn [G.A.]
- Dr. Harish Vedantham [H.K.]
- Prof. dr. Marc Verheijen [M.A.W.]
- Drs. Martin Vogelaar [M.G.R.]
- Dr. Lingyu Wang [L.]
- Prof. dr. Rien van de Weijgaert [M.A.M.]
- Prof. dr. Saleem Zaroubi [S.]

Other UG institutes:

- Prof. dr. Michael Biehl [M.] (BI)
- Prof. dr. Anupam Mazumdar [A.] (VSI)
- Dr. Daan Meerburg [P.D.] (VSI)
- Prof. dr. Jos Roerdink [J.B.T.M.] (BI)
- Prof. dr. Diederik Roest [D.] (VSI)
- Prof. dr. Rob Timmermans [R.G.E.] (VSI)
- Prof. dr. Holger Waalkens [H.] (BI)
- Dr. Michael Wilkinson [M.H.F.] (BI)

Relation between the learning outcomes and the curriculum

The following tables show for each of the specializations how the individual course units contribute the final qualifications of the programme.

'+' indicates that a course unit has some contribution to the qualification under consideration.
'++' idem ... significant contribution to the qualification under consideration.
The numbers in the table correspond to the qualifications that are listed in appendix I.

Propaedeutic phase

Learning outcomes	Mechanics and Relativity	Electricity and Magnetism	Physics Laboratory 1	Introd. Progr. and Comp. Methods	Physics of the Quantum Universe	Physics of Modern Technology	Observational Astronomy	Energy and Environment	Medical Physics	Nanophysics	Introduction to Astronomy	Calculus 1 (for Physics)	Linear Algebra (for Physics)	Calculus (for Physics)	Mathematical Physics
A1	++	++			+	+	+	+	+	+	+	+	+	+	+
A2	++	++	+				+					+	+	+	+
A3					+	+		+	+	+	+				
A4	+	+	+	++			+					+	+	+	+
A5	++	++	+									++	++	++	++
A6			+		+	+		+	+	+	+				
B1				+			+								
B2				+			+								
B3				+	+	+	+	+	+	+	+				
B4			+	+	+	+	+	+	+	+	+				
B5				+	+	+	++	+	+	+	+				
B6															
B7							+								
1.1	++	++					+					++	++	++	++
1.2					+	+	++	+	+	+	+				
1.3															
1.4							++								
1.5															
1.6															
1.7															
1.8															
2.1			+	+	+	+	++	+	+	+	+				
2.2							++								
2.3			++	++			+								

Year 2													
Learning outcomes	Observational Astronomy	Numerical Methods	Statistical Astronomy	Physics of Stars	Physics of Galaxies	Electricity and Magnetism 2	Quantum Physics 1	Thermal Physics	Waves and Optics	Structure of Matter 1	Quantum Physics 2	Complex Analysis	Science, Ethics, Technology and Society
A1	+			+	+	+	+	+	+	+	+	+	++
A2	+			+	+								
A3													
A4	+	++	++	+	+	+	+	+	+	+	+	++	
A5		+	+			++	++	++	++	++	++	++	
A6													++
B1	+												
B2	+	+	+										
B3	+	+	+										+
B4	+	+	+	+	+				+				+
B5	++	+	+	+	+								+
B6													+
B7	+												
1.1	+	++	++	++	+	+	+	+	+		+		
1.2	++												
1.3				++	++								
1.4	++	+	+										
1.5				+	+								
1.6		+	+									++	
1.7						++	++	++	++	++	++		
1.8													
2.1	++												
2.2	++												
2.3	+	++	++										

Year 3							
Learning outcomes	Free minor	Astronomy Minor	Instrumentation and Informatics Minor	Interstellar Medium	Astrophysical Hydrodynamics	Astroparticle Physics	Bachelor research project
A1		+	+	+	+	+	+
A2			++	+			
A3		++	++	+	+	+	++
A4					+		
A5							+
A6							+
B1							++
B2		+	+		+		++
B3							++
B4		+	+	+	+		+
B5				+	+		++
B6							++
B7					+		++
1.1		+		+	+	+	+
1.2							+
1.3				++	+	+	+
1.4		+	++				+
1.5				+	++	+	+
1.6			+				
1.7							
1.8	++	++	++				
2.1		+	+				+
2.2			+				+
2.3		+	+		++		+

Appendix I, Learning outcomes of the degree programme

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 astronomy.

A2. Bachelor's graduates have mastered the basic concepts of astronomy (see Appendix 1.1 for further specification) to a certain extent and are familiar with the interrelationships of these concepts within astronomy as well as with other disciplines.

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

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 astronomy, 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 astronomy.

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 level of supervision. Bachelor's graduates are able to evaluate the value and limitations of their research and assess its applicability outside of astronomy.

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 both modern and conventional 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.

Appendix 1.1 Degree programme-specific learning outcomes - Basic Knowledge

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. has mastered the basic astrophysics of planets, stars, galaxies, and interstellar medium,
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, relativity, electro-magnetism, 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.

Appendix 1.2. Degree programme-specific learning outcomes – Skills

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.