Assessment plan for the curriculum of the **Bachelor's** degree programme in Astronomy, 2024-2025

Programme director: M.A.M. van der Weijgaert

Date advice Board of Examiners: June 21, 2024

Date approval Faculty Board:

1. Vision on assessment

Objectives
The vision behind the Bachelor's degree programme in Astronomy is to organize and facilitate the teaching and training of the next generation of ambitious physicists. The programme aims to offer students a solid foundation to explore the boundaries of our understanding of the fundamental workings of nature. This is done by providing the astronomy student with profound knowledge of general astronomy subjects, as well as more specialized ones and those at the interface with adjacent disciplines; by training them in performing scientific research; and by providing the astronomy student with general academic skills. Independent and critical thinking, an open mind, problem solving eagerness, skills in clear writing and exposition, and a dedication to astronomy both as an academic discipline and as a field that has strong connections to adjacent scientific disciplines and societal developments – these are important general objectives of the programme.

Assessment vision statement:

- The assessment guides and evaluates student learning in a diverse manner, with a focus on knowledge of physical concepts as well as relevant skills including problem-solving, collaboration, scientific reasoning and experimental lab work.
- The assessment stimulates students to adopt an active learning stance and to learn from their mistakes, by combining formative aspects at various stages and a summative assessment.
- The assessment stimulates students to approach problems from an astronomy perspective that observes, models and explains physical processes, thereby preparing them for further study or career in related science disciplines.

2. Assessment guidelines

Guidelines for assessment quality:
The BSc programme consists of 165 ECTS worth of courses and a 15 ECTS research project. There are four 10-ECTS courses in the first two years of the programme, all other courses are 5 ECTS. The programme offers a variety of different assessment methods, assessing different learning outcomes and skills. The course assessment scheme can be found on Brightspace and Ocasys from the start of the course, and cannot be changed during the course (unless given explicit permission by the Board of Examiners).

- The majority of courses are assessed with an individual, written exam at the end of the course. A number of these courses have intermediate assessment moments as well, consisting of e.g. midterm exams or homework assignments, that contribute a fraction to the final grade.
- The 10-ECTS courses in the first year of the programme have a practical assignment as well, that needs to be completed with a pass grade before the full course can be passed.
- To facilitate preparation by the students for the final exam, a mock exam (for example an exam from a previous year) must be available, at least two weeks prior to the exam.
- A clear and explicit answer key for the exam is drawn up by the course coordinator to ensure the transparency and fairness of the grading process.

- Most resits of these courses consist of a single, individual, written exam. The examiner can opt for an oral exam in case there are very few students attending a resit. These are graded using the dedicated oral exam grading form and an independent observer (preferably the preassigned second examiner) must be present during the full exam. At the beginning of the exam, the student should be informed of the topics to be examined.

- Next to the courses with individual assessment, the programme also contains courses that are based on group work, e.g. practical or project-based courses. In these cases, the course grade is determined by presentations of the students as well as the final report that is handed in.

- Clear and explicit rubrics are available that facilitate the grading of the project as well as the feedback to students.

- The 15-ECTS research project at the end of the programme takes place in one of the research groups and supervised by an examiner of the programme.
- Regular progress meetings (at least every week) with the (daily) supervisor will take place, in which the student will be given feedback and instructions on the day-to-day research. Progress meetings (at least every four weeks) with the supervisor should take place, in which the students will be given clear feedback on their progress.
- The examiner should provide feedback on at least one full draft version of the thesis, provided the student meets the agreed deadline for handing in the full draft.
- To ensure standardized and fair grading, the project is assessed by the examiner and a second examiner from another research unit than the first supervisor.
- All written assignments must be checked for plagiarism before grading.
- All assessment and feedback, final and day-to-day, is provided in English to prepare students for further study and a future career with an international job market.

3. Learning outcomes of the degree programme

Learning Outcome:	
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 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 2.
Appendix 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 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: a) has experience in working with astronomical observations and/or astronomical simulations b) is able to write software in a common programming language.

4. Overview of assessment methods, test moments for course units, and examiners

The abbreviations for the relevant teaching methods are explained in the legend of the table. Examples of assessment methods include:

- *Written Exam (WE)*
- *Multiple Choice (MC)*
- *Oral Exam (OR)*
- *Report (R)*
- *Presentation (P)*
- *Practical Work (PR)*
- *Assignment (AST)*

Year 1

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1A	Calculus 1 (for Physics) (WBPH057-05)	5	AST, WE	Yes	continuous assessment, exam week	T.F. Görbe	H. Jardon Kojakhmetov
1	1B	Calculus 2 (for Physics) (WBPH058-05)	5	AST, WE	Yes	continuous assessment, exam week	T.F. Görbe	H. Waalkens
1	2A	Introduction to Programming and Computational Methods (WBAS018-05)	5	AST	Yes		TBA	TBA
1	2	Electricity and Magnetism (WBPH033-10)	10	PR, WE	Yes	continuous assessment, exam week	M.S. Pchenitchnikov	J. Aalbers
1	2A	Linear Algebra (for Physics) (WBPH054-05)	5	AST, WE, PR	Yes	continuous assessment, exam week	M. Mendez	D. Boer
1	2B	Mathematical Physics (WBPH049-05)	5	AST, WE	Yes	continuous assessment, exam week	E. Dimastrogiovanni	TBD
1	1	Mechanics and Relativity (WBPH001-10)	10	MC, WE	Yes	continuous assessment, exam week	P.D. Meerburg	D. Roest
1	2B	Observational Astronomy (WBAS015-05)	5	AST, P	Yes		TBA	S.C. Trager
1	1A	Physics Lab: Skills (WBPH077-05)	5	PR, WE, R	Yes	continuous assessment, exam week	J.S. Blijleven	R.J.H. Klein-Douwel

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
1	1B	Physics of Modern Technology (WBPH027-05)	5	WE, P	Yes		C.H. van der Wal	M.H. Diniz Guimaraes, A. Giuntoli
1	1B	Introduction to Astronomy (WBAS007-05)	5	AST, WE, IT	Yes		E. Starkenburg	M.A.M. van de Weijgaert
1	1B	Introduction to Energy and Environment (WBPH019-05)	5	WE, IT	Yes		H.A.J. Meijer	TBD
1	1B	Introduction to Nanophysics (WBPH055-05)	5	WE, IT, P	Yes	continuous assessment, exam week	R. lo Conte	B. Noheda Pinuaga
1	1B	Physics of the Quantum Universe (WBPH028-05)	5	AST, MC, WE	No	continuous assessment, exam week	K.A.M. de Bruyn	D. Roest
1	1B	Medical Physics & Biophysics (WBPH022-05)	5	AST, P, WE	Yes		R. Vlijm	T. Schlathölter

Year 2

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
2	1A	Statistics for Astronomy (WBAS004-05)	5	AST, WE	Yes		H. Vedantham	S.C. Trager
2	2A	Physics of Galaxies (WBAS016-05)	5	AST, PR, WE	Yes		F. Rizzo	J.S. Blijleven
2	1B	Materials Science and Engineering (WBPH071-05)	5	AST, WE	Yes		V. Ocelik	B.J. Kooi
2	2B	Physics of Stars (WBAS017-05)	5	WE, AST, PR	Yes		E. Tolstoy	M.A.W. Verheijen
2	2B	Numerical Methods (WBAS014-05)	5	AST, PR	Yes		Q. Changeat	S.C. Trager

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
2	2A	Astronomy & Society: Ethical & Professional Aspects (WBAS019-05)	5	MC, AST, WE, P, R	Yes	continuous assessment	M. van Rijsel	J. Zevenberg
2	1A	Quantum Physics 1 (WBPH014-05)	5	AST, WE	Yes	continuous assessment, exam week	M.H. Diniz Guimaraes	D. Roest
2	1B	Quantum Physics 2 (WBPH052-05)	5	WE	Yes		E. Pallante	D. Boer
2	2A	Subatomic physics: concepts and experiments (WBPH088-05)	5	WE, AST	Yes		J. Aalbers	A. Perrevoort
2	2	From Atoms to Solids 1 (WBPH086-05)	10	WE	Yes		A. Borschevsky	T.A. Schlathölter
2	1	Thermal Physics (WBPH002-10)	10	WE	Yes	mid-term, exam week	G. Palasantzas	L.J.A. Koster
2	1B	Waves and Optics (WBPH032-05)	5	AST, R	Yes	continuous assessment	S. Hoekstra	A.K. Biegun
2	2B	Complex Analysis (for Physics) (WBPH059-05)	5	AST, WE	Yes		A. Mazumdar	O. Lorscheid

Year 3

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
3	2A	Advanced Electrodynamics (WBPH079-05)	5	AST, WE	Yes		R.G.E. Timmermans	R. Klein
3	2A	Astrophysical Hydrodynamics (WBAS011-05)	5	AST, WE	Yes		F. Fraternali	M.A.M. van de Weijgaert
3	2A	Interstellar Medium (WBAS012-05)	5	AST, WE	No	continuous assessment, exam week	K. Caputi	I.E.E. Kamp

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
3	2B	Bachelor Research Project (WBAS901-15)	15	AST, PR. P, R	Yes	continuous assessment	P. Dayal, *see list examiners research projects below*	S.C. Trager

Year 3 - Deepening minor: Astronomy

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
3	1A	Advanced Mechanics (WBPH017-05)	5	AST, WE	Yes	continuous assessment, exam week	E. Dimastrogiovanni	E. van der Giessen
3	1B	Atoms & Molecules (WBPH003-05)	5	AST, WE	Yes	continuous assessment	R. Hoekstra	A. Borschevsky
3	1A	Cosmology (WBAS001-05)	5	WE	Yes		S. Zaroubi	M.A.M. van de Weijgaert
3	1B	Introduction to Science Communication (WBEC001-05)	5	R	Yes		L.T.J. Kraan	H.A.J. Mulder, F.H.C.E. van der Graaf
3	1A	Nuclear Physics (WBPH011-05)	5	WE	Yes		J. Even	C. Rigollet
3	1B	Oriëntatie op Onderwijs in de Bètawetenschappen (WBEC002-05)	5	OR, R	Yes		J.E. van der Laan	G. Roorda, S. Tuenter
3	1A	Planetary Systems (WBAS002-05)	5	AST, WE	Yes		I.E.E. Kamp	F.F.S. van der Tak
3	1B	Introduction to Radio Astronomy (WBAS008-05)	5	AST, WE	Yes		J.P. McKean	M.W. Verheyen
3	1B	Space Mission Technology (WBAS003-05)	5	PR	Yes		G. de Lange	P. Roelfsema

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
3	1B	Statistical Signal Processing (WBAS009-05)	5	AST, WE, R	Yes		S. C. Trager	R.F. Peletier

Year 3 - Deepening minor: Instrumentation and Informatics

Year	Period	Course	EC	Assessment methods	Does (part of the) assessment have a formative function?	Test moment(s) (e.g. mid-term, continuous assessment, exam week, etc)	First examiner	Second examiner
3	1A	Control Engineering for BME (WMBE024-05)	5	WE	Yes		C. De Persis	J. Sjollema
3	1A	Cosmology (WBAS001-05)	5	AST, WE	Yes		S. Zaroubi	M.A.M. van de Weijgaert
3	1B	Introduction to Science Communication (WBEC001-05)	5	R	Yes		L.T.J. Kraan	H.A.J. Mulder, F.H.C.E. van der Graaf
3	1B	Oriëntatie op Onderwijs in de Bètawetenschappen (WBEC002-05)	5	OR, R	Yes		J.E. van der Laan	G. Roorda, S. Tuenter
3	1B	Principles of Measurement Systems (WBPH029-05)	5	AST, WE	Yes		A.K. Biegun	J.S. Blijleven
3	1B	Introduction to Radio Astronomy (WBAS008-05)	5	AST, WE	Yes		J.P. McKean	M.W. Verheyen
3	1A	Space Mission Technology (WBAS003-05)	5	PR	Yes		G. de Lange	A.M. Baryshev
3	1B	Statistical Signal Processing (WBAS009-05)	5	AST, WE, R	Yes		S. C. Trager	R.F. Peletier

Astronomy examiners for Bachelors Research projects

For the Bachelor Research project of Astronomy the 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.]
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. 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)

5. Relationship between course units and details of the learning outcomes

	Learning outcomes	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 1	Mechanics and Relativity	X	X		X	X											X				X							
	Electricity and Magnetism	X	X		X	X											X			X	X							
	Physics Lab: Skills		X		X	X	X					X													X		X
	Introd. Progr. and Comp. Methods				X				X	X	X	X	X				X	X		X	X					X		X
	Physics of the Quantum Universe	X		X			X				X	X	X													X		
	Physics of Modern Technology	X		X			X				X	X	X													X		
	Observational Astronomy	X	X		X				X	X	X	X	X		X		X	X		X						X	X	X
	Energy and Environment	X		X			X				X	X	X													X		
	Medical Physics	X		X			X				X	X	X													X		
	Nanophysics	X		X			X				X	X	X													X		
	Introduction to Astronomy	X		X			X				X	X	X				X	X	X	X	X					X		
	Calculus 1 (for Physics)	X	X		X	X											X					X						
	Linear Algebra (for Physics)	X	X		X	X											X					X						
	Calculus (for Physics)	X	X		X	X											x					X						
	Mathematical Physics	X	X		X	X											X			X		X	X					

	Learning outcomes	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	Observational Astronomy	X	X		X				X	X	X	X	X		X		X	X		X	X					X	X	X
	Numerical Methods				X	X				X	X	X	X				X			X	X	X						X
	Statistical Astronomy				X	X				X	X	X	X				X			X	X	X						X
	Physics of Stars	X	X		X							X	X				X		X		X							
	Physics of Galaxies	X	X		X							X	X				X		X		X							
	Electricity and Magnetism 2	X			X	X																	X					
	Quantum Physics 1	X			X	X											X						X					
	Thermal Physics	X			X	X											X						X					
	Waves and Optics	X			X	X						X					X			X			X					
	From Atoms to Solids 1	X			X	X																	X					
	Subatomic physics: concepts and experiments	X			X	X																	X					
	Quantum Physics 2	X			X	X																	X					
	Complex Analysis	X			X	X														X		X						
	Astronomy & Society: Ethical & Professional Aspects	X					X				X	X	X	X			X											

Year 3	Learning outcomes	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
	Free minor																							X				
	Astronomy Minor	X		X						X		X					X			X				X		X		X
	Instrumentation and Informatics Minor	X	X	X						X		X								X		X		X		X	X	X
	Interstellar Medium	X	X	X								X	X				X		X		X		X					
	Astrophysical Hydrodynamics	X		X	X					X		X	X		X		X		X		X		X					X
	Advanced Electrodynmics	X		X													X		X		X		X					
	Bachelor Research Project	X		X		X	X		X	X	X	X	X	X	X		X	X	X	X	X					X	X	X