



**university of
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Appendices to the Teaching and Examination Regulations

2020-2021

Master's degree programme in Astronomy



Appendix I Teaching outcomes of the degree programme (art. 3.1)

The master graduate in Astronomy:

1. Knowledge and understanding

- 1.1. masters the fundamental astronomical and astrophysical concepts as well as the necessary tools from physics, mathematics and computer science, including modeling skills, at a level which permits admission to a PhD programme;
- 1.2. is familiar with the quantitative character of astronomy and astrophysics and with the relevant research methods;
- 1.3. who has completed
 - the Quantum Universe track has operational knowledge in i) an observational or theoretical astronomical or astrophysical subarea, ii) the area of instrumentation and information technology in astronomy, physics, and/or space research, or iii) the area of data science in astronomy, as well as knowledge of the state-of the art in at least one specific research area;
 - the Business, Science and Policy track has operational knowledge of and insight into the functioning of companies and administrations, as well as the relevant legislation and knowledge of the state-of the art in at least one specific research area;

2. Application of knowledge and understanding

- 2.1. is capable of carrying out research, aimed at understanding of astronomical phenomena, both observational and theoretical;
- 2.2. is capable of analyzing a (new) complex astrophysical problem, and to use modelling skills to develop a structured and well-planned research approach;
- 2.3. is capable of applying his/her specific knowledge and mathematical, experimental, and computer skills to solve astronomy problems in his/her own and related subject areas and fields;
- 2.4. is capable of collaborating in a (multi-disciplinary) team and has basic skills to manage a (collaborative) project;

3. Judgement

- 3.1. is capable of obtaining relevant information using modern information channels, and of interpreting this information critically in the context of an absolute standard;
- 3.2. is capable of managing and judging his/her and others' actions within a highly scientific and professional context, taking societal and ethical aspects into account;
- 3.3. is able of drawing conclusions on the basis of limited or incomplete information, and is able to realize and formulate the limitations of such conclusions;
- 3.4. is acting and conducting research according to the VSNU Code of Conduct for Academic Practice

4. Communication skills

- 4.1. is capable of communicating clearly in English, both verbally and in writing, on his/her subject and relevant applications, at a level which is understandable to experts and non-experts, and using modern communication tools;

5. Learning skills

- 5.1. is capable of addressing issues inside as well as outside his/her main subject area, therefore and thereby gaining new knowledge and skills.



Appendix II Tracks of the degree programme (art. 3.5)

1. The Master's degree programme in Astronomy offers the following tracks:
 - Quantum Universe
 - Science, Business and Policy

2. In the Quantum Universe-track, the following specialisations exist:
 - Theoretical and Observational Astronomy
 - Instrumentation and Informatics
 - Data Science



Appendix III Content of the degree programme (art. 3.6)

The assessment method(s) of the courses below can be found in the assessment plan of the degree programme and on Ocasys.

Quantum Universe: Theoretical and Observational Astronomy

Course unit	ECTS	Practical	Entry Requirements
Astronomy colloquium	-		
Electrodynamics of Radiation Processes	5		
General Relativity	5		
Particle Physics Phenomenology	5		
Student seminar Quantum Universe	5		
Astrophysics Core Courses	20	see app. IV	see app. IV
Optional Courses in Theoretical and Observational Astronomy	20	see app. IV	see app. IV
Master Research Project Astronomy	60	X	

Quantum Universe: Instrumentation and Informatics

Course unit	ECTS	Practical	Entry Requirements
Astronomy colloquium	-		
Electrodynamics of Radiation Processes	5		
General Relativity	5		
Particle Physics Phenomenology	5		
Student seminar Quantum Universe	5		
Astrophysics Core Courses	20	see app. IV	see app. IV
Optional courses in Instrumentation and Informatics	20	see app. IV	see app. IV
Industrial Internship	20	X	
Master Research Project Astronomy	40	X	

Quantum Universe: Data Science

Course unit	ECTS	Practical	Entry Requirements
Astronomy colloquium	-		
Electrodynamics of Radiation Processes	5		
General Relativity	5		
Introduction to Data Science	5	X	
Particle Physics Phenomenology	5		
Statistical Signal Processing	5		
Student seminar Quantum Universe	5		
Astrophysics Core Courses	20	see app. IV	see app. IV
Optional Courses in Data Science	10	see app. IV	see app. IV
Master Research Project Astronomy	60	X	



Science, Business and Policy

Course unit	ECTS	Practical	Entry Requirements
Astrophysics Core Courses	20	see app. IV	see app. IV
Optional Courses in Theoretical and Observational Astronomy	10	see app. IV	see app. IV
Introduction Science, Business and Policy	20		
Internship Science, Business and Policy	40	X	
Astronomy colloquium	-		
Master Research / Thesis	30	X	



Appendix IV Electives (art. 3.7)

The assessment method(s) of the courses below can be found in the assessment plan of the degree programme and on Ocasys.

Astrophysics Core Courses

Course unit	ECTS	Practical	Entry Requirements
Yearly courses			
Formation and Evolution of Galaxies	5		
Biennial courses, offered in 2020-2021			
Cosmic Structure Formation	5		
Star and Planet Formation	5		
High-Energy Astrophysics	5	X	
Biennial courses, offered in 2021-2022			
Astrochemistry	5		
Dynamics of Galaxies	5		
Stars, Nucleosynthesis and Chemical Evolution	5		

Optional Courses in Quantum Universe: Theoretical and Observational Astronomy

Course unit	ECTS	Practical	Entry Requirements
Yearly courses			
Applied Optics	5		
Basic Detection Techniques	5	X	
Computational Physics	5	X	
Elementary Particle Physics	5		
Fundamental Constants	5		
Gravitational Waves	5		
Introduction to Plasma Physics	5		
La Palma Observation Trip	5	X	
Lie Groups in Physics	5		
Mathematical Methods of Physics	5		
Nuclear Astrophysics	5		
Quantum Experiments	5		
Quantum Field Theory	5		
Statistical Methods in Physics	5		
Statistical Signal Processing	5		
Basiscursus Master Lerarenopleiding	5		
Masterstage 1 Lerarenopleiding	5	X	
Biennial courses, offered in 2020-2021			
Active Galaxies and AGN	5		
Astronomical Data Science	5	X	
Geometry & Differential Equations	5		
Biennial courses, offered in 2021-2022			
Geometry and Topology	5		



For the specialization Theoretical and Observational Astronomy (Quantum Universe) a maximum of 20 ECTS may be chosen from the option groups in the table above or from the Capita Selecta Courses, listed below. For the specialization Science, Business and Policy a maximum of 10 ECTS may be chosen from the option groups in the table above or from the Capita Selecta Courses, listed below. For both specialisations, though, no more than three Capita Selecta Courses may be selected.

Optional Courses in Quantum Universe: Instrumentation and Informatics

Course unit	ECTS	Practical	Entry Requirements
Yearly courses			
Advanced Detection Techniques	5		
Advanced Instrumentation and Extreme Environments	5		
Applied Optics	5		
Systems Engineering	5		
Opto-mechatronics	5		
Basic Detection Techniques	5	X	
Control Engineering	5	X	
Device Physics	5		
Imaging Techniques in Radiology 1	5		
La Palma Observation Trip	5	X	
Mechatronics	5		
Numerical Mathematics 2	5	X	
Robotics	5	X	
Scientific Visualization	5	X	
Statistical Signal Processing	5		
Basiscursus Master Lerarenopleiding	5		
Masterstage 1	5	X	
Biennial courses, offered in 2020-2021			
Active Galaxies and AGN	5		
Astronomical Data Science	5	X	

For the specialization Instrumentation & Informatics a maximum of 20 ECTS may be chosen from the option groups in the table above or from the Capita Selecta Courses, listed below. Though no more than three Capita Selecta Courses may be selected.



Optional Courses in Quantum Universe: Data Science

Course unit	ECTS	Practical	Entry Requirements
Yearly courses			
Gravitational Waves	5		
Image Processing	5	X	
Information Systems	5	X	
La Palma Observation Trip	5	X	
Machine learning	5	X	
Modelling and Simulation	5	X	
Neural Networks and Computational Intelligence	5	X	
Pattern Recognition	5	X	
Robotics for AI	5	X	
Scalable Computing	5	X	
Scientific Visualization	5	X	
Software Maintenance & Evolution	5	X	
Statistical Signal Processing	5		
Systems Engineering	5	X	
Web and Cloud Computing	5	X	
Basic Detection Techniques	5	X	
Basiscursus Master Lerarenopleiding	5		
Masterstage 1	5	X	
Biennial courses, offered in 2020-2021			
Active Galaxies and AGN	5		
Astronomical Data Science	5	X	

For the specialization Data Science & Systems Complexity a maximum of 10 ECTS may be chosen from the option groups in the table above or from the Capita Selecta Courses, listed below. Though no more than three Capita Selecta Courses may be selected.

Capita Selecta Courses

Course unit	ECTS	Practical	Entry Requirements
Biennial courses, offered in 2020-2021			
Dwarf Galaxies	3		
Gas Flows in Galaxies	3		
Interferometry	3		
Exoplanets	3		
Biennial courses, offered in 2021-2022*			
Cosmic Star Formation History	3		
Cosmic Web	3		
Stellar Populations in Galaxies	3		
Mergers in Galaxy Formation	3		
HI in Galaxies	3		

* The capita selecta courses for 2020/2021 are not guaranteed. Courses are decided on short notice by the degree programme.



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Appendix V Entry requirements and compulsory order of examinations (art. 4.4)

For students admitted to the programme there is no compulsory order in modules. Entry requirements for the individual Modules are listed in App. III and App. IV.



Appendix VI Admission to the degree programme and different tracks/specializations (art. 2.1.1 + art. 2.2)

Graduates with a degree from one of the following degree programmes and universities are considered to have sufficient knowledge and skills and will be admitted to the Master's degree programme in Astronomy on that basis:

- BSc Astronomy, University of Groningen
- BSc Astronomy, Leiden University
- BSc Physics & Astronomy, University of Amsterdam/Vrije Universiteit Amsterdam
- BSc Physics & Astronomy, Radboud University



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Appendix VII Transitional provisions (art. 7.1)

There are no transitional provisions for astronomy students.



Appendix VIII

Application deadlines for admission (art. 2.6.1)

Deadline of Application	Non-EU students	EU students
Astronomy	May 1st 2020	May 1st 2020

Decision deadlines (art. 2.6.3)

Deadline of Decision	Non-EU students	EU students
Astronomy	June 1st 2020	June 1st 2020