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Appendices to the Teaching and Examination Regulations

2018-2019

Master's degree programme in Astronomy



Appendix I Teaching outcomes of the degree programme (art. 1.3)

1. *Knowledge, skills, and insight*
 - 1.1 The MSc masters the fundamental astronomical and astrophysical concepts as well as the necessary tools from physics, mathematics and computer science including modeling skills. The level of these skills permits admission to PhD studies.
 - 1.2 The MSc is familiar with the quantitative character of astronomy and astrophysics, and with the relevant research methods.
 - 1.3 The MSc who has completed
 - the Astronomy track has operational knowledge in an observational or theoretical astronomical or astrophysical subarea and knowledge of the state-of-the art in at least one specific research area;
 - the Instrumentation and Informatics track has operational knowledge in the area of instrumentation and information technology in astronomy, physics, and/or space research and knowledge of the state-of the art in at least one specific research area;
 - the Business 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 skills*
 - 2.1 The MSc is capable to carry out research, aimed at understanding of astronomical phenomena, both observational and theoretical.
 - 2.2 The MSc is capable to analyze a (new) complex astrophysical problem, and develop a structured and well-planned research/modeling approach.
 - 2.3 The MSc is capable to apply his/her specific knowledge and skills in his/her own and related subject areas.
 - 2.4 The MSc is capable to collaborate in a (multi-disciplinary) team and has basic skills to manage a (collaborative) project.
3. *Judgement*
 - 3.1 The MSc is capable to obtain relevant information using modern information channels, and to interpret this information critically in the context of an absolute standard.
 - 3.2 The MSc is capable to judge his/her and others' actions within a scientific context, taking societal and ethical aspects into account.
 - 3.3 The MSc is able to draw conclusions on the basis of limited or incomplete information, and is able to realize and formulate the limitations of such conclusions.
 - 3.4 The MSc is acting and conducting research according to the VSNU Code of Conduct for Academic Practice.
4. *Communication skills*

The MSc is capable to communicate clearly, 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*

The MSc is capable to also address issues outside his/her main subject area, therefore and thereby gaining new knowledge and skills.



Appendix II Tracks of the degree programme (art. 2.2)

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. 2.3)

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		
Project Information Technology	10	X	
Student seminar Quantum Universe	5		
Optional courses in Astrophysics Core Courses or Instrumentation and Informatics	30	see app. IV	see app. IV
Internship in Industry	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. 2.4)

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 2018-2019			
Cosmic Structure Formation	5		
Star and Planet Formation	5		
Stars, Nucleosynthesis and Chemical Evolution	5		
Biennial courses, offered in 2019-2020			
Astrochemistry	5		
Dynamics of Galaxies	5		
High-Energy Astrophysics	5	X	

Optional Courses in Quantum Universe: Theoretical and Observational Astronomy

Course unit	ECTS	Practical	Entry Requirements
Yearly courses			
Big Experiments	5		
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	
Laser Cooling Trapping	5	X	
Lie Groups in Physics	5		
Mathematical Methods of Physics	5		
Nuclear Astrophysics	5		
Quantum Field Theory	5		
Statistical Methods in Physics	5		
Statistical Signal Processing	5		
Biennial courses, offered in 2018-2019			
Active Galaxies and AGN	5		
Astronomical Data Science	5	X	
Geometry & Differential Equations	5		
Interferometry	5		
Biennial courses, offered in 2019-2020			
Basic Detection Techniques	5	X	
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			
Control Engineering	5	X	
Device Physics	5		
Gravitational Waves	5		
Imaging Techniques in Radiology 1	5		
La Palma Observation Trip	5	X	
Mechatronics	5		
Numerical Mathematics 2	5	X	
Principles of Measurement Systems	5		
Robotics	5	X	
Scientific Visualization	5	X	
Statistical Signal Processing	5		
Instrumentation related physics courses on approval of the board of examiners		See app. III or IV of the corresponding programme	See app. III or IV of the corresponding programme
Biennial courses, offered in 2018-2019			
Active Galaxies and AGN	5		
Astronomical Data Science	5	X	
Interferometry	5		
Biennial courses, offered in 2019-2020			
Astrochemistry	5		
Basic Detection Techniques	5	X	
Dynamics of Galaxies	5		
High-Energy Astrophysics	5	X	

For the specialization Instrumentation & Informatics a maximum of 30 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			
Contemporary Statistics with Applications	5	X	
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	
Systems Engineering	5	X	
Web and Cloud Computing	5	X	
Biennial courses, offered in 2018-2019			
Active Galaxies and AGN	5		
Astronomical Data Science	5	X	
Interferometry	5		
Biennial courses, offered in 2019-2020			
Basic Detection Techniques	5	X	

For the specialization Data Science & Systems Complexity a maximum of 15 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 2018-2019			
Dwarf Galaxies	3		
Gas Flows in Galaxies	3		
History of Modern Astronomy	3		
Project management	3		
Biennial courses, offered in 2019-2020*			
Cosmic Star Formation History	3		
Cosmic Web	3		
HI in Galaxies	3		

* The capita selecta courses for 2017/2018 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. 3.4)

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.



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Appendix VI Admission to the degree programme and different tracks/specializations (art. 5.1.1 + art. 5.2)

Holders of the following Bachelor's degrees from the University of Groningen 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



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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. 5.6.1)

Deadline of Application	Non-EU students	EU students
Astronomy	May 1st 2019	May 1st 2019

Decision deadlines (art. 4.6.3)

Deadline of Decision	Non-EU students	EU students
Astronomy	November 1st 2019	November 1st 2019