Assessment plan
Master's degree programme Physics
2022-2023

June 2022

Introduction

This assessment plan is a systematic description of the type of assessment used in the various modules of the Master's degree programme Physics. 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 programme [2].

The assessment plan is based on:

- the learning outcomes of the degree programme (appendix 1);
- the Teaching and Examination regulations of the degree programme;
- the description of the various modules of the degree programme 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 methods used for all modules in the Physics Master's programme. The following assessment methods are distinguished in this scheme:
    - Written examination (WE);
    - Oral examination (OR);
    - Assignment, including homework and written report (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 describes the relation between the various modules of the programme and the specified learning outcomes of the degree programme. The specified learning outcomes are defined in the programme's Teaching and Examination Regulation and have been included in appendix 1.

[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

Advanced Materials track (core programme)

Module	First examiner	Assessment method	Second examiner and other teachers
Advanced Quantum Mechanics (WMPH032-05)	M.V. Mostovoy	WE	R.G.E. Timmermans
Computational Physics (WMPH007-05)	P.R. Onck	AST	E. van der Giessen
Cross-disciplinary Materials Science (WMPH049-05)	M. Lerch	AST, P	W.R. Browne
Mathematical Methods of Physics (WMPH016-05)	R. Klein	AST	D. Boer
Statistical Mechanics (WMPH029-05)	T. La Cour Jansen	AST, OR	M.V. Mostovoy
Physics Master Research Project (WMPH902-60)	*See list examinors research projects below*	AST, PR, P	

Advanced Materials track (optional courses)

Module	First examiner	Assessment method	Second examiner and other teachers
Atomic and (Bio-)Molecular Interactions (WMPH046-05)	S. Bari	WE	R.A. Hoekstra
Basics of Teaching (TEM0105)	C.A.M. Griep-Hoebink	WE	**
Bioinspired Designer Materials (WMCH009-05)	M.M.G. Kamperman	WE, P	G. Portale
Biophysical Imaging & Manipulation Techniques (WMPH047-05)	W.H. Roos	WE/OR	M.S. Pchenitchnikov
Characterisation of Materials (WMPH021-05)	G.R. Blake	WE	W. Roos, B.J. Kooi
Properties of Functional Materials (WMPH051-05)	G.R. Blake	WE	C.H. van der Wal
Internship in secondary education 1 Teacher Education (TEM0205)	S. Tuenter	AST, OR	**
Many-particle systems (WMPH036-05)	M.V. Mostovoy	WE	R.G.E. Timmermans
Mechanical Properties (WMPH023-05)	E. van der Giessen	AST	B.J. Kooi
Mesoscopic Physics (WMPH037-05)	B.J. van Wees	AST, WE, P	C.H. van der Wal
Non-linear Optics (WMPH024-05)	T. La Cour Jansen	WE	E. Palacino González
Physics of Lasers (WMPH027-05)	R. Hildner	WE/OR	R.A. Hoekstra
Structure at Macro, Meso and Nano Scale (WMPH020-05)	L. Protesescu	AST, WE	B.J. Kooi, B. Noheda Pinuaga
Supramolecular Chemistry (WMCH020-05)	S. Otto	WE	R.C. Chiechi
Surfaces and Interfaces (WMPH014-05)	A. Grubisic-Cabo	WE	P. Rudolf
Theoretical Condensed Matter Physics (WMPH031-05)	M.V. Mostovoy	AST, WE	T. La Cour Jansen
Ultrafast Time-Resolved Spectroscopy (WMPH040-05)	M.S. Pchenitchnikov	AST, PR, WE	T. La Cour Jansen

** Course provided by the Lerarenopleiding which is part of the Faculty of Behavioural and Social Sciences. As such the course is bound to different quality assurance procedures. One of the differences being that there is only one examiner assigned to the course.

Quantum Universe track (core programme)

Module	First examiner	Assessment method	Second examiner and other teachers
Advanced Quantum Mechanics (WMPH032-05)	M.V. Mostovoy	WE	R.G.E. Timmermans
Computational Physics (WMPH007-05)	P.R. Onck	AST	E. van der Giessen
Electrodynamics of Radiation Processes (WMAS008-05)	H.K. Vedantham	WE	W.J.G. de Blok
General Relativity (WMPH009-05)	E.A. Bergshoeff	AST, WE	D. Roest
Mathematical Methods of Physics (WMPH016-05)	R. Klein	AST	D. Boer
Particle Physics Phenomenology (WMPH026-05)	K.A.M. de Bruyn	WE	C.J.G. Onderwater
Statistical Mechanics (WMPH029-05)	T. La Cour Jansen	AST, OR	M.V. Mostovoy
Student Seminar Quantum Universe (WMPH039-05)	L. Willmann	P	P. Dayal, P.D. Meerburg
Physics Master Research Project (WMPH902-60)	*See list examinors research projects below*	AST, PR, P	

Quantum Universe track (optional courses)

Module	First examiner	Assessment method	Second examiner and other teachers
Basics of Teaching (TEM0105)	C.A.M. Griep-Hoebink	WE	**
Collider Experiments (WMPH033-05)	M. Mulder	WE, P	C.J.G. Onderwater
Cosmic structure formation (WMAS004-05)	M.A.M. van de Weijgaert	AST, P, WE	S. Zaroubi
Elementary Particles (WMPH034-05)	E. Pallante	OR	R.G.E. Timmermans
Formation and Evolution of Galaxies (WMAS005-05)	K. Caputi	WE	P. Dayal
Fundamental Constants (WMPH008-05)	L. Willmann	AST, P	C.J.G. Onderwater
Geometry and Differential Equations (WMMA017-05)	A.V. Kiselev	AST, WE, P	J. Top
Gravitational Waves (WMPH022-05)	A. Mazumdar	WE, AST	D. Roest
Hamiltonian Mechanics (WMMA019-05)	M. Seri	AST, WE	H.W. Broer
High-Energy Astrophysics (WMAS006-05)	P. Dayal	AS, OP	M. Mendez
Internship in secondary education 1 Teacher Education (TEM0205)	S. Tuenter	AST, OR	**
Introduction to Plasma Physics (WMPH035-05)	R.A. Hoekstra	WE	*TBD*
Lie Groups in Physics (WMPH011-05)	D. Boer	OR/WE	R.G.E. Timmermans
Nuclear Astrophysics (WMPH038-05)	C.E. Rigollet	WE	J. Even
Quantum Experiments (WMPH017-05)	L. Willmann	WE	K.H.K.J. Jungmann
Quantum Field Theory (WMPH018-05)	E. Pallante	OR	R.G.E. Timmermans
Star and planet formation (WMAS017-05)	F.F.S. van der Tak	AST, WE	I.E.E. Kamp
Statistical Methods in Physics (WMPH030-05)	M. Kavatsyuk	WE	C.J.G. Onderwater

** Course provided by the Lerarenopleiding; no second examiner assigned (see footnote page 3).

Science, Business and Policy track

Module	First examiner	Assessment method	Second examiner and other teachers
Computational Physics (WMPH007-05)	P.R. Onck	AST	E. van der Giessen
Introduction Science and Business (WMSE001-10)	S. Grooters	AST, WE	M.R. Berger, C. Carroll, G.J.W. Euverink, S. Grooters, H.J. van der Windt, J. Zevenberg
Introduction Science and Policy (WMSE002-10)	S. Grooters	AST, WE	M.R. Berger, B. Brink, J. de Ridder, G.J.W. Euverink, H.J. van der Windt, H.B. Winter, J. Zevenberg
Mathematical Methods of Physics (WMPH016-05)	R. Klein	AST	D. Boer
Optional courses (courses from the Advanced Materials track or the Quantum Universe track)	*See specific courses above*	*See specific courses above*	
Physics Research (WMPH005-30)	*See list examiners research projects below*	AST, PR, P	
Work Placement Business and Policy (WMSE902-40)	S. Grooters	AST, PR, P	M.R. Berger, M.K. de Boer, G.J.W. Euverink, C.M. Ree, M. van Rijssel, J. Zevenberg

Examiners for Master's Research Projects

VSI
Bergshoeff, prof.dr. E.A.
Bethlem, dr. H.L.
Boer, prof.dr. D.
Borschevsky, prof.dr. A.
Bruyn, dr. K.A.M. de
Dimastrogiovanni, dr. E.
Eijk, D. van
Even, dr. J.
Hoekstra, prof.dr. S.
Jungmann, prof.dr. K.H.K.J.
Mazumdar, prof.dr. A.
Meerburg, dr. D.
Mulder, dr. M.
Onderwater, dr.ir. C.J.G.
Pallante, prof.dr. E.
Pellegrino, prof.dr. A.
Roest, prof.dr. D.
Timmermans, prof.dr. R.G.E.
Veghel, dr. M. van
Willmann, dr. L.

Zernike Institute
Banerjee, prof.dr. T.
Giessen, prof.dr.ir. E. van der
Grubisic-Cabo, dr. A.
Hildner, prof.dr. R.M.
Jansen, dr. T.L.C.
Mostovoy, prof.dr. M.V.
Onck, prof.dr.ir. P.R.
Pchenitchnikov, prof.dr. M.S.
Roos, prof.dr. W.H.
Rudolf, prof.dr. P.
Schlathölter, dr. T.A.
Slawinska, dr. J.
Vlijm, dr. R.
Wal, prof.dr.ir. C.H. van der
Wees, prof.dr.ir. B.J. van
Wel, prof.dr. P.C.A. van der
Zaag, dr. P.J. van der

ESRIG
Chen, prof.dr. H.
Dee, prof.dr. M.W.
Dusek, prof.dr. U.
Kavatsyuk, dr. M.
Meijer, prof.dr. H.A.J.
Mokhov, dr. A.V.

An examiner for the Master Research projects of Applied Physics, Astronomy and of Mathematics may also act as second supervisor for a Master Research Project.

Relation between the learning outcomes and the curriculum

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

'+' indicates that a course unit contributes to the qualification under consideration.
'*' indicates that the contribution depends on individual choices of the student (only applicable for optional courses and individual research projects).

The numbers in the table heading correspond to the qualifications that are listed in Appendix I.

Advanced Materials track

Learning outcomes	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	4.1	5.1
Advanced Quantum Mechanics	+	+										
Characterization of Materials	+		+									+
Computational Physics	+	+		+							+	
Cross-disciplinary Materials Science	+		+					+			+	+
Properties of Functional Materials	+		+									+
Mathematical Methods of Physics	+	+										
Statistical Mechanics	+	+										
Structure at Macro, Micro and Nano Scale	+		+									+
Supramolecular Molecules	+		+									+
Optional courses Advanced Materials	+	*	*		*			*	*	*		*
Research [4]	+	+	+	+	+	+	+	+	+	+	+	+

Quantum Universe track

Learning outcomes	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	4.1	5.1
Advanced Quantum Mechanics	+	+										
Computational Physics	+	+		+							+	
Electrodynamics of Radiation Processes	+		+									+
General Relativity	+		+									
Mathematical Methods of Physics	+	+										
Particle Physics Phenomenology	+		+									
Statistical Mechanics	+	+										
Student seminar Quantum Universe	+		+	+				+	+	+	+	+
Optional courses Quantum Universe	+	*	*					*	*	*		*
Research [4]	+	+	+	+	+	+	+	+	+	+	+	+

[4] The research project includes the compulsory modules Academic Skills, Scientific Integrity, General Physics Colloquium and Career Prespectives.

Science, Business and Policy track

Learning outcomes	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	4.1	5.1
Computational Physics	+	+		+							+	
Internship Sience, Business and Policy			+			+	+	+	+	+	+	+
Introduction Sience, Business and Policy		+	+				+	+	+	+	+	+
Mathematical Methods of Physics	+	+										
Optional courses in Science	+	*	*	*	*			*	*	*	*	*
Research [4]	+	+		+	+	+	+	+	+	+	+	+

Appendix I Teaching outcomes of the degree programme

The master graduate in Physics:

1. **Knowledge and understanding**
    1.1. understands the advanced concepts of physics, including the necessary mathematics and computer science, at a level which permits admission to a PhD programme;
    1.2. is familiar with the advanced quantitative character of physics and with the relevant research methods;
    1.3. [*Advanced Materials track*] has a thorough understanding of the current state of the art in materials science, more specifically of structure, functional properties and characterisation of advanced materials;
    1.4. [*Quantum Universe track*] has a thorough understanding of the main fields and presently active topics in theoretical physics, more specifically in the fields of general relativity, statistical mechanics, quantum mechanics, particle physics and radiation processes;
    1.5. [*Science, Business and Policy track*] has operational knowledge of, and insight into, the present functioning of companies and administrations, as well as the relevant legislation, in relation to physics oriented working areas;

2. **Application of knowledge and understanding**
    2.1. is capable of carrying out research, aimed at the understanding of physical phenomena and their description in scientific terms;
    2.2. is capable of analyzing a (new) complex physical 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 physical problems in his/her own and related subject areas and fields;
    2.4. is capable of collaborating in a (multi-disciplinary) team;

3. **Judgement**
    3.1. is capable of obtaining relevant information using modern information channels, and to interpret this information critically;
    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 to draw conclusions on the basis of limited or incomplete information, and is able to realize and formulate the limitations of such conclusions;

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.