Assessment plan of the Top Master degree programme in Nanoscience 2023-2024

Introduction

This assessment plan is a systematic description of the testing and assessment modes for all study components in the curriculum of the Top Master degree programme in Nanoscience, 2023-2024.
The plan is based on the assessment policy of the Faculty of Science and Engineering, as set out in the FSE Quality Assurance Manual and the protocol setting out the duties and powers of the Faculty's Board of Examiners (*FSE Protocol Board of Examiners).*
Faculty documents about the Quality Assurance Policy can be found through the following link: https://myuniversity.rug.nl/infonet/medewerkers/fse/education/policy-quality-education/quality-assurance-policy.

The assessment plan for the curriculum consists of the following parts:

1. Objective(s) of the degree programme.
2. The learning outcomes of the degree programme.
3. Descriptions of the course units, as set out in the appendices to the Teaching and Examination Regulations 2023-2024 of the degree programme.
4. Descriptions of the content of each course unit in Ocasys, the online course catalogue. The following elements are relevant in this context:
    - objectives;
    - description of content;
    - lecturers;
    - assessment mode(s) and calculation of final mark;
    - mode(s) of instruction.
5. An overview of the examiners and a detailed assessment mode for each course unit. This overview is based on the curriculum approved by the Programme Committee, as set out in the appendices to the Teaching and Examination Regulations 2023-2024 for the degree programme.
6. A matrix showing the relationship between the course units and the detailed learning outcomes for each competence area.

Parts 3 and 4 are not included in this document. For the descriptions of the course units, see the Appendices to the Teaching and Examination Regulations 2023-2024 for the Top Master degree programme in Nanoscience. Descriptions of the content of each course unit can be found in Ocasys, the online course catalogue (https://ocasys.rug.nl/2023-2024/catalog/programme/60618).

1. Objectives of the degree programme

A brief description of the mission and objective of the degree programme. These are found in the Critical Self-Reflection (Standard 1 of the limited degree programme assessment) Nanoscience 2018.

Domain-specific requirements

The Master's degree programme in Nanoscience has been conceived by active world-class researchers in Nanoscience to convey to the students the knowledge, skills, attitude, and ethics needed for an independent research career in the field of Nanoscience. On the international scene, students with such Nanoscience/Nanotechnology background are in high demand[1]. The highly interdisciplinary nature of Nanoscience comprising parts of chemistry, physics and aspects of molecular biology, all present at the Zernike Institute for Advanced Materials, forms an integral part of its research approach and is reflected in the curriculum of the programme. The curriculum prepares the students for understanding the entire chain of research starting from design, through synthesis, device building, characterization, investigation of the theoretical foundation and feedback to the design process.

2. Learning outcomes of the degree programme

As set out in the appendices to the Teaching and Examination Regulations of the Top Master Nanoscience for 2023-2024:

The graduate of the Top Master Programme in Nanoscience:

1. is able to perform Nanoscience research in the international and interdisciplinary environment of a world-leading institute;
2. has the knowledge, skills, and attitude that are needed for successful entrance and participation in a PhD programme;
3. understands the importance of proper scientific conduct and responsible behaviour when performing research, and is aware of the social and ethical ramifications of scientific research and its applications;
4. can apply knowledge of those parts of the disciplines of physics, chemistry, and mathematics that are relevant to Nanoscience, as well as knowledge of a selection of topics within molecular biology and medicine that are relevant to Nanoscience;
5. is able to solve realistic scientific problems in the interdisciplinary field of Nanoscience, even on the basis of a rudimentary problem specification;
6. is capable of acquiring sufficient knowledge within a limited time span to work in a different speciality within Nanoscience;
7. is capable of critically using the scientific literature in his/her/their chosen speciality;
8. is capable of both performing scientific research, analysing the data, and of interpreting the results;
9. can effectively convey and discuss results of scientific research, orally and in written form, to specialists as well as non-specialists;
10. is able to plan and conduct research independently;
11. is able to perform research in a research team and work together with fellow students;
12. can formulate and defend a realistic and well-argued research plan on the basis of a rudimentary problem specification;
13. is able to adapt to the rapid changes occurring in the field of Nanoscience.

[1] See for example: http://www.bioin.or.kr/InnoDS/data/upload/tech/1191845407000.pdf http://www.sciencemag.org/careers/2007/09/skills-survey-highlights-varied-needs-nanotech-industry https://pubs.acs.org/doi/pdf/10.1021/acsnano.6b03872

3. Overview of examiners and testing and assessment modes for course units

Course unit name	**ECTS**	**Practical**	**Examiner(s) (*second examiner(s)*)**	**Mode of assessment**
WMNS003-06 Guided Self-study in Nanoscience	6	No	Coordinator: G.R. Blake Part Quantum Physics: C. H. van der Wal (*G.R. Blake*) Part Solid-Phase physics: J. Ye (*M.A. Loi*) Part Organic chemistry: T.L.C. Jansen (*S. Otto*) Part Inorganic Chemistry: G. R. Blake (*B. Noheda*)	All parts: WE. For resit: eventually OR instead of WE, depending on the number of students.
Core module WMNS009-08 Characterization of Nanomaterials and Devices	8	Yes	Coordinator: B.J. Kooi Part 1, Surface and Single Molecule Techniques, W.H. Roos (*R. Vlijm*) Part 2, X-ray Diffraction, G. R. Blake/G. Portale (*B. Noheda*) Part 3, Optical Spectroscopy, R. Hildner (*M. S. Pchenitchnikov*) Part 4, Electron Microscopy, B. J. Kooi (*G.R. Blake*)	Part 1: WE, PR, R Part 2: WE, PR Part 3: WE, PR, R Part 4: WE, PR All parts: Eventually OR instead of WE for resit depending on the number of students.
Core module WMNS013-06 Preparation of Nanomaterials and Devices	6	Yes	Coordinator: T. Banerjee Part 1, Thin-film growth, T. Banerjee (*B.J. van Wees*) Part 2, Preparation of inorganic devices, B.J. van Wees (*C.H. van der Wal*) Part 3, Preparation of solution processable devices, M.A. Loi (*L.J.A. Koster*)	Part 1: PR, R Part 2: PR, R Part 3: PR, R
Core module WMNS015-05 Nanomaterial Design	5	Yes (lab visit)	Coordinator: S. Otto Part 1, Design of Biomimetic Materials, M.M.G. Kamperman/N.H. Katsonis (*N.H. Katsonis/M.M.G. Kamperman*) Part 2, Ordered molecular structures, S. Otto, *(N.H. Katsonis)* Part 3, Nanomedicine, A. Salvati/P.H.C. Aberg (*P.H.C. Aberg, A. Salvati)*	Part 1: WE Part 2: WE Part 3: WE
Core module WMNS014-05 Fundamental Properties of Nanomaterials and Devices	5	Yes (computer practical)	Coordinator: R.W.A. Havenith Part 1, Electronic Structure Properties, R.W.A. Havenith (*T.L.C. Jansen*) Part 2, Optical Properties, M.S. Pchenitchnikov (*T.L.C. Jansen*) Part 3, Magnetic Properties, J. Ye (*G.R. Blake*) Part 4, Guest-lectures (TV-lectures in collaboration with Osaka University), T.L.C. Jansen *(R.W.A. Havenith)*	Part 1: WE, PR Part 2: WE Part 3: WE Part 4: ATT
Core module WMNS016-05 Functional	5	No	Coordinator: G. Portale Part 1, Surfaces and Interfaces, G. Portale (*P. Rudolf*)	Part 1: WE Part 2: OR Part 3: WE

Properties of Nanomaterials and Devices			Part 2, Electronic Transport Properties of Organic and Hybrid Materials and Devices, M.A. Loi (*L.J.A. Koster*) Part 3, Electronic Transport Properties of Inorganic Materials and Devices, B.J. van Wees (*C.H. van der Wal*)	
WNMS011-06 Review Paper	6	No	Coordinator: P.R. Onck Part ethics/scientific integrity: T. Banerjee Part literature search, academic writing: M.S. Pchenitchnikov *Various staff members for individual guidance*	R, ATT, ALT*
WMNS007-13 Small Research Project and Symposium	13	Research/ Yes	Coordinator: C.H. van der Wal Part lab journal: C.H. van der Wal Part oral presentations: M.H. Guimaraes Part Organization of scientific symposium: C.H. van der Wal *Various staff members for individual guidance*	PR, P, R, ATT, ALT*
WMNS901-45 Master Thesis	45	Research/ Yes	Coordinator T.L.C. Jansen Part planning, time-management: T.L.C. Jansen *Various staff members for individual guidance*	PR, R, P, ALT*
WMNS012-06 PhD Research Proposal	6	No	Coordinator S.S. Faraji Part presentation and writing research proposal: S.S. Faraji *Various staff members for individual guidance*	P, R, ALT*
Electives	15	See the Ocasys course descriptions of the electives and the assessment plan of the responsible degree programme. The electives are chosen from other degree programmes.		

Electives from other master degree programmes

The students must choose at least three elective courses at master level (15 ECTS) that have relevance for their personal study programme, in particular in relation with the MSc thesis project. The electives are typically chosen from the master programmes of (Applied) Physics and Chemistry, but can also come from any other master programme of the Faculty of Science and Engineering. Before participating in these electives, the student must discuss and develop the choice with her/his mentor (staff member), and subsequently get it approved by the programme management. Before starting the Master Thesis (WMNS901-45), the students also ask approval from the supervisor of the Master Thesis. A list with approved electives is part of the Appendices of the Teaching and Examination Regulations for the Top Master Nanoscience and published on Ocasys for the students.

Examples of assessment modes include:

- *Written exam with open questions (WE)*
- *Written exam with multiple-choice questions (MC)*
- *Oral exam (OR)*
- *Report (R)*
- *Presentation (P)*
- *Interim test (IT)*
- *Assignment (AST)*
- *Practical work (PR)*
- *Other assessment mode to be specified (ALT)*
- *Mandatory Attendance (ATT)*

ALT* In the assessment of these courses, part of the grade is based on the student's performance during the project, on aspects that are specified on the grading form.

4. Relationship between course units and details of the learning outcomes[2]

The numbering of columns 1 to 13 refers to the 13 learning outcomes that are listed in section 2, on page 2 of this assessment plan.

	1	2	3	4	5	6	7	8	9	10	11	12	13
WMNS003-06 Guided Self-study				**X**		**X**							
WMNS013-06 Core module Preparation				**X**		**X**		x	x				
WMNS015-05 Core module Nanomaterial Design				**X**		**X**							
WMNS009-08 Core module Characterization				**X**		**X**		x	x				
WMNS014-05 Core module Fundamental Properties				**X**		**X**		x	x				
WMNS016-05 Core module Functional Properties				**X**		**X**			x				
WMNS011-06 Review Paper	x	x	**X**	x		**X**	**X**		**X**	**X**	x	x	**X**
WMNS007-13 Small Research Project	**X**	x	**X**		**X**	x	x	**X**	**X**	**X**	**X**	x	**X**
WMNS901-45 Master Thesis	**X**	**X**	x		**X**	x	**X**	**X**	**X**	**X**	**X**	**X**	**X**
WMNS012-06 PhD Research Proposal	x	**X**	x		**X**	x	**X**		**X**	**X**		**X**	**X**
Electives				**X**		x							

[2] **X**: makes an essential or advanced contribution to the specified learning outcome; x: makes an introductory or partial contribution to the specified learning outcome

This table shows the relationship between the learning outcomes and the course units of the curriculum.

5. List of Examiners for the Top Master Nanoscience containing

a. supervisors (examiners) for individual projects (WMNS011-06, WMNS007-13, WMNS012-06, WMNS901-45) for 2023-2024;

b. and lecturers teaching in the Nanoscience curriculum.

1. Staff at Research groups of Zernike Institute for Advanced Materials

Name staff member	**Research group**
Banerjee, T.	Spintronics of Functional Materials
Blake, G.R.	X-ray/Neutron Scattering and Spectroscopy
Broer-Braam, H.B.	Theoretical Chemistry
Chicca, E.	Bio-inspired Systems & Circuits
Faraji, S.S.	Theoretical & Computational Chemistry
Giessen van der, E.	Micromechanics
Giuntoli, A.	Micromechanics
Grubisic-Cabo, A.	Surfaces and Thin Films
Guimaraes, M.H.	Opto-Spintronics of Nanostructures
Hildner, R.	Optical Spectroscopy of Functional Nanosystems
Hoekstra, R.A.	Quantum Interactions and Structural Dynamics
Jansen, T.L.C.	Computational Spectroscopy
Kamperman, M.M.G.	Polymer Science
Knoester, J.	Theory of Condensed Matter
Kooi, B.J.	Nanostructured Materials and Interfaces
Koster, L.J.A.	Physics of Novel Semiconductors and Devices
Loi, M.A.	Photophysics and Opto-Electronics
Loos, K.U.	Macromolecular Chemistry and New Polymeric Materials
Maniar, D.	Polymer-based composite materials
Mostovoy, M.V.	Theory of Condensed Matter
Noheda, B	Nanostructures of Functional Oxides
Ocelik, V.	Microstructural Characterization of Materials
Onck, P.R.	Micromechanics of Biological and Active Materials
Palasantzas, G.	Surface Interactions and Nanostructures
Pchenitchnikov, M.S.	Ultrafast Dynamics in Molecular Systems

Portale, G.	Physical Chemistry of Polymeric and Nanostructured Materials
Protesescu, L.	Nanomaterials Chemistry
Roos, W.H.	Molecular Biophysics
Rudolf, P.	Surfaces and Thin Films
Schlathölter, T.A.	Gas Phase Biomolecules and Energetic Interactions
Slawinska, J.L.	Computational Materials Science
Stöhr, M.A.	Surface Science
Tromp, M.	Materials Chemistry
Vlijm, R.	Molecular & Cellular Scale Biophysics
Wal, C.H. van der	Quantum Devices
Wees, B.J. van	Physics of Nanodevices
Wel, P.C.A. van der	Solid-state Nuclear Magnetic Resonance
Ye, J.	Device Physics of Complex Materials
Zaag, P.J. van der	Molecular Biophysics

2. Associate members from Research Groups Stratingh Institute of Chemistry (Stratingh)

Staff	**Research Group**
Browne, W.R.	Molecular Inorganic Chemistry
Chiechi, R.C.	(Bio) Organic Materials and Devices
Feringa, B.L.	Synthetic Organic Chemistry
Harutyunyan, S.	Homogeneous Catalysis
Havenith, R.W.A.	(Bio) Organic Materials and Devices
Katsonis, N.H.	Active Molecular Systems
Klein, J.E.M.N.	Molecular Inorganic Chemistry
Kudernac, T.	Molecular Inorganic Chemistry
Minnaard, A.J.	Chemical Biology 2
Otten, E.	Molecular Inorganic Chemistry
Otto, S.	Systems Chemistry
Pollice, R.	(Bio) Organic Materials and Devices
Roelfes, J. G.	Biomolecular Chemistry & Catalysis

3. Associate members from Research Groups Biomolecular Sciences and Biotechnology Institute (GBB)

Staff	Research group
Driessen, A.J.M.	Molecular Microbiology
Marrink, S.J.	Molecular Dynamics
Poolman, B.	Membrane Enzymology
Slotboom, D.J.	Membrane Enzymology
Vries, de A.H.	Molecular Dynamics

4. Long-term research associates, but not listed above

Staff	Research Institute
Aberg, P.H.C.	Groningen Research Institute of Pharmacy, lecturer in Nanoscience core modules
Jaeger, H.	Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence; Note: only second examiner for research projects related to Computing in Cognitive Materials
Pei, Y	Engineering and Technology Institute Groningen; Note: only second examiner for research projects related to Advanced Production Engineering
Pescarmona, P.P.	Engineering and Technology Institute Groningen; research group Catalysis & Sustainability.
Rijn, van P.	Faculty of Medical Sciences; Note: only second examiner for research projects related to Nanobiotechnology and Advanced Therapeutic Materials
Salvati, A.	Groningen Research Institute of Pharmacy, lecturer in Nanoscience core modules
Stuart, M.C.A.	Stratingh Institute for Chemistry; Note: only second examiner for research projects regarding Advanced Software TEM Characterization
Taatgen, N.A.	Bernoulli Institute; Note: only second examiner for research projects regarding to Artificial Intelligence
Timmermans, R.G.E.	Van Swinderen Institute; Note: only second examiner for research projects regarding Theoretical Physics