university of groningen

Appendices for the Master's degree programme(s) in Nanoscience

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

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 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.

Appendix II. Tracks/specializations (art. 3.6)

The Degree Programme is not divided into tracks/specializations.

Appendix III. Content of the degree programme (art. 3.8)

Course Unit	Course Code	Topics	ECTS	Practical	Entry requirements
FIRST YEAR					
Guided Self-study in Nanoscience	WMNS003-06	Two topics from the following list will be assigned on an individual basis on advice from the Admission Board: -Solid-state Physics -Quantum Physics -Organic Chemistry -Inorganic Chemistry -Mathematics	6	No	None
CORE MODULES					
Preparation of Nanomaterials and Devices	WMNS013-06	-Thin-film growth -Preparation of inorganic devices -Preparation of solution processable devices -The preparation of colloidal nanomaterials	6	Yes	Guided Self-study in Nanoscience*1
Nanomaterial Design	WMNS015-05	-Design of biomimetic materials -Ordered molecular structures -Nanomedicine	5	No	Guided Self-study in Nanoscience*1
Characterization of Nanomaterials and Devices	WMNS009-08	-Surface and Single Molecule Techniques -X-ray Diffraction -Spectroscopy -Electron Microscopy and Diffraction	8	Yes	Guided Self-study in Nanoscience*1
Fundamental Properties of Nanomaterials and Devices	WMNS014-05	-Electronic Structure Properties -Optical Properties -Magnetic Properties -TV-lectures in collaboration with Osaka University	5	Yes	Guided Self-study in Nanoscience*1
Functional Properties of Nanomaterials and Devices	WMNS016-05	-Surfaces and Interfaces -Electronic Transport Properties of Organic and Hybrid Materials and Devices	5	No	Guided Self-study in Nanoscience*1

		-Electronic Transport Properties of Inorganic Materials and Devices			
INDIVIDUALLY SUPERVISED PROJECTS					
Review Paper*2	WMNS011-06	Including workshops academic skills: -literature search -scientific writing -ethics and scientific integrity	6	No	Guided Self-study in Nanoscience
Small Research Project and Symposium*2	WMNS007-13	Including workshops academic skills: -lab-journal keeping -oral presentation skills -organization scientific symposium	13	Yes	Guided Self-study in Nanoscience
SECOND YEAR					
PhD Research Proposal	WMNS012-06	Including workshops academic skills: - writing and presenting proposal	6	No	Review Paper, Small Research Project and Symposium, and a maximum of one resit for one part of the core modules.
Master Thesis*2	WMNS901-45	Including workshops academic skills: - planning and time-management of a research project - Zernike colloquia - Zernike workshops	45	Yes	Review Paper, Small Research Project and Symposium, and a maximum of one resit for one part of the core modules.

***1:** The Guided Self-study (WMNS003-06) has to be completed prior to participating in the remainder of the programme. Students must participate in the first-offered partial exams on their tasks in the Guided Self-study before the first lectures of the core modules. When a re-exam is needed for passing a part of the Guided Self-study, the re-exam must be held and passed before the first partial exams of the core modules.

***2: Note on having sufficient diversity in the topics of the individually supervised projects, and the choice of electives:**
The Review Paper (WMNS011-06), the Small Research Project and Symposium (WMNS007-13) and the Master Thesis (WMNS901-45) cannot be on the same topic nor in the same research group. The three topics must be a diverse choice from the research topics that are present in the Zernike Institute National Research Centre (incl. associate members). The choice of electives (see Appendix IV) must support the choice of topics for the individually supervised projects, in particular the Master Thesis.
The choice of the topics and electives requires consultation with the mentor.
The choices of a student have to meet these criteria. Exceptions are only possible with clarified motivation and explicit written approval from the programme director.

Appendix IV. Electives (art. 3.9.1)

Electives from other Master's Degree Programmes
The student will spend at least 15 ECTS on electives, on topics related to Nanoscience but not sufficiently covered by the core modules. These electives are taken from master programmes at the University of Groningen in directly related disciplines (typically, but not limited to, the regular master programmes in Physics and Chemistry). Each student must pass at least two electives from the core elective list. Additional electives can be taken from either the core or supplementary electives list.

The Board of Examiners may permit the student to select one or more course units from a wider range of programmes (from the University of Groningen or from another university).

List of pre-approved core electives
Electives MSc Chemistry/Chemical Engineering:

Course unit	Course code	ECTS	Practical	Entry requirements
Organic Synthesis: Methods and Strategy 1	WMCH017-05	5	See Ocasys	See Ocasys
Organometallic Chemistry	WMCH018-05	5	See Ocasys	See Ocasys
Polymer Physics*	WMCH025-05	5	See Ocasys	See Ocasys
Reaction Mechanisms	WMCH006-05	5	See Ocasys	See Ocasys
Stereochemistry	WMCH013-05	5	See Ocasys	See Ocasys
Structure Determination with Spectroscopic Methods*	WMCH008-05	5	See Ocasys	See Ocasys
Supramolecular Chemistry	WMCH020-05	5	See Ocasys	See Ocasys
Sustainable Electric Energy Storage*	WMCH029-05	5	See Ocasys	See Ocasys
Synthetic Biology and Systems Chemistry*	WMCH021-05	5	See Ocasys	See Ocasys

Electives MSc (Applied) Physics:

Course unit	Course code	ECTS	Practical	Entry requirements
Advanced Quantum Mechanics	WMPH032-05	5	See Ocasys	See Ocasys
Introduction to Plasma Physics*	WMPH035-05	5	See Ocasys	See Ocasys
Many-particle Systems*	WMPH036-05	5	See Ocasys	See Ocasys
Memristive Devices*	WMPH043-05	5	See Ocasys	See Ocasys
Mesoscopic Physics*	WMPH037-05	5	See Ocasys	See Ocasys
Neuromorphic Circuit Design	WMPH044-05	5	See Ocasys	See Ocasys
Physics of Lasers*	WMPH027-05	5	See Ocasys	See Ocasys
Statistical Mechanics	WMPH029-05	5	See Ocasys	See Ocasys
Theoretical Condensed Matter Physics*	WMPH031-05	5	See Ocasys	See Ocasys
Ultrafast Time-resolved Spectroscopy	WMPH040-05	5	See Ocasys	See Ocasys
Nanoscale Material Modeling	WMPH053-05	5	See Ocasys	See Ocasys

*Core electives, which are commonly taken.

List of pre-approved supplementary electives

Supplementary electives MSc Chemistry/Chemical Engineering:

Course unit	Course code	ECTS	Practical	Entry requirements
Advanced Product Engineering	WMCE007-05	5	See Ocasys	See Ocasys
Advances in Chemical Biology	WMCH014-05	5	See Ocasys	See Ocasys
Chemical Catalysis	WMCH015-05	5	See Ocasys	See Ocasys
Quantum Chemistry Methods I	WMCH038-05	5	See Ocasys	See Ocasys
Design of Industrial Catalysts	WMCE009-05	5	See Ocasys	See Ocasys
Interfacial Engineering	WMCE003-05	5	See Ocasys	See Ocasys
Quantum Chemistry Methods II	WMCH039-05	5	See Ocasys	See Ocasys

Organic Synthesis, Methods and Strategy 2	WMCH024-05	5	See Ocasys	See Ocasys
Advanced Methods in Spectroscopy	WMCH042-05	5	See Ocasys	See Ocasys
Polymer Products	WMCE005-05	5	See Ocasys	See Ocasys
Topics in Chemistry with Python	WMCH028-05	5	See Ocasys	See Ocasys

Supplementary electives MSc (Applied) Physics:

Course unit	**Course code**	**ECTS**	**Practical**	**Entry requirements**
Computational Physics	WMPH007-05	5	See Ocasys	See Ocasys
Lie Groups in Physics	WMPH011-05	5	See Ocasys	See Ocasys
Mathematical Methods of Physics	WMPH016-05	5	See Ocasys	See Ocasys
Quantum Field Theory	WMPH018-05	5	See Ocasys	See Ocasys
Optoelectronic Devices	WMPH042-05	5	See Ocasys	See Ocasys
Deep Learning in Physics	WMPH054-05	5	See Ocasys	See Ocasys

Supplementary electives other MSc programmes FSE:

Course unit	**Course code**	**ECTS**	**Practical**	**Entry requirements**
Biomaterials 2	WMBE001-05	5	See Ocasys	See Ocasys
MEMS, NEMS and Nanofabrication	WMIE010-05	5	See Ocasys	See Ocasys
Statistical Signal Processing	WMAS011-05	5	See Ocasys	See Ocasys

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

The entry requirements and compulsory order of examinations are mentioned in Appendix III. The conditional entry requirements for individual modules (electives) and order of examinations are listed in Ocasys.

Appendix VI. Admission to the degree programme (art. 2.1A.1 + 2.1B.1)

1. The additional admission requirements comprise:
   - a bachelor's degree in chemistry, (applied) physics, materials science, or another field deemed relevant by the Admissions Board;
   - sufficient knowledge of the relevant sciences;
   - a suitable attitude, motivation and talent to follow the programme.

2. Candidates apply to the admission procedure by submitting the following documents:
   - a complete curriculum vitae;
   - a survey of the study results attained in academic courses so far;
   - a letter in which the applicant states why they want to follow this programme in particular, what their expectations and ambitions are;
   - (if desired) results of former research projects, like reports or articles;
   - two or three letters of recommendation from scientists or academic lecturers, who are also willing to provide personal information on the applicant;
   - (if desired) other documents the applicant thinks are useful in furthering their application.

   These documents are to be sent to the University of Groningen in a manner that is specified on the webpages associated with the programme, by the specified deadline, preceding the start of the programme.

3. The Admissions Board assesses the applicant's fulfilment of the requirements. Part of the assessment is an interview with a scientific presentation.

4. Applicants who meet the requirements receive an admission letter from the Admission Board. Applicants in possession of an admission letter can be admitted to the programme. An admission letter is only valid for the academic year following the academic year in which the letter is granted. Other conditions may be attached to the admission letter. The requirements must be met before the programme has started.

Appendix VII. Pre-master programmes

The MSc degree programme does not offer pre-master programmes.

Appendix VIII. Transitional provisions (art. 7.1)

Transitional provision for the Master's Degree Programme Nanoscience (cohort 2022 and earlier)
The package of the three core modules in the old curriculum:

- WMNS008-10 Preparation of Nanomaterials and Devices – 10 ECTS
- WMNS009-08 Characterization of Nanomaterials and Devices – 8 ECTS
- WMNS010-11 Fundamental and Functional Properties of Nanomaterials and Devices – 11 ECTS

has been replaced by the following package of five core modules:

- WMNS013-06 Preparation of Nanomaterials and Devices – 6 ECTS
- WMNS015-05 Nanomaterial Design – 5 ECTS
- WMNS009-08 Characterization of Nanomaterials and Devices – 8 ECTS
- WMNS014-05 Fundamental Properties of Nanomaterials and Devices – 5 ECTS
- WMNS016-05 Functional Properties of Nanomaterials and Devices – 5 ECTS

Transitional provision for the Master's Degree Programme Nanoscience (cohort 2023)
The students can freely choose between all electives, core and supplementary.

Appendix IX. Additional Requirements Open degree Programmes (art. 3.10)

Students wishing to pursue an Open Degree Programme may file a request with the Board of Examiners. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the Degree Programme and can determine further conditions in their rules and regulations.